

# Vevo<sup>®</sup> LAB

## User Manual

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# Getting Started

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This section introduces you to Vevo LAB.

## About Vevo LAB

Vevo LAB is VisualSonics' software-only image analysis workstation. Vevo LAB provides the broad range of tools and features you need to analyze images that were acquired on the Vevo 1100, 2100, 3100, LAZR and LAZR-X Imaging Systems.

Vevo LAB can be installed on any Windows-based system that meets the technical requirements.

**Note:** You cannot acquire images using Vevo LAB.

## Installing Vevo LAB

Vevo LAB software is configured to run on a stand-alone PC with Microsoft Windows version 7, 8 and 10.

If you need help installing this software, contact VisualSonics Technical Support at 1.866.416.4636 or online at [www.visualsonics.com/support/technical-support](http://www.visualsonics.com/support/technical-support).

## PC technical requirements

To successfully install and run Vevo LAB, your computer must meet or exceed the following requirements:

**Note:** Please note that only 64-bit operating systems are supported.

- 64-bit Microsoft Windows 7, or newer.
- 2 GB of RAM (4 GB is recommended).
- 2.0 GHz dual core processor (or faster).
- Installation of the application requires 1 GB of hard disk space. Imaging data may require significantly more (500 GB of space is recommended).
- Available USB port (USB 2, or newer).
- Video card that can run at a minimum resolution of 1024 x 768 in 32-bit color mode.

**Note:** Certain third party software may conflict with the Vevo LAB software. For optimal performance, it is recommended that you do not run other Microsoft Windows applications on your PC when the Vevo LAB software is running.

**Note:** The Vevo LAB License Dongle may not run if it is connected through a USB hub –insert the Vevo LAB License Dongle directly into a USB port on your PC.

## Software install/upgrade requirements

**Note:** If User Management Mode is enabled, this task can only be completed by an Administrator.

You need the following parts and tools to perform the software install/upgrade:

- The Vevo LAB PC SW Update VX.X.X USB
- The Vevo LAB Installation/Upgrade Instructions for Vevo LAB
- Vevo LAB License Dongle

**Note:** For new installations, do not insert the Vevo LAB License Dongle until the software is loaded.

## Installation

Installing Vevo LAB takes only a few minutes.

### To install Vevo LAB

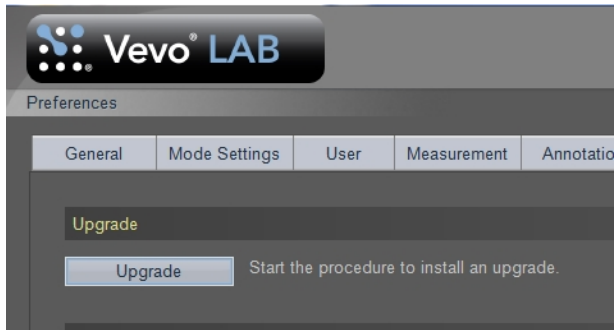
- 1 Turn on your PC.
- 2 Insert the LAB PC SW Update VX.X.X USB into your computer's USB port.

If a version of Vevo LAB software is already installed on the computer, skip to step 6.

- 3 Open Windows Explorer and browse to the Vevo LAB PC SW Update VX.X.X USB.
- 4 Double click the Vevo LAB install file—VevoLABSetup-X.X.X.XXXXX.x64.exe. The install begins automatically. Skip to step 8.

**Note:** 'X.X.X.XXXXX' represents the version of the Vevo LAB software. This information is important when contacting FUJIFILM VisualSonics with questions regarding Vevo LAB.

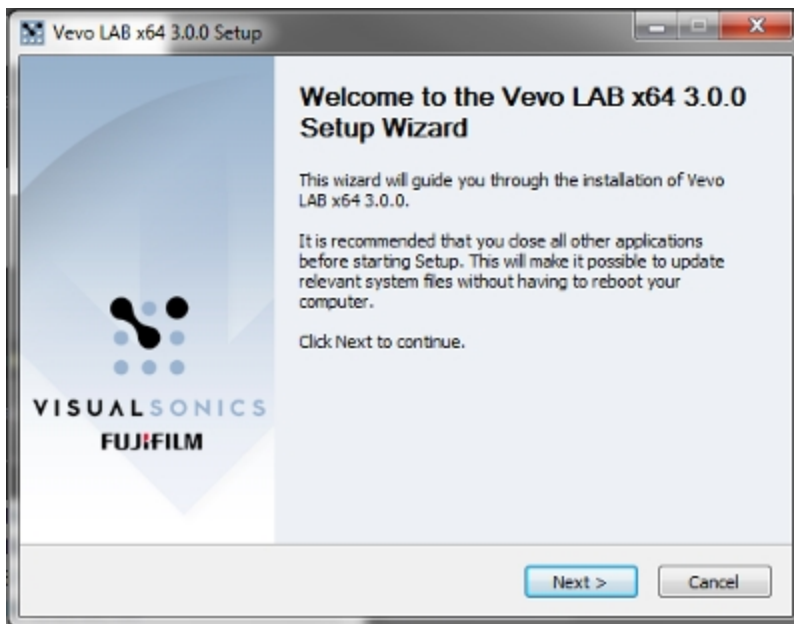
- 5 Start the Vevo LAB software.
- 6 In the Preferences screen, click **Maintenance** and then click **Upgrade**.



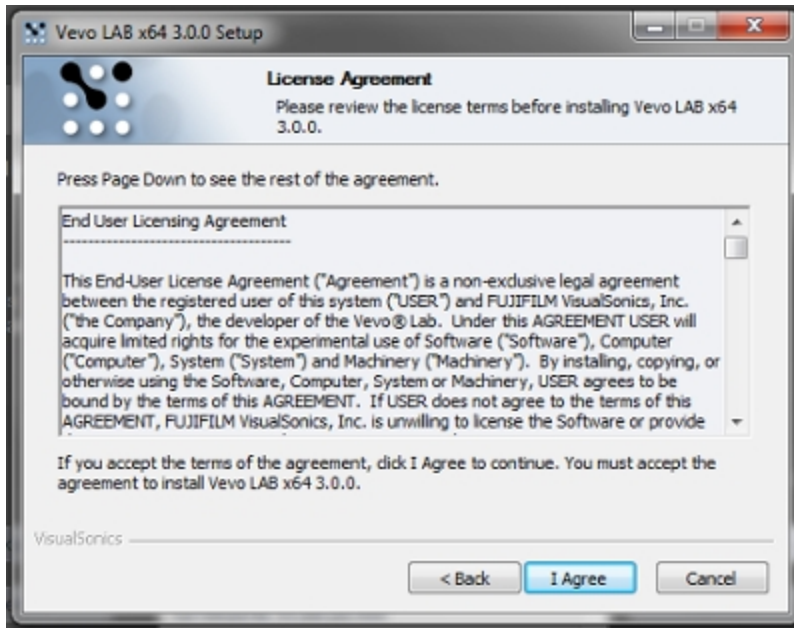
7 In the upgrade window, browse to the Vevo LAB Software Upgrade Package VX.X.X and select the build under the Available upgrades section and click Upgrade.



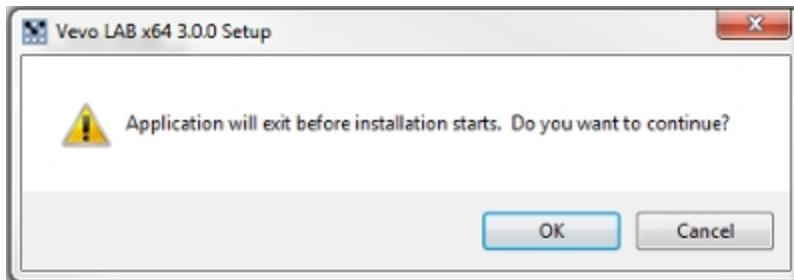
8 The Setup Wizard guides you through the installation. Click **Next** to continue.



9 In the License Agreement window click I Agree.

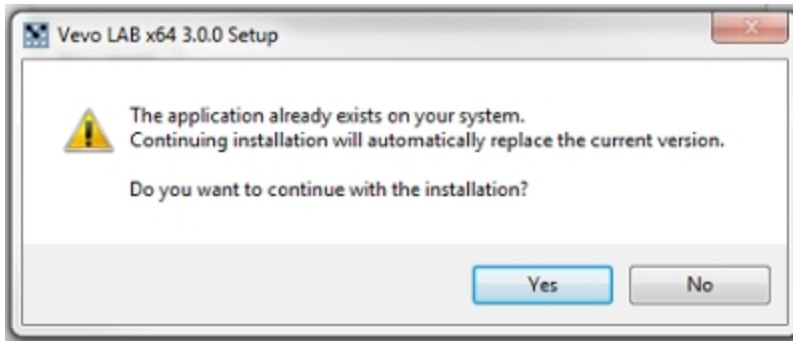


10 In the case of a software upgrade, a dialog appears, click OK to continue or Cancel to cancel the installation.

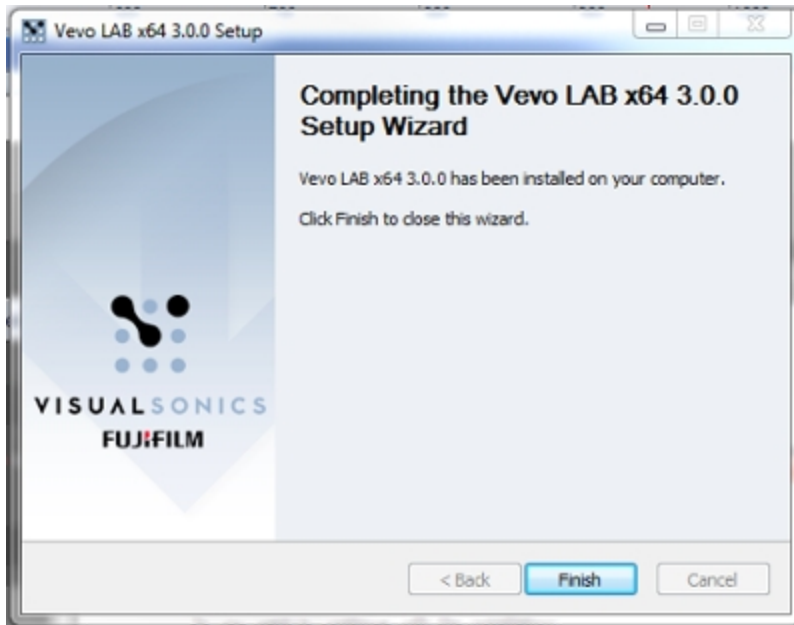


11 In the case of a software upgrade, another dialog appears, click Yes to continue or No to cancel the installation.





12 In the Completing the Vevo LAB x64 X.X.X Setup Wizard window, click Finish.



13 When an installation is complete, insert the Vevo LAB License Dongle into an available USB port (for new installations only).

**Note:** Need help? Call us toll-free at 1-866-416-4636, or go to [www.visualsonics.com/support/technical-support](http://www.visualsonics.com/support/technical-support).

**Important:** After you install Vevo LAB, do not modify the access permission for the application data folder.

## Downloading updates

When downloading the Vevo LAB PC update, download the zip file named "Vevo LAB Software Upgrade Package V3.1.0.zip" and unzip the downloaded file onto the root of a USB storage device.

Within the downloaded file, go to the folder named Software and double click the Vevo LAB install file—VevoLABSetup-3.1.0.xyz.x64.exe. The install begins automatically.

**Note:** 'xyz' represents numbers used internally by FUJIFILM VisualSonics.

The automated installer guides you through the installation, see step 11 in the procedure "Installation" on page 29.

## About this manual

This manual provides detailed descriptions and procedures for Vevo LAB.

## Document conventions

**Warning:** Introduces precautions that prevent injury or death.

**Caution:** Introduces precautions that prevent damage to the equipment.

**Important:** Introduces important information that you need to be aware of.

**Note:** Introduces helpful information for you to better understand the subject matter.

- Numbered lists in procedures must be performed in order (includes lists using lower-case roman numerals).
- Bulleted lists in procedures can be performed in any order.
- Lower-alpha lists display choices.
- The step in a single-step procedure begins with ♦ .
- Active links are [blue](#), visited links are [green](#).

## Formatting conventions

This documentation uses the following typeface conventions:

### **Bold**

- Buttons you click when you are using the software
- Keys you use on your keyboard
- Subheadings
- Titles and column headings in a table

### *Italic*

- Titles of images

## Getting more information

In addition to Vevo LAB Help (click ? from the Study Browser), the following resources are available:

- Vevo LAB User Manual printable PDF version available on the Customer Site at [www.visualsonics.com](http://www.visualsonics.com).
- Technical Support, see "[Technical Support](#)" on page 857.
- Scientific Support, see "[Scientific Support](#)" on page 857.

# Software Workspaces

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This section describes the primary software workspaces that you use when you work with Vevo LAB.

## User Management Mode login workspace

When User Management Mode has been enabled, each user must log in and out of Vevo LAB.

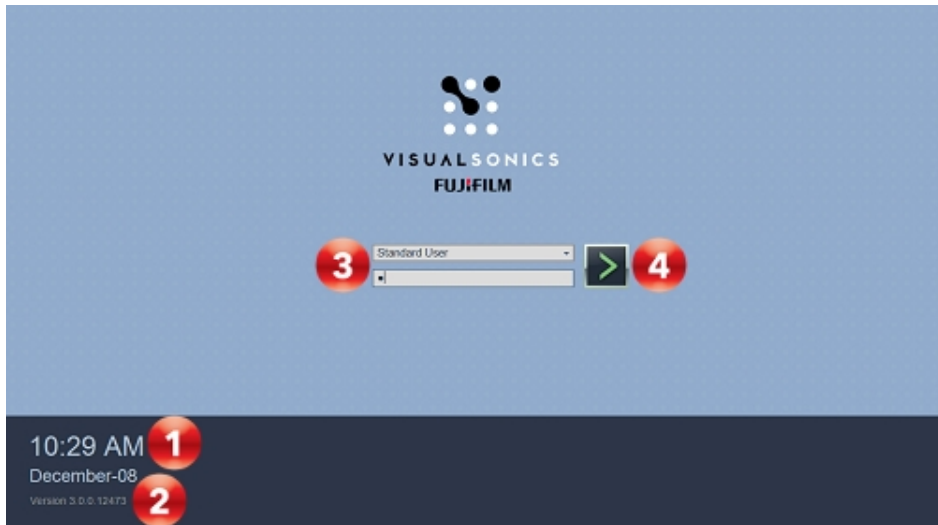
The login window workspace provides features you can use to:

- Log in with your user name and password.
- Check the Vevo LAB status.
- Identify the software version.

### To view the User Management Mode login window

- If User Management Mode is enabled and you are analyzing images, in the upper-right area of the monitor, click **Log Out**. The login window appears.
- If User Management Mode is off (you are in standard mode) you can switch to User Management Mode and access the login window, but only if you are an Administrator.

The following illustration describes the login window workspace.



**1** Time and status indicator

**2** Version stamp

Helpful for quick reference when you are communicating with VisualSonics Technical Support.

**3** User name/password login

In the top box select your name, in the lower box type your password.

**Caution:** 10-try limit for incorrect passwords. Vevo LAB then temporarily disables your account. Contact your Administrator to reset your password, or restart Vevo LAB and try up to 10 more passwords again.

To get another 10 tries, select another user name, select your name again and then try up to 10 passwords again.


#### 4 Log in

Click after you select the user and type the password.

## Mode workspace

The mode window is the workspace you use when you review image data in any ultrasound imaging mode.

### To open a mode window:

- From the Study Browser, expand a study row, select a series in the study. Next, either double-click one of the thumbnails or expand one of the series and double-click one of the image rows.
- From the mode window, click  in the image review controls near the bottom-right of the window to scroll through additional image thumbnails.

The following illustration describes the most common mode window workspace features.



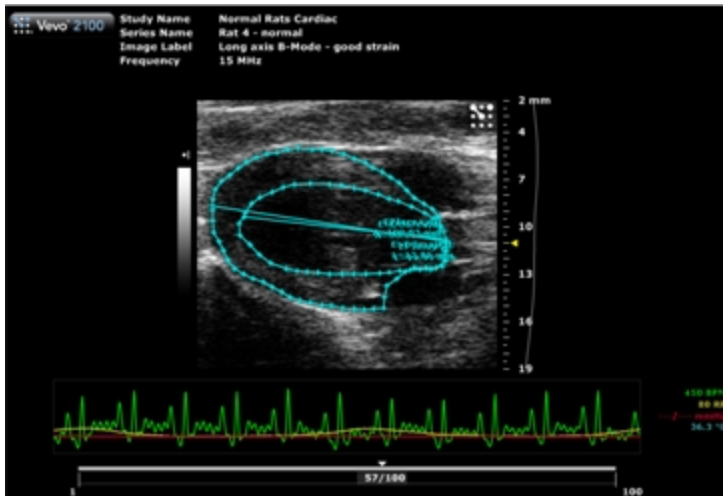
## 1 Mode image area

This large area:

- Displays the acquired image mode data.
- Displays any recorded physiological data and waveforms for the animal.
- Provides cine loop review controls.

If you export an image and click **Image** as your export type, Vevo LAB includes this image area content plus the image identity header information.





## 2 Focus depth indicator

Indicates the distance from the transducer face. The triangular arrow indicates the focal zone depth of the transducer.

## 3 Image scale

Indicates in mm the distance from the transducer face to the tissue being imaged at that moment of acquisition.


## 4 Image data panel

The image data that the transducer acquires. This is where you do the majority of work with images such as reviewing, adding measurements and annotations, post-processing image properties, and more.

**Note:** When you export a stored image and configure your export to send only the image area, this is the area of the window that is exported, along with header information.

## 5 Transducer orientation indicator

The orientation icon indicates the orientation of the transducer during acquisition in relation to the image.

For Vevo 3100 and Vevo LAZR-X image data, you can change the orientation in Vevo LAB via the Image Processing panel , under the Display Settings section in the Orientation drop down menu. Choose between Upper Left, Upper Right, Lower Left, and Lower Right.

**Note:** For M-Mode and AM- Mode, changing the orientation not only affects the B-Mode scout but also affects the M-Mode/AM-Mode image data. For PW Doppler Mode and PW Tissue Doppler Mode, changing the orientation only affects the B-Mode scout.

## 6 Dynamic range bar

Indicates the dynamic range of the display. The contrast of the image is measured in dB and is adjusted at time of acquisition.

## 7 Physiological data trace panel

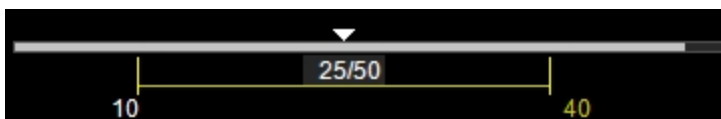
Displays the animal's recorded dynamic heart rate, temperature, respiration rate and blood pressure during acquisition.

## 8 Cine loop controls

Displays the length of the cine loop for frame-based images. The triangular white marker identifies the individual frame number within the cine loop. See ["Frame-based modes and time-based modes"](#) on page 83.



To create a range within the loop, drag the left and right vertical markers.





## 9 Playback control

The example below displays the playback control for a frame-based image.

You can select the playback speed (via slider or - / + controls) and what image frame is being displayed in the mode window.



The example below displays the playback control for a time-based image.

You can select playback speed (via slider or increase  /decrease  controls), volume levels, and what data is being displayed in the region of interest window.



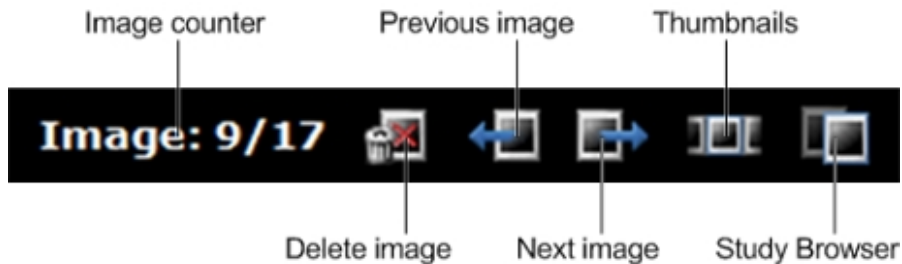
**Note:** The playback controls for M-Mode do not include volume level control. Volume level controls are only included for PW Doppler Mode and PW Tissue Doppler Mode images.

**Note:** In any mode, when playback is paused, the software will automatically enable scrolling mode of the image window. Use the mouse wheel to scroll forward and backward through the cine loop.

### 10 Physiological data values

Displays the recorded numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature.

### 11 Image review controls



### 12 User name

Displayed when User Management Mode is enabled (where User Management Mode is supported).

### 13 Available storage space

Percentage of free space to store image data.

## 14

## Functions panel

## Functions panel

Function button	Description
Export	Opens the Export Image window so you can export the image. For more information, see <a href="#">"Exporting image data"</a> on page 186.
Report	Opens the Report window. For more information, see <a href="#">"Report workspace"</a> on page 74.
Cine Store	Saves the displayed cine loop. For more information, see <a href="#">"Saving an image"</a> on page 184.
Frame Store	Saves the displayed frame. For more information, see <a href="#">"Saving an image"</a> on page 184.
Image Store	Saves the displayed frame in a time-based mode cine loop. For more information, see <a href="#">"Saving an image"</a> on page 184.
Image Label	Opens the Image Label window so you can create a new custom name for the displayed image. For more information, see <a href="#">"Labeling an image"</a> on page 183.
Split Screen	<p>When Split Screen is enabled, you can review two images in the image area at one time—available for both frames and cine loops.</p> <p>If two frame-based cine loops are loaded into Split Screen, you will be able to play both using Sync Play—a feature that enables both cine loops to play at the same playback rate</p>

## Functions panel

Function button	Description
	<p><b>Note:</b> Sync Play will only be available in Split Screen for EKV Mode images if both images are EKV Mode images.</p> <p><b>Note:</b> Sync Play is not available for any 4D-Mode cine loops.</p>

### 15

#### Dynamic control feedback



Displays:



- Updated mode settings values when changed by the user. Vevo LAB then displays the updated setting value in the Mode Settings panel.
- Confirmation messages when you store an image.

### 16

#### Image mode management panel


Displays a unique set of controls and information depending on the image management panel tab you click:

- Click the Mode Settings tab icon  to open the Mode Settings panel and display a read-only list of Mode Settings for the image. This is the default panel when you open a mode window.
- Click the Image Processing tab icon  to open the Image Processing panel and to display the following:

- Any available mode-specific image controls you can apply to the image.
- Read-only image control settings that were applied during acquisition.
- Click the Measurements tab icon  to open the Measurements panel and display the available measurement tools.
- Click the Physiological tab icon  to open the Physiological panel and display the following, (if physiological data was recorded during acquisition):
  - The Physiological Display options that you can apply to the image.
  - Physiological Display settings and Respiration Gating settings that were recorded during acquisition.

**Note:** This panel is always available and editable.

You can clear the View Physiology check box to hide the data from the image. Hiding the data will increase the size of the image.

- Click the Preferences tab icon  to open the Preferences window. This window provides a series of tabs you can use to customize the way you work with a range of Vevo LAB features, see "[Preferences](#)" on page 93.

## 17 Acquisition profile

- Displays the name of the Granting Institution if this was added in the Study Information.
- Displays the owner.
- Identifies the transducer that acquired the image data.

## 18 Image details

- Displays the Study Name and the Series Name.
- Displays the Animal ID if one was added via the Study Information window; if nothing was entered, it will be blank. See "[Study Information workspace](#)" on page 70.
- Displays the Image Label if one was added via **Image Label**; if nothing was entered, it will be blank.

## 19 Image status

Image Status

Text color	Description
Yellow	Imaging mode used to acquire the image (for example, B-Mode).
White	Current state of the image:  Recalled - Opened for review.  Stored - Just saved as a cine loop or cine frame.



### Image Status

Text color	Description
	Regenerated - B-Mode/EKV to AM-Mode, MIP in NLC or loading data into 3D Mode/4D-Mode.



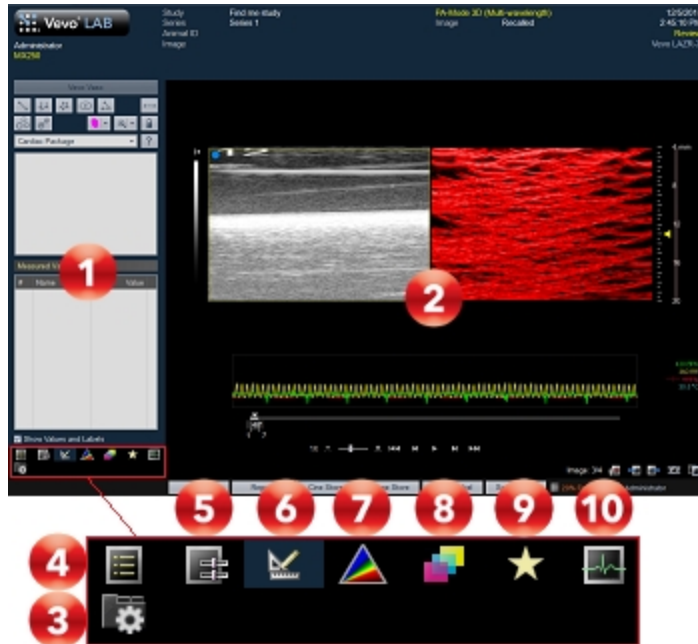
Time stamp/system status

### Time Stamp/System Status

Text color	Description
White	Date and time when the image was stored.
Yellow	Current state of the image.
Light blue	The model of the Vevo Imaging System that originally acquired the image.

## Image management panel workspace

The image management panel displays tools and information that help you work with the image that is displayed in the image area.



The tabs in the image management panel display the panels that are available, based on the mode of the image you are reviewing.

To change the content of the image management panel, click the appropriate tab.

There are additional panels when you load 3D data into 3D view—3D Settings panel and Volume Measurement panel, see "[3D Mode Analysis](#)" on page 373 for more information.

- 1 Image management panel
- 2 Image area
- 3 Preferences
- 4 Mode Settings
- 5 Image Processing
- 6 Measurements
- 7 Spectral Unmixing Control
- 8 Multiplexer Control
- 9 Frame Marker
- 10 Physiological

## Mode Settings panel

Presents a read-only list of Transmit, Acquisition and Display settings.

To display the Mode Settings panel

- ◆ In the image management panel tabs, click the Mode Settings tab icon .

<b>Application</b>	Mel (Small) Cardiology
<b>Transmit</b>	
Frequency	21 MHz
2D Power	100%
PA Power	100%
<b>Acquisition</b>	
Wavelength Range	695-870
Frame Rate	5
PA Gain	35.0 dB
2D Gain	34.0 dB
Depth	20.00 mm
Width	22.04 mm
Sensitivity	High
Stop Gate	Off
Persistence	Off
PA Acquisition	Single
Wavelength	700 mm
Comet Filter	On
<b>Display</b>	
Display Map	PA1
Priority	92%
Brightness	60
Contrast	60
PA Brightness	60
PA Contrast	60

## Image Processing panel

Provides tools for modifying the visual properties of your image.

To display the Image Processing panel

- ◆ In the image management panel tabs, click the Image Processing tab icon



## Measurements panel

Provides tools for adding measurements to an image when you are reviewing an individual frame or when you pause a cine loop.

To display the Measurements panel

- ◆ In the image management panel tabs, click the Measurements tab icon 


**Note:** Measurements are only available when playback is paused.

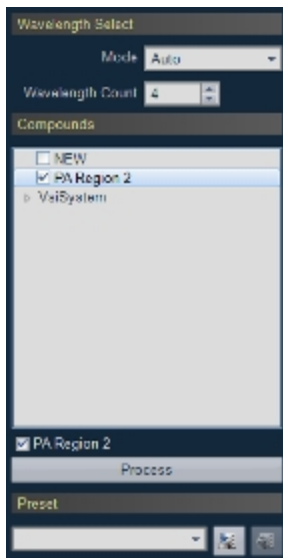


## Spectral Unmixing Control panel

Displays controls for you to unmix the acquired image according to components that you select. The unmixing process then creates layers for the chosen components when viewing the image in review so you can select/deselect those components according to your study requirements.

### To display the Spectral Unmixing Control panel

- ◆ In the image management panel tabs, click the Spectral Unmixing Control tab icon .



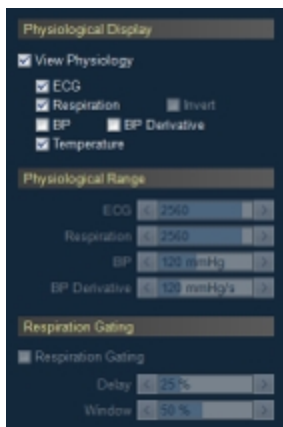
## Physiological panel

Provides controls for displaying the physiological data. In Vevo LAB, only the Physiological Display section controls are available. Physiological Range and Respiration Gating sections are disabled and only available when the image is acquired.

To display the Physiological panel

- ◆ In the image management panel tabs, click the Physiological tab icon .

**Note:** This panel is not applicable in 3D Mode.






## Multiplexer Control panel

Provides tools for assigning color and other visual properties to each wavelength in a PA-Mode (Multi-wavelength/NanoStepper), PA-Mode (Spectro) or PA (Unmixing) acquisition.

To display the Multiplexer Control panel

- ◆ With a PA-Mode (Multi-wavelength/NanoStepper), PA-Mode (Spectro) or PA (Unmixing) image open, click the Multiplexer Control tab icon .

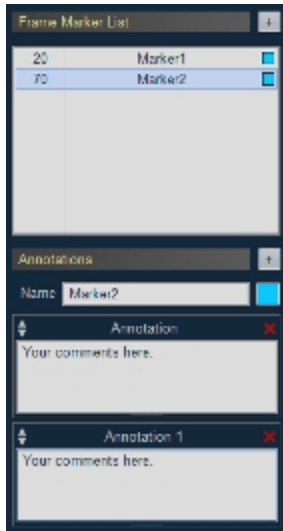


## Frame Marker panel

Frame markers are small markers on the clip buffer to indicate an important point in the acquisition, like an injection or withdraw from the Vevo Infusion Pump.

To display the Frame Marker panel

- ◆ In the image management panel tabs, click the Frame Marker tab icon ★.

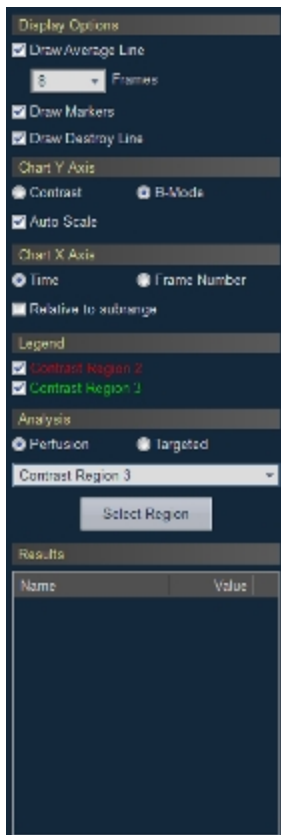


## Region Graph Analysis panel

Provides tools for modifying a Region Graph.

To display the Region Graph Analysis panel

- ◆ Right-click a measurement that includes a graph feature and click **Region Graph** from the menu.



## 3D Mode panels


See "[3D Mode Analysis](#)" on page 373 for details on the 3D Settings and Volume Measurement panels.

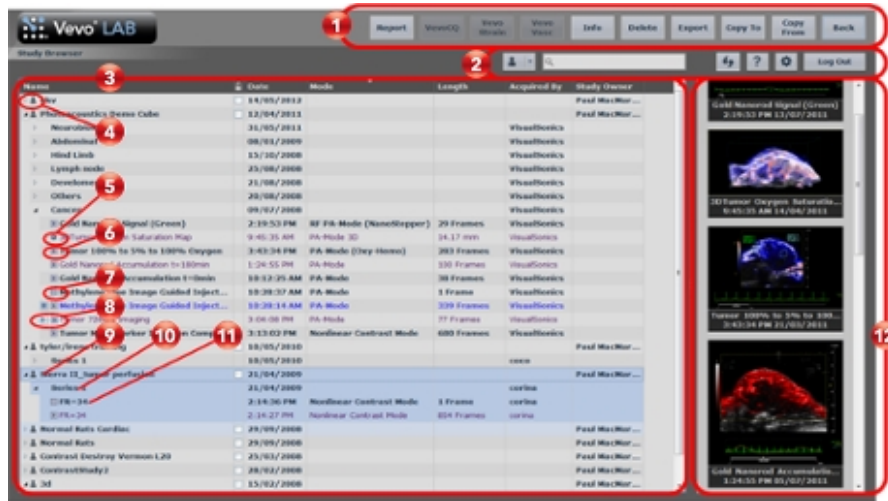
## Study Browser workspace

The Study Browser workspace is where you manage your studies, series and individual images. Use the Study Browser to:



- View the list of available studies and series.
- Export studies and series.
- Import studies and series.
- Delete studies and series.
- Move series.
- Search and edit study information content.
- Select and load an image to review.

## To open the Study Browser

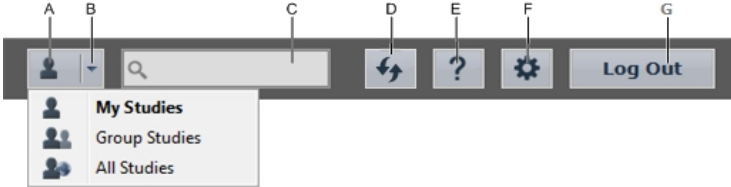
From an open image, click . Vevo LAB to display the Study Browser. The following illustration describes the Study Browser workspace.













Study Browser Workspace

Area	Description
	Study Browser window commands.
	When User Management Mode is on, this toolbar provides the following:




## Study Browser Workspace

Area	Description
	 <p>The screenshot shows a toolbar with the following elements from left to right: a user profile icon (A), a dropdown arrow (B), a search input field (C), a refresh icon (D), a help icon (E), a settings gear icon (F), and a 'Log Out' button (G). A dropdown menu is open under the user profile icon, showing 'My Studies', 'Group Studies', and 'All Studies'.</p> <p><b>Note:</b> The toolbar provides different tools depending on whether User Management Mode is on or off.</p>

## Study Browser Workspace








Area	Description												
	<p>A. Study sharing level display selector. Each time you click, the Study Browser displays the list of studies that match the study sharing level (only displayed when User Management Mode is enabled).</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <thead> <tr> <th style="width: 25%;">Study sharing level</th> <th style="width: 15%;">Icon</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Keep Private</td> <td style="text-align: center;"></td> <td>Provides study access to you and Administrators.</td> </tr> <tr> <td>Share with Group</td> <td style="text-align: center;"></td> <td>Provides study access to you, to all users in your group and to Administrators.</td> </tr> <tr> <td>Share with Everyone</td> <td style="text-align: center;"></td> <td>Provides study access to everyone.</td> </tr> </tbody> </table> <div style="background-color: #1a3d4d; color: white; padding: 10px; border-radius: 5px; margin: 10px 0;"> <p><b>Note:</b> If you have installed the Vevo Brain Neuroanatomical Atlas to use with the Vevo Brain Stereotactic Frame, you will have a fourth option—Reference Studies.</p> <div style="background-color: #ccc; padding: 5px; border-radius: 3px; display: inline-block; margin-top: 5px;">  Reference Studies         </div> </div> <p>B. Study sharing level selector. Click the down arrow and then select the study sharing level. The Study Browser displays the list of studies that match your selection (only displayed when</p>	Study sharing level	Icon	Description	Keep Private		Provides study access to you and Administrators.	Share with Group		Provides study access to you, to all users in your group and to Administrators.	Share with Everyone		Provides study access to everyone.
Study sharing level	Icon	Description											
Keep Private		Provides study access to you and Administrators.											
Share with Group		Provides study access to you, to all users in your group and to Administrators.											
Share with Everyone		Provides study access to everyone.											

## Study Browser Workspace








Area	Description
	<p>User Management Mode is enabled).</p> <p>C. Search for content from any column in the Study Browser. To search, type your words or phrase in the box. Vevo LAB auto-displays the matching results with each character you type. To return to the full Study Browser list, click  in the search box.</p> <p>D. Refresh button updates the Study Browser list.</p> <p>E. Opens the Help information options.</p> <p>F. Opens the Preferences window.</p> <p>G. Logs you out and displays the User Management Mode log in window (only appears when User Management Mode is enabled).</p>
	<p>When User Management Mode is off this is the toolbar that is displayed. This toolbar provides the tools explained in the following keyed illustration.</p> <div style="text-align: center; margin: 10px 0;">  </div> <p>A. Search for content from any column in the Study Browser. To search the Study Browser, type your words or phrase in the box—the results are displayed.</p> <p>B. Refresh button updates the Study Browser list.</p>




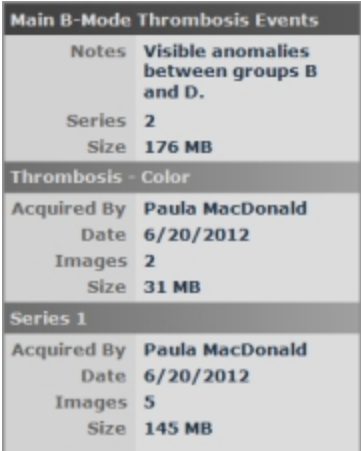
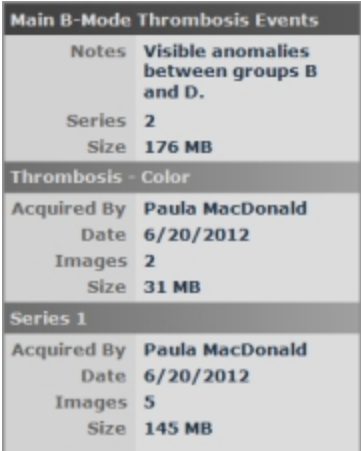
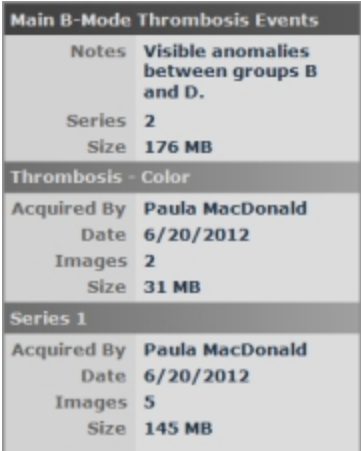
## Study Browser Workspace

Area	Description
	<p>C. Opens the Help information options.</p> <p>D. Opens the Preferences window.</p>
	<p>This Study Browser lists the available studies and the series that contain the images.</p> <ul style="list-style-type: none"> <li>• To sort the Study Browser by column, click the column header. Click again to toggle the sort order between ascending/descending.</li> <li>• To re-position any column except Name, drag it to the left or right side of another column.</li> <li>• To resize the width of a column, drag the right-side column divider left or right.</li> <li>• To hide a column, right-click anywhere in the header row and click the column title to remove the check mark.</li> <li>• To show a hidden column, right-click anywhere in the header row and click the column title to apply the check mark.</li> </ul>
	<p> Indicates the study sharing level when in User Management Mode.</p>
	<p> Double-click the icon to view the image.</p>
	<p> Double-click the icon to play the cine loop.</p>

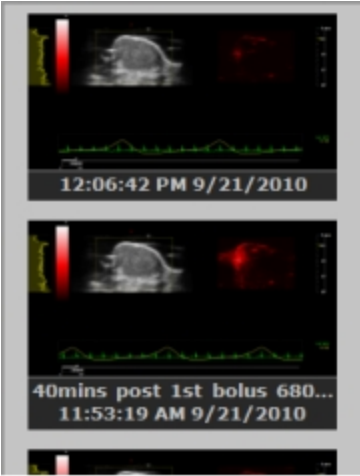
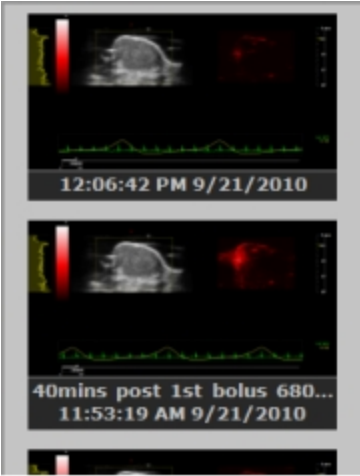
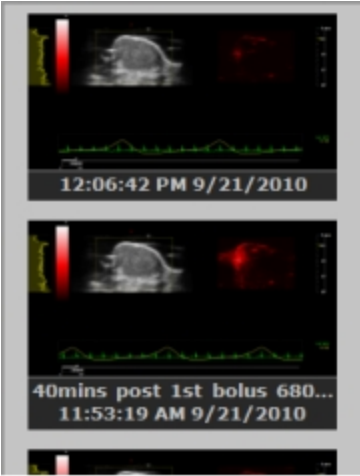
## Study Browser Workspace

Area	Description
	 Double-click the icon to view the image frame.
	 Indicates that the image is currently displayed on either the left or right side in Split Screen.
	<p>Study row in the Study Browser. Notes for a study are only displayed when you select a study or series and then click <b>Info</b>.</p> <p>Right-click a study for options to:</p> <ul style="list-style-type: none"> <li>• Change the measurement package for the study.</li> <li>• Change the study access level (only available when User Management Mode is on).</li> <li>• Delete the study.</li> </ul>
	<p>Series row within a study. To display a series, double-click or expand the study, then select the series.</p> <p>Right-click a series for options to:</p> <ul style="list-style-type: none"> <li>• Change the measurement package for the series.</li> <li>• Move the series to another study.</li> <li>• Delete the series.</li> </ul>
	Image row within a series. To view an image, expand the study then expand the series, then double-click the image row or double-click the image thumbnail on the right panel.




## Study Browser Workspace

Area	Description				
	<p>Right-click an image for options to:</p> <ul style="list-style-type: none"> <li>• Open the image.</li> <li>• Add an image label.</li> <li>• Change the measurement package for the image.</li> <li>• Delete the image.</li> </ul>				
	<p>Displays the content that relates to the study or series that you have selected, as described in the table below.</p> <p style="text-align: center;"><b>Notes/Thumbnails Panel</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Grid Row Selected</th> <th style="text-align: center;">Preview Panel</th> </tr> </thead> <tbody> <tr> <td style="vertical-align: top;"> <p>When you select the study row, the panel displays study notes if any have been entered in the Study Notes field of the Study Info window.</p> <p>Summary details of each series are displayed.</p> </td> <td style="text-align: center; vertical-align: top;">  </td> </tr> </tbody> </table>	Grid Row Selected	Preview Panel	<p>When you select the study row, the panel displays study notes if any have been entered in the Study Notes field of the Study Info window.</p> <p>Summary details of each series are displayed.</p>	
Grid Row Selected	Preview Panel				
<p>When you select the study row, the panel displays study notes if any have been entered in the Study Notes field of the Study Info window.</p> <p>Summary details of each series are displayed.</p>					

Study Browser Workspace

Area	Description				
	<p style="text-align: center;">Notes/Thumbnails Panel</p> <table border="1"> <thead> <tr> <th>Grid Row Selected</th> <th>Preview Panel</th> </tr> </thead> <tbody> <tr> <td> <p>When you select the series row, the panel displays all thumbnails of the images in the series.</p> <p>Double-click a thumbnail to open the image.</p> </td> <td>  </td> </tr> </tbody> </table>	Grid Row Selected	Preview Panel	<p>When you select the series row, the panel displays all thumbnails of the images in the series.</p> <p>Double-click a thumbnail to open the image.</p>	
Grid Row Selected	Preview Panel				
<p>When you select the series row, the panel displays all thumbnails of the images in the series.</p> <p>Double-click a thumbnail to open the image.</p>					

Study Browser Workspace

Area	Description				
	<p style="text-align: center;">Notes/Thumbnails Panel</p> <table border="1"> <thead> <tr> <th>Grid Row Selected</th> <th>Preview Panel</th> </tr> </thead> <tbody> <tr> <td> <p>When you select the image row, the panel highlights the image thumbnail.</p> <p>Double-click the thumbnail to open the image.</p> </td> <td>  </td> </tr> </tbody> </table>	Grid Row Selected	Preview Panel	<p>When you select the image row, the panel highlights the image thumbnail.</p> <p>Double-click the thumbnail to open the image.</p>	
Grid Row Selected	Preview Panel				
<p>When you select the image row, the panel highlights the image thumbnail.</p> <p>Double-click the thumbnail to open the image.</p>					

## Study Information workspace

Use the Study Information window to:

- Display or manage the information for a study.
- Display or manage the information for a series.

### To open the Study Information window

When you are in the Study Browser and you have selected a study or series, click **Info**. If you select the row for a series, Vevo LAB displays the information for the series and the study that contains the series. If you select the row for a study, Vevo LAB only displays the information for the study.

The following illustration describes the Study Information window workspace.



### Study Information Workspace

Area	Description
<p><b>1</b></p>	<p>Study Information window commands. You must click <b>OK</b> to save any changes you make in the fields below.</p>
<p><b>2</b></p>	<p>Study Information includes the information that describes a study. When User Management Mode is on, this area includes a Sharing field to display the sharing level that has been selected for the study.</p>
<p><b>3</b></p>	<p>Series Information includes the information that describes a series within a study.</p>

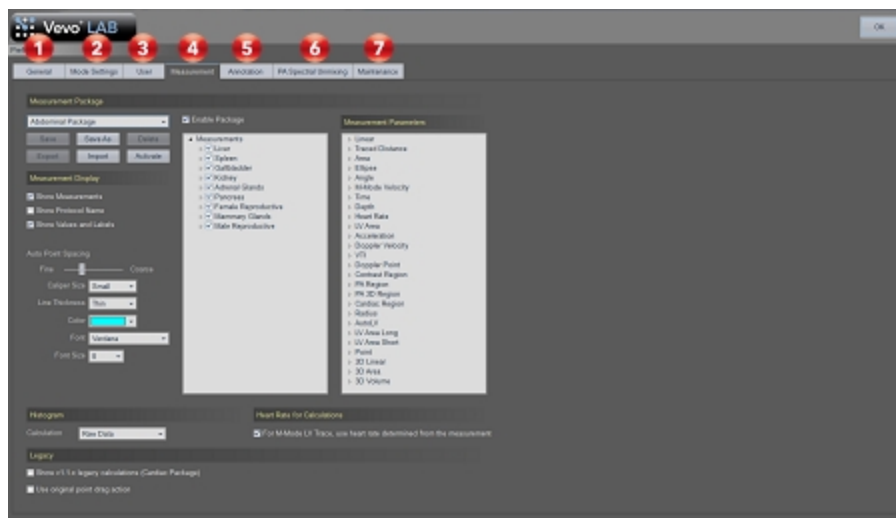
## Preferences workspace

The Preferences workspace provides a series of tabs you can use to configure default values for a range of operational settings.


To open the Preferences workspace

- ◆ In the Study Browser, click  or if you are in the mode window click .

The following illustration describes the Preferences workspace.









Preferences Workspace

Area	Description
	Use General preferences to specify Studies Location, Institution, Image Export header option, and Study Browser Lock options.



## Preferences Workspace

Area	Description
	Use Mode Settings preferences to configure Frame Based Mode Screen Layout, PW Doppler scale and 3D/4D Mode Multi-slice View Defaults.
	Use User preferences to enable/disable User Management Mode, manage Users, enable/disable Usage Log, and Export/Purge the Usage Log Table.
	Use Measurement preferences to manage and customize the measurement packages you want to work with, specify which protocol and protocol measurements you want the system to display, specify Legacy settings, set the Histogram Calculation and enable/disable the Heart Rate for Calculations option.
	Use Annotation preferences to customize the annotations in the measurement packages.
	Use PA Spectral Unmixing to separate wavelengths or components for PA-Mode (Multi-wavelength/NanoStepper) and PA-Mode (Spectro) images.
	Use Maintenance preferences to perform an Upgrade, manage Monitor settings, export System Logs, and Backup and Restore system settings.

## Report workspace

The Report workspace displays a report of the measurements and calculations for one or more studies or a series.

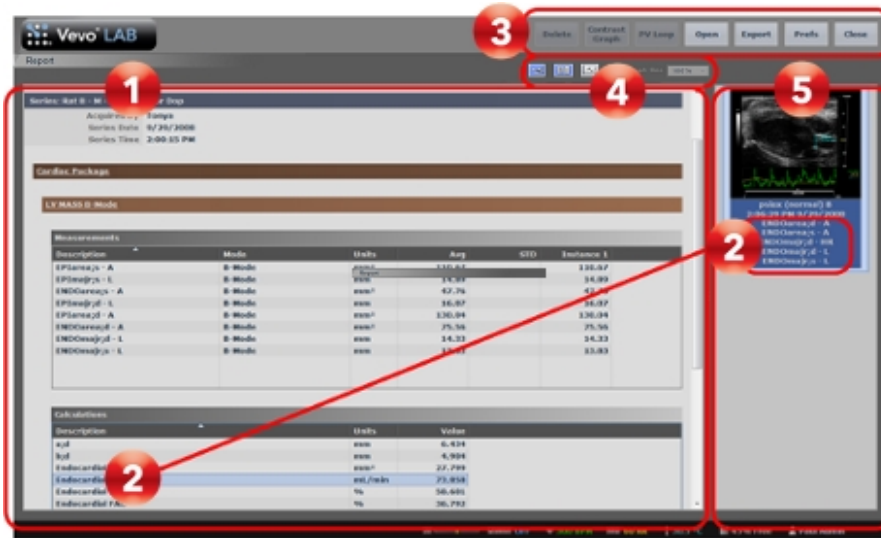
### To open the Report workspace from the mode window

- 1 From an open image, click **Report**.
- 2 Vevo LAB displays a report of the measurements and calculations for the series.

### To open the Report workspace from the Study Browser

- 1 From the Study Browser select a study or series.
- 2 Click **Report**. Vevo LAB displays a report of the measurements and calculations for the study or the series.

The following illustration describes the Report workspace.



### 1 Report details

Displays the Study and Series information, measurement packages used, measurement descriptions/values and calculation descriptions/values.

To display the measurements and/or calculations and/or graphs for all images in a study

1 In the Study Browser, select the study row.

2 Click Report.

## To display the measurements and/or calculations and/or graphs only for images in a series

- 1 In the Study Browser, select the series row.
- 2 Click **Report**.



### Individual calculation display

When you click a calculation description in the Calculations table, the thumbnail of the image is displayed.



### Report window commands

- Delete - Click on a graph to highlight it, then click **Delete**.
- Contrast Graph - Click a Contrast Region measurement check box to select it, then click **Contrast Graph**. The Contrast Region Analysis workspace will open. Edit your Display Options then save or export your graph.

## To export the Contrast Graph

- 1 Within the Report window, select a Contrast Region by clicking its checkbox.
- 2 Click **Contrast Graph**.
- 3 (Optional) Tap **Save** to save the Graph.
- 4 (Optional) Tap **Export** to export the Graph. The Export Graph Window is displayed.

5 Under Export Type, select Graph.

6 (Optional) Under the Options section, type a custom file name by clicking the Save As text box and enter a new name with your keyboard.

7 Select your export type.

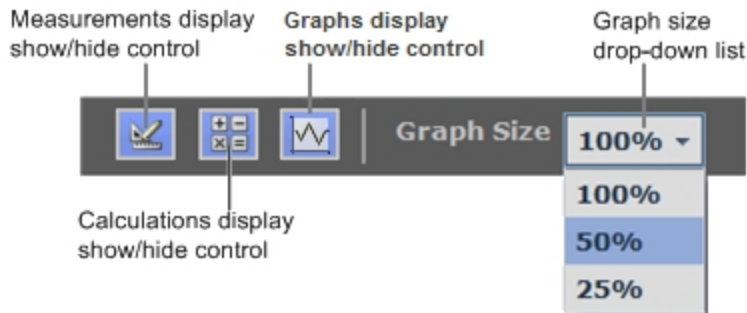
Contrast Graph Export Types and Descriptions

Export Types	Description
CSV	Comma Separated Value (CSV) file format used to represent database fields. Each entry of the file represents one field and is separated from the next field by a comma.
BMP	Bitmap (BMP) file format of a static image file format. Each bit of the saved BMP file represents a piece or pixel of the image.  An additional option to export graph parameters is available. Click the <b>Export Graph Parameters for BMP/TIFF checkbox</b> .
TIFF	Tagged Image File (TIFF) Format is a standard still image file format that includes tagged fields with the image that can be read by the opening application.  An additional option to export graph parameters is available. Click the <b>Export Graph Parameters for BMP/TIFF checkbox</b> .

- PV Loop – Click to check an LV Area measurement check box, then click **PV Loop**. The Pressure Volume Relationship graph will open. Select your calculations then save or export the graph.

- Open - Click to highlight a measurement or calculation row, then click **Open**. The image containing your selection will be opened in the Mode workspace.
- Export - Click to export the Report.
- Prefs - If you want to return to Preferences, click **Prefs**.
- Close - To close the Report and return to your previous workspace, (Mode, Study Browser), click **Close**.

#### 4 Report window toolbar



- Measurements/Calculations/Graphs display controls - Click one or all controls to show or hide the data. Blue icon = enabled/displayed, gray icon = disabled/not displayed.

**Note:** These controls are for monitor display only; they do not affect the source data if you export it. If you want to apply show/hide for data export, complete this in the Options section when you export the data.

- Graph size drop-down list - Select the output size for the graph in the report (100%, 50%, 25%).

## 5

### Image thumbnails

- Select a measurement to display a thumbnail of the image that contains the measurement.
- Double-click the thumbnail to review the full-size image in the Mode workspace.

## Export, Copy To, Copy From common workspace

The following three workspaces include common core features:

- Export Image
- Copy Study To
- Copy Study From

### To open the Export Image window

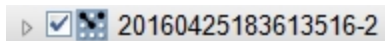
- 1 Open the Study Browser.
- 2 Select one or more studies and/or series and click **Export**.

### To open the Copy Study To window

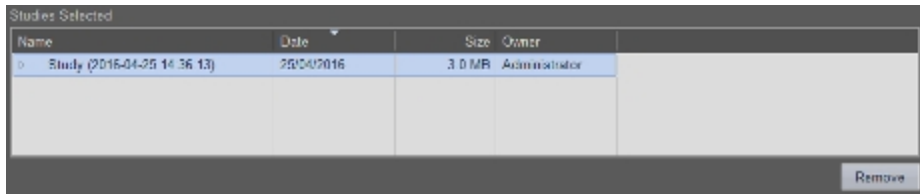
- 1 Open the Study Browser.
- 2 Select one or more studies and click **Copy To**.

## To open the Copy Study From window

- 1 Open the Study Browser.
- 2 Click **Copy From**.
- 3 In the Copy Study From workspace, select the Owner User from the drop down menu.
- 4 Select your study to import by clicking the check box beside the study name.



- 5 Studies that you select will be added to the Studies Selected section.



- 6 (Optional) Remove a study from the Studies Selected section by left-clicking on a study, then click **Remove**.
- 7 Click **OK**. The studies selected are added to the Study Browser.

## To open the Export Report window

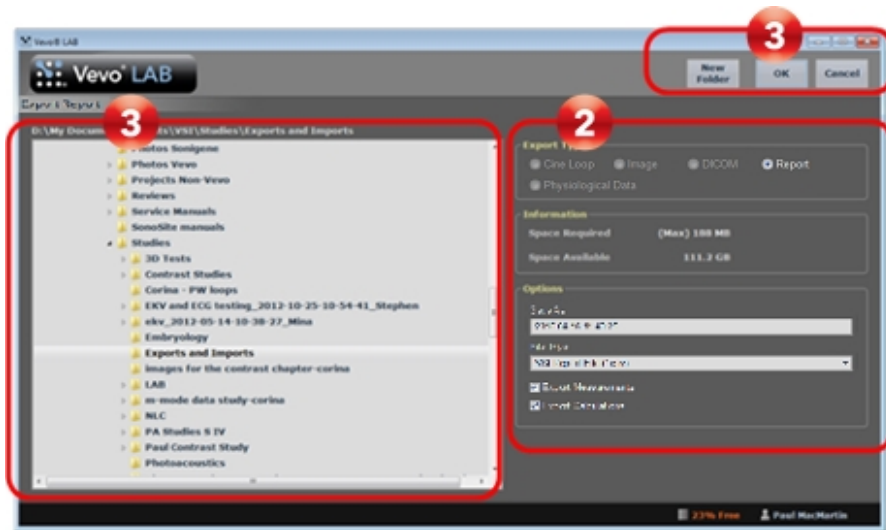
- 1 Open the Study Browser.
- 2 Select one or more studies and/or series and click **Report**. Vevo LAB displays the Report workspace.








3 Click Export. The Export Report window appears.

The following illustration and table details the information and features in the Export Report window.



## Export Report Window

Area	Description
	Folder browser - Similar to how Windows Explorer works on a Windows PC, browse the folders hierarchy to navigate to your destination folder.
	File transfer information and options. <ul style="list-style-type: none"><li>• The Export Type section only appears when you are exporting images or analysis reports.</li><li>• The Information section is read-only and shows you the Space Required and Space Available.</li><li>• The Options section includes fields for specifying a file name, file type and if you want to export measurements and calculations (if available) with your image.</li></ul>
	Export window commands. <ul style="list-style-type: none"><li>• If you need to create a new folder for the file you are exporting, click <b>New Folder</b>.</li><li>• When you have set your Export Type and Options, click <b>OK</b>.</li></ul>

## Basics

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This section introduces you to the basics of Vevo LAB.

### How Vevo LAB works

This section shows you how the following three core features of Vevo LAB work together to help you generate useful analysis and reports.

### Image mode analysis tools

Vevo LAB can analyze all images acquired on the Vevo 1100, 2100, LAZR, LAZR-X and 3100 Imaging Systems in all supported imaging modes.

### Frame-based modes and time-based modes

Because many image acquisition features apply to multiple imaging modes, this manual includes references to frame-based modes and time-based modes.

Frame-based Imaging Modes	Time-based Imaging Modes
Images are measured in frames, based on two-dimensional B-Mode data. Frame-base modes include: B-Mode, PA-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode and EKV Mode.	Images are measured in seconds, based on unique source data characteristics. Time-base modes include: M-Mode, AM-Mode, PW Doppler Mode and PW Tissue Doppler Mode.

## **B-Mode overview**

B-Mode is the imaging mode you will work with most often because it is the most effective mode for locating anatomical structures.

Many other Vevo imaging modes use B-Mode as the background orientation image over which the active mode data is applied or overlaid.

## **PA-Mode overview**

PA-Mode (Photoacoustic Mode) is a method for obtaining optical contrast from biological tissues and detecting it with ultrasound. A PA-Mode image is acquired by illuminating tissue with pulsed laser light; thermoelastic expansion occurs and this expansion creates an ultrasound wave which can be detected with an ultrasound transducer.

## **M-Mode overview**

M-Mode is used primarily to measure the movement and dimensions of cardiac structures such as chambers and walls.

M-Mode works in a fundamentally different way than B-Mode. Where B-Mode is a frame-based image that uses multiple scanning beams to create its image, M-Mode is a time-based image that is created by the movement of the heart structure as it moves up and down a single beam. The movements are the wave-like image cycles that are visible in the M-Mode image.

After an image is saved, open the image and take measurements along the single beam line.

### **AM-Mode overview**

AM-Mode (Anatomical M-Mode) is a modification to standard M-Mode typically used in echocardiography in order to steer the sample volume to any angle during acquisition, rather than position the sample volume in a strictly vertical position.

### **PW Doppler Mode overview**

PW Doppler Mode (Pulsed Wave Doppler) is an ultrasound mode that is used to measure the velocity and direction of flow. Vevo LAB presents the detected PW Doppler signal as both a spectral image in the display window as well as an audio output through your computer's speakers.

### **PW Tissue Doppler Mode overview**

PW Tissue Doppler mode images provide all the measurement and analysis tools that are provided in PW Doppler mode analysis.

### **3D Mode overview**

3D Mode provides a three-dimensional view of an area of interest from frame-based imaging modes, excluding PA-Mode (Spectro) and EKV Mode.

### **4D-Mode overview**

4D-Mode is a three dimensional EKV Mode (ECG-based Kilohertz Visualization) image of one complete cardiac cycle synthesized from B-Mode

image data acquired at a high frame rate.

The software acquires EKV acquisitions at different 3D motor positions. Each EKV acquisition is a complete heart cycle. What we end up with are complete heart cycles for each motor position creating a 4D-Mode clip of the entire heart cycle.

4D-Mode settings are optimized to produce high quality renderings in as short a time as possible.

### **Color Doppler Mode overview**

Color Doppler Mode uses PW Doppler Mode ultrasound to produce an image of a blood vessel. In addition, the Doppler sounds are converted into colors that are overlaid on the image of the blood vessel to represent the speed and direction of blood flow through the vessel.

This mode is useful for blood flow applications such as:

- Distinguishing non-vascular tissue structures from vascular tissue structures.
- Identifying vascular structures that can be more difficult to identify in other ultrasound mode image data.

### **Power Doppler Mode overview**

Power Doppler Mode provides tools to visualize and measure flow dynamics. This imaging mode displays the energy from the returning Doppler signal and assigns a color range to the energy generated by moving blood flow. This is useful for applications such as detecting vascularity in and around orthotopic and subcutaneous tumors and producing a measure of relative quantification.

## Linear Contrast Mode overview

Linear Contrast Mode imaging provides tools to detect and quantify vascular structures and dynamics at the molecular level in two dimensions or three dimensions.

This mode is useful in cancer, vascular and cardiology research for real-time in vivo applications such as:

- Targeted molecular imaging for visualizing and quantifying the expression of intravascular molecular markers for example, angiogenesis and inflammation.
- Tumor perfusion and relative quantification of vascular volume and structure.
- Assessment of myocardial perfusion and area of infarction.

## Nonlinear Contrast Mode overview

Nonlinear Contrast Mode is a high-frequency imaging mode that produces improved sensitivity in microbubble detection and quantification. This mode suppresses the tissue signal while increasing the detection of the contrast agents.

## EKV Mode overview

EKV Mode (ECG-based Kilohertz Visualization) is an image reconstruction technique that produces a one-heart-cycle cine loop synthesized from B-Mode image data acquired at a very high frame rate.

The process works by acquiring data over multiple heart cycles, extracting data at specific time points in these cycles, then producing a representative one-heart-cycle cine loop.

To analyze an EKV Mode image, you can use the same analysis tools you use to analyze a B-Mode image. Additional EKV Mode refinement tools in the Image Processing panel are also available.

### RF Mode overview

RF Mode provides data in RF, Raw and IQ format for further analysis. RF Mode allows users to digitize and view the RF data from the high-frequency ultrasound signal, which can be acquired in both frame-based and time-based imaging modes.

The data can be envelope detected and log compressed to be exported in a range of file formats. Envelope format is a useful way of storing raw data that correlates exactly to what is seen in the B-Mode image and is readily available for image processing applications.

### Studies, series and images

Studies are similar to studies in a paper based system. They work much like a file directory and hold the collection of images that are part of your study.

Studies are composed of one or more grouped image sets called series, and the series are composed of one or more images (individual frames and/or multiple-frame cine loops).



## Users

Users are people who use Vevo LAB. There are two levels of user accounts:

- Standard users
- Administrators

Vevo LAB provides two user access modes:

- Standard mode (no log-in required) – This is the default access mode and provides minimal user restrictions.
- User Management Mode (log-in is required) – This is an administrative option that activates advanced user account controls, user groups, user-assignable study sharing levels and Usage Log availability.

## Logging in and out

This section walks you through the procedures for logging in and out of a Vevo LAB session.

### Logging in to a session in user management mode

User Management Mode is an administrative option that activates advanced user account controls, user groups, user-assignable study sharing levels and Usage Log availability.


Permissions, restrictions and exceptions:

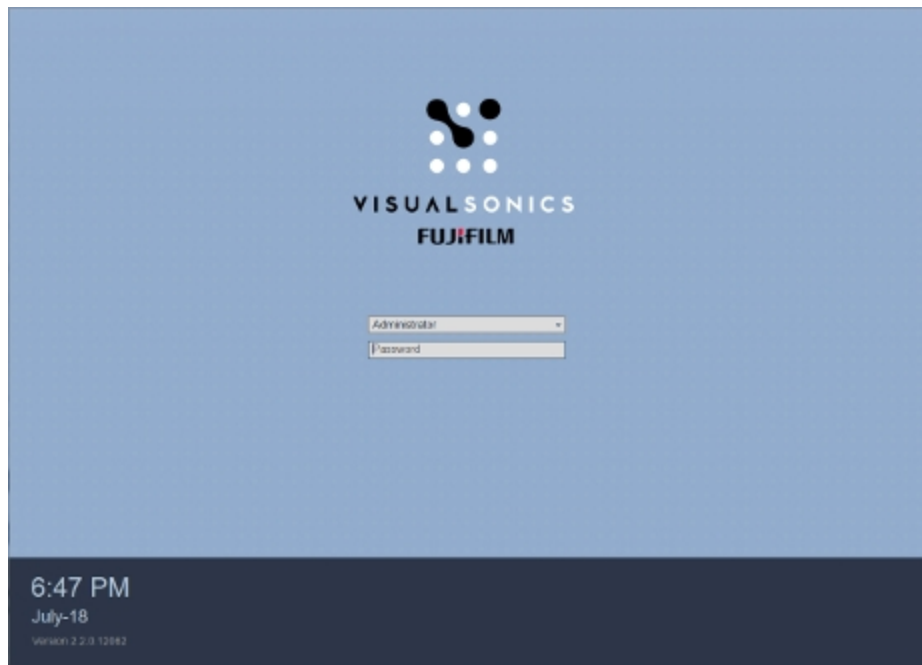
- At least one Administrator must exist in User Management Mode in order to create users and passwords.

- A user must have a password-protected account to log in when User Management Mode is enabled.
- To enable an existing user to access Vevo LAB in User Management Mode, an Administrator must add a password to the user's account.

## To log in for a typical session in User Management Mode

1 Select your user name in the top field and then type your password in the lower field.

2 Press **Enter** on your keyboard or click the log in icon . The Study Browser window appears.

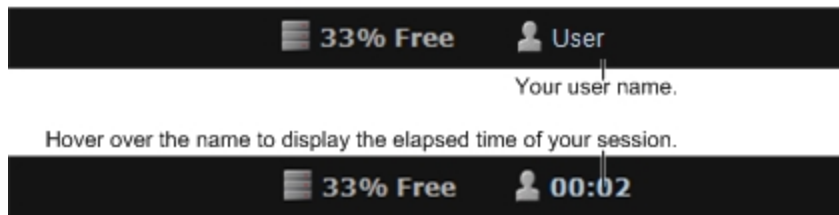


## Logging out of a session in user management mode

If your facility uses User Management Mode, log out when your work is done.

The following identifiers indicate that User Management Mode is enabled:

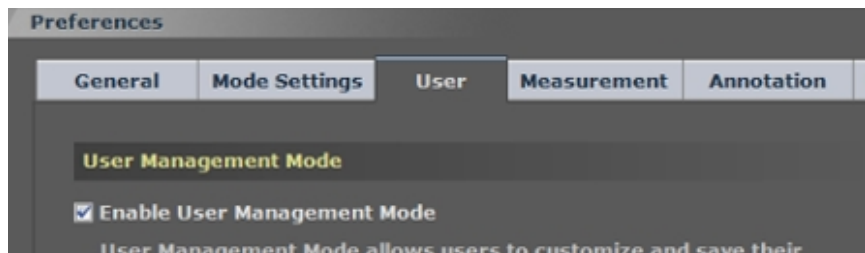
- The user icon and your user name appears in the status bar in the bottom-right corner of the window.



- The Study Browser toolbar provides the study sharing levels selector as well as the Log Out button.

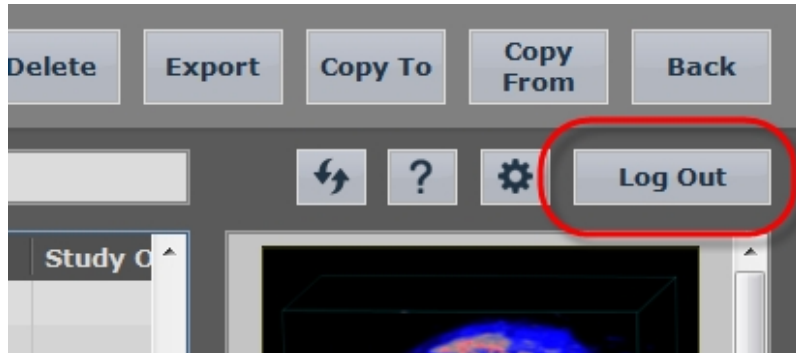


- In the User tab of the Preferences window, the Enable User Management Mode check box is selected.



To log out of a User Management Mode session

- ◆ From the Study Browser click Log Out.





# Preferences

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The Preferences window provides a series of tabs you can use to customize the way you work with Vevo LAB.

## To view the Preferences window

- ◆ If you are in the Study Browser, in the toolbar click  or if you are reviewing an image, click the Preferences tab icon .

## General

Use the General preferences to customize a range of features.

### General

Enter your Institution name that you would like to see when you export a Report.

Set your Studies Location for Vevo LAB to retrieve your data.

### Image Export

To include or exclude the date and time stamp in the header area of any image you export, enable or disable the Show Date/Time on Image Header check box.

## Study Browser Lock

### To set the Study Browser Lock preferences

- 1 Select the appropriate lock preference for your work:
  - a. If you want to prevent studies from being deleted but still let users review and modify them or move series into different studies, click **Lock Delete Only**.
  - b. If you want to prevent studies from being deleted, modified or moved but still let users review them, click **Lock All**.
- 2 Click **OK**.


## Mode Settings

Use the Mode Settings to configure preferences that apply to each image acquisition mode.

### Frame Based Mode Screen Layout

Use the Frame Based Mode Screen Layout to change the size of the mode data window when you are reviewing frame based image data.

### To set the Frame Based Mode Screen Layout

- 1 From the Study Browser, click the Preferences icon  and then click the **Mode Settings** tab.


2 In the Frame Based Mode Screen Layout section, click the appropriate layout graphic.

3 Click **OK**.

## PW Doppler Scale

Use the PW Doppler Scale section to select the scale type for the spectral display (either Velocity or Frequency).

### To set the PW Doppler Scale

1 From the Study Browser, click the Preferences icon  and then click the **Mode Settings** tab.

2 In the PW Doppler Scale section, select the scale you want to work with:

- a. Click **Velocity** to set the scale to measure the data in mm/s.
- b. Click **Frequency** to set the scale to measure the data in kHz.

3 Click **OK**. Vevo LAB applies the selected scale on the Y axis.

## 3D/4D Mode Multi-slice View Defaults

Set the default view for 3D Mode and 4D-Mode images when viewed in the Multi-slice View.

Choose a Step Size Factor between 1X, 2X, 3X or 4X to set the distance between the slices displayed in the Multi-slice View. Choosing a smaller Step Size Factor will increase the number of slices shown.

Choose your Slice Size between Auto, Small, Medium and Large to set the size of the slices displayed in the Multi-slice View. Choosing a smaller Slice Size will allow you to see more slices without scrolling.

## User

The User preferences is where you create and manage user profiles for individuals who use Vevo LAB.

- For instructions and information on managing users in standard mode, see "[Managing users in standard mode](#)" on page 134.
- For instructions and information on managing users in User Management Mode, see "[Managing users in User Management Mode](#)" on page 141.
- For instructions and information on enabling and disabling User Management Mode, see "[Enabling User Management Mode](#)" on page 126 and "[Disabling User Management Mode](#)" on page 129.
- For instructions and information on enabling and disabling Usage Log, see "[Usage Log](#)" on page 150.

## User Management Mode

Use the Enable User Management Mode check box to enable or disable User Management Mode.

User Management Mode allows users to customize and save their favorite settings and specify the sharing of their studies; to enable, an Administrator account with a password must exist, and there cannot be an open series.

Users must have a password to log in once User Management Mode is enabled.



## Usage Log

Use the Enable Usage Log check box to enable or disable the Usage Log.

The Usage Log provides Administrators with the ability to track the time users spend on Vevo LAB.

In order to use Usage Log, User Management Mode must be enabled.

## Users

The Users section is the list area where you add, delete and modify users in both standard mode as well as User Management Mode.

## Usage Log Table

The Usage Log Table displays a list where you track and manage individual user sessions when User Management Mode is enabled.

## Measurement

Use the Measurement preferences to customize the way you work with measurements.

A measurement package is a set of protocol measurements that are related to a specific application—this makes it easier and faster to apply measurements to an image.

Vevo LAB includes five default measurement packages:

- Abdominal
- Cardiac

- Embryology
- Ophthalmology
- Vascular

## Measurement Package


Use the Measurement Package section to manage a group of measurement packages.

### Creating custom measurement packages

A custom measurement package is a copy of an existing factory measurement package that is customized to include a unique protocol set.

**Note:** Vevo LAB does not alter or delete custom measurement packages when you update the software.

### To create a custom measurement package

- 1 From the Study Browser, click the Preferences icon  and then click the **Measurement** tab.
- 2 In the Measurement Package section select a measurement package that closely relates to the type of analysis you routinely perform for the respective imaging.
- 3 Click **Save As**, type a name for your new package in the New Measurement Package box and then click **OK**.

4 In the Measurement Package drop-down list, select the package you want to modify.

5 In the middle panel:

- Select or clear the check boxes to set the protocols you want to display in the Measurements panel.
- Expand individual protocols and then select or clear the check boxes to set the measurements you want to appear in the Measurements panel.


6 In the Measurement Parameters list, expand the generic measurement types and select or clear the parameters that you want Vevo LAB to display as part of each measurement label.

7 Click **Save**.

## Modifying and deleting custom measurement packages

You can modify or delete custom measurement packages. You cannot modify or delete an existing factory measurement package.

### To modify a factory measurement package

1 From the Study Browser, click the Preferences icon  and then click the **Measurement** tab.

2 In the Measurement Package drop-down list, select the package you want to modify.

3 In the middle panel:

- Select or clear the check boxes to set the protocols you want to appear in the Measurements panel.
- Expand individual protocols and then select or clear the check boxes to set the measurements you want to display in the Measurements panel.

4 In the Measurement Parameters list expand the generic measurement types and select or clear the parameters that you want to display as part of each measurement label.

5 Click **Save**.

### To delete a custom measurement package

1 In the Measurement Package drop-down list click to select the package you want to delete.


2 Click **Delete**.

3 Click **OK**.

### Exporting and importing custom measurement packages

You can export or import custom measurement packages, however, you cannot export or import the existing factory measurement packages.


### To export a custom measurement package

1 From the Study Browser, click the Preferences icon  and then click the **Measurement** tab.

2 In the Measurement Package section, in the drop-down list select the custom measurement package you want to export and then click **Export**.

3 In the Export Measurement Package window, browse to the location where you want to export your selected measurement package, select the folder and then click **OK**.

### To import a custom measurement package

1 From the Study Browser, click the Preferences icon  and then click the **Measurement** tab.

2 In the Measurement Package section, click **Import**.

3 In the Import Measurement Package window:

- a. Browse to the directory in the external storage location where the package you want to import is located.
- b. Expand the directory, select the custom measurement package and then click **OK**.


4 Next to the Measurement Package section, ensure that the Enable Package check box is selected (it is selected by default) so that the measurement package will appear in the list of available packages in the Measurements panel.

### Sharing custom applications and presets

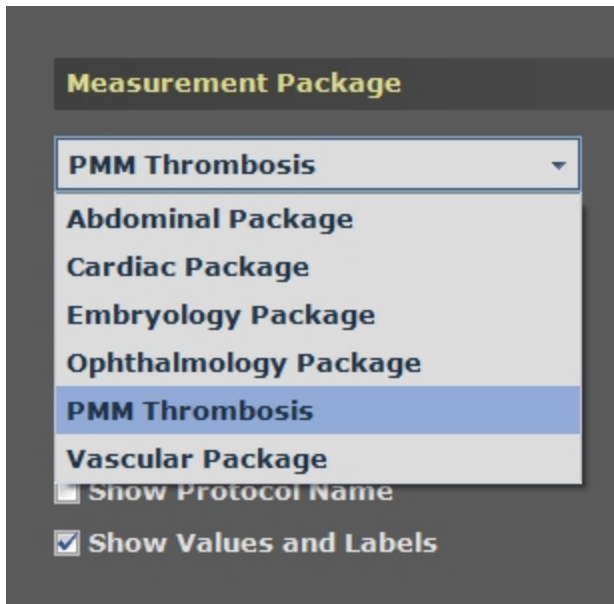
When User Management Mode is enabled, any custom applications and presets you create are only available to you.

When User Management Mode is disabled (standard mode), any custom applications and presets you create are available to everyone.

To view the available applications


1 From the Study Browser, click the Preferences icon  and then click the **Measurement** tab.

2 In the Measurement Package section click the drop-down list.





## Activating measurement packages

### To activate a measurement package from a mode window

- 1 Open an existing image from the Study Browser.
- 2 Click  to view the Measurements panel.
- 3 In the Measurement Package drop-down list, select the package you want to activate.

### To activate a measurement package from the Preferences window

- 1 Open the Preferences window ( in the Study Browser /  in the mode window).
- 2 Click the **Measurement** tab and then select the package you want to activate in the Measurement Package drop-down list.
- 3 Ensure that the Enable Package check box is selected.
- 4 Click **Activate**.
- 5 Click **OK**. When you analyze an image, the measurement package you selected is active in the Measurements panel.

### To deactivate a measurement package

- 1 In the Measurement Package list, select the package you want to deactivate.

2 Clear the Enable Package check box. The Activate button becomes disabled.

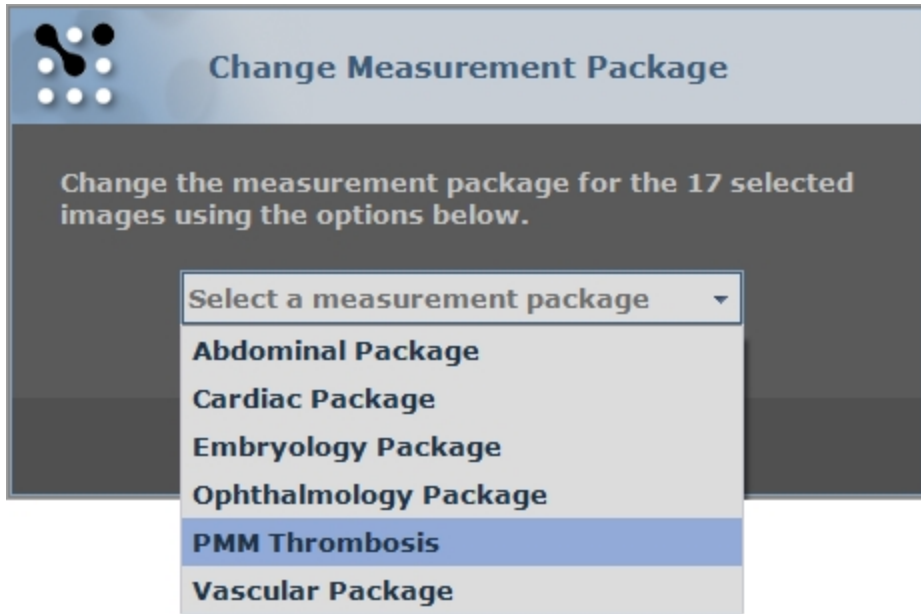
## Changing measurement packages for multiple images

You can use the Change Measurement Package option to apply a measurement package to as many images as you would like.

### To change measurement packages for multiple images

- 1 In the Study Browser, select any combination of studies, series and images.
  - To select one item, click it.
  - To select a collection of individual items, press and hold **CTRL** on your keyboard and then click to select each item.
  - To select a consecutive group of items, click to select the first item, press and hold **SHIFT** on your keyboard and then click to select the last item in the range.
- 2 Right-click one of the selections and click **Change Measurement Package**. The Change Measurement Package box appears.
- 3 In the drop-down list select the measurement package you want to apply to all the selected images.






4 Click **Save**. Vevo LAB applies the selected measurement package to the selected images.


### Enabling and disabling measurement packages in the mode window

To enable a measurement package when you are working in the mode window

1 From the Study Browser, click the Preferences icon  and then click the **Measurement** tab.

2 Next to the Measurement Package section, ensure that the Enable Package check box is selected (it is selected by default) so that the measurement package you selected is active in the Measurements panel.

## To disable a measurement package

1 From the Study Browser, click the Preferences icon  and then click the **Measurement** tab.

1 In the Measurement Package section, in the list of packages, select the package you want to disable.


2 Ensure that the Enable check box is unchecked and then click **OK**. The package you disabled will not appear in the list of available packages in the Measurements panel.

## Measurement Parameters

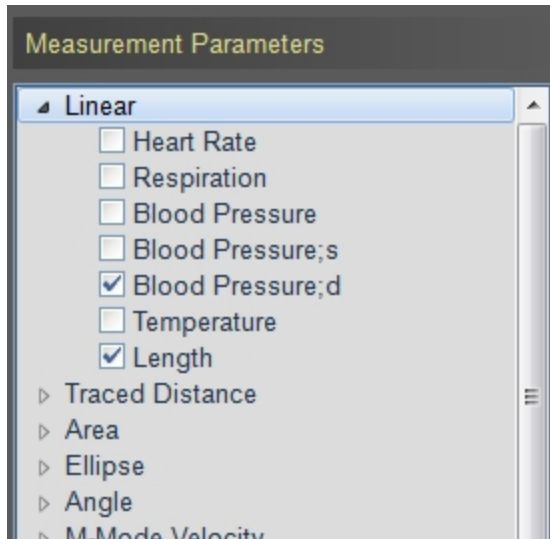
Use the Measurement Parameters section to select the measurement parameters that you want to display when you add a measurement to an image for a specific measurement package.

You can customize the measurements and measurement parameters for custom measurement packages. You cannot customize the measurements and measurement parameters for the existing factory measurement packages.

## To select the Measurement Parameters

1 From the Study Browser, click the Preferences icon  and then click the **Measurement** tab.

2 Expand the appropriate measurement and then select the parameter check boxes that you want to display.



*In this example, Length and Blood Pressure;d have been selected for the Linear measurement.*

3 Set the parameters for any other measurements you want to customize and click **OK**. Vevo LAB saves your measurement parameters preferences.

When you add a measurement, please note the following:



- In the mode window, the image displays only the measurement parameters you selected in the Measurement Parameters section.
- In the mode window, on the Measured Values section in the Measurements panel, only the selected measurement parameters are listed.

## Measurement Display

Use the Measurement Display preference section to customize how you want your measurements to appear on the images you create for a specific measurement package.

You can customize the measurement display style for custom measurement packages. You cannot customize the measurement display style for the existing factory measurement packages.

### To customize the Measurement Display settings

- 1 Click the Preferences gear icon ( in the Study Browser /  tab when an image is open) and then click the **Measurement** tab.
- 2 In the Measurement Package section, in the drop-down list select the custom measurement package you want to customize.
- 3 In the Measurement Display section select your display style options as described in the following table.

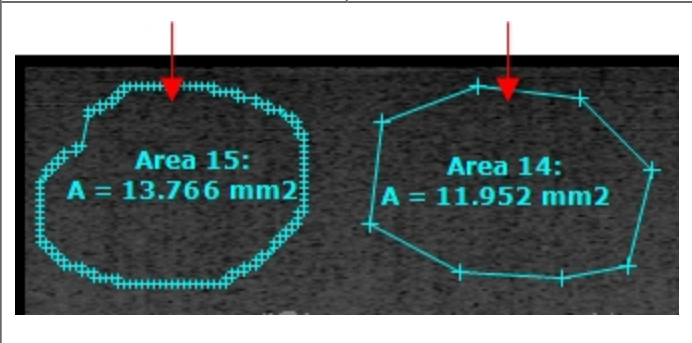
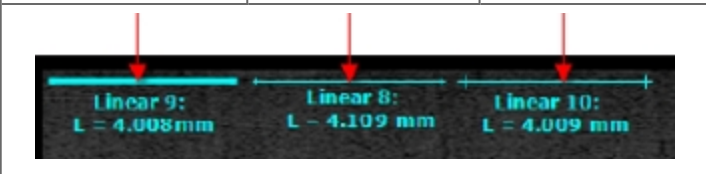
Measurement Display Options

Option	Description
Show Measurements	<p>When you select this option, Vevo LAB makes the list of measurement protocols available so you can add measurements to your image.</p> <p>When you don't select this option, Vevo LAB hides any measurements that have already been made in the image but not in the list of measured values. Vevo LAB also disables the list of measurements so you can see the list items but you cannot work with them.</p>

## Measurement Display Options

Option	Description
	<div style="border: 2px solid #00AEEF; border-radius: 10px; padding: 10px;"> <p><b>Important:</b> You must select this check box to add measurements to your image data.</p> </div>
Show Protocol Name	When you apply a protocol measurement in the image area, Vevo LAB adds the name of the protocol to the name of the measurement.
Show Values and Labels	<p>By default, this option is selected and the name of the measurement and its parameters are displayed when the measurement is placed on an image. If this option is not selected, Vevo LAB identifies measurements with sequential index numbers.</p> <div style="background-color: #1A3D4D; color: white; padding: 10px; border-radius: 10px;"> <p><b>Note:</b> When an image is displayed in the mode window, the state of the Show Values and Labels check box on the Measurements panel overrides whatever state is selected in the Preferences window.</p> </div>
Show Embryo Index	Displays the embryo index information. This option is only available when Embryo Package is displayed in the Measurement Package drop-down list.
Auto Point Spacing	Sets how densely you want Vevo LAB to add caliper points for the Traced Distance ROI or the Polygon ROI trace tool. Drag the slider to set the caliper density.

### Measurement Display Options

Option	Description						
	<table border="1" style="width: 100%; text-align: center;"> <tr> <td colspan="2">Auto Point Spacing</td> </tr> <tr> <td>Fine</td> <td>Course</td> </tr> </table> 	Auto Point Spacing		Fine	Course		
Auto Point Spacing							
Fine	Course						
Caliper Size	Set the size of the calipers that display when you add a measurement.						
Line Thickness	<p>Set the thickness of the line that displays when you add a measurement.</p> <table border="1" style="width: 100%; text-align: center;"> <tr> <td>Line Thickness: Heavy</td> <td>Line Thickness: Thin</td> <td>Line Thickness: Thin</td> </tr> <tr> <td>Caliper Size: Small</td> <td>Caliper Size: Small</td> <td>Caliper Size: Large</td> </tr> </table> 	Line Thickness: Heavy	Line Thickness: Thin	Line Thickness: Thin	Caliper Size: Small	Caliper Size: Small	Caliper Size: Large
Line Thickness: Heavy	Line Thickness: Thin	Line Thickness: Thin					
Caliper Size: Small	Caliper Size: Small	Caliper Size: Large					

### Measurement Display Options

Option	Description
Color	Sets the default color for your measurements.
Font	Select a font from the drop-down list.
Font Size	Select a font size from the drop-down list

4 Click **Save**. Vevo LAB applies your new settings to the next measurements that you add. The settings do not alter the appearance of any existing measurements.

#### To modify the properties of an existing measurement

◆ While reviewing an image in the mode window, right-click the measurement and select Properties. Make your changes in the Measurement Properties box and click **OK**.

### Histogram preferences

You can create histograms for area measurements that you complete in PA-Mode, B-Mode, Power Doppler Mode, Linear Contrast Mode and Nonlinear Contrast Mode.


You must select one of two source data options in the Histogram preferences to select the data to be used when you create a histogram from a 2D Area measurement:

- Raw Data - Calculates the histogram from the original image data acquired by the transducer.

**Note:** In Power Doppler Mode, the Image Data preference is applied at all times, even when Raw Data has been selected.

- Image Data - Calculates the histogram from a combination of the original image data plus any modifications you make in the Image Processing tab of the image mode management panel. For example, if you modify the brightness value, the histogram is created based on the original image data plus the modified brightness.

### To select the Histogram preference

- 1 From the Study Browser, click the Preferences icon  and then click the **Measurement** tab.
- 2 In the Histogram section, select either Raw Data or Image Data from the drop-down list and click **OK**.

## Heart Rate for Calculations

If you want this preference, select the check box **For M-Mode LV Trace, use heart rate determined from the measurement** on the Measurement tab in Preferences.

## Legacy

To display the Cardiac Package calculations as they were displayed in V1.1.x software versions, select the check box **Show V1.1.x legacy calculations (Cardiac Package)**.

To enable the original point and drag action as it was in software versions earlier than V2.1.x of Vevo LAB, select the check box **Use original point drag action**.



### To use the original point drag action

- 1 Enable the **Use original point drag action** check box in the Legacy section on the Measurement tab in Preferences.
- 2 Load an image with an existing measurement or add a new measurement.
- 3 Hover over a measurement until it becomes active (label text will turn white) and left-click either on the measurement line, contour or center or measurement (depending on measurement type).
- 4 Drag the entire measurement to a new location.
- 5 Left-click to save the measurement at its new location.

### To use the new point drag action

- 1 Disable the Use original point drag action check box in the Legacy section on the Measurement tab in Preferences.
- 2 Load an image with an existing measurement or add a new measurement.
- 3 Hover over a measurement until it becomes active (label text will turn white) and left-click and hold either on the measurement line, contour or center or measurement (depending on measurement type).
- 4 Continue to hold the left mouse button down while dragging the measurement to a new location.
- 5 Release the left mouse button to save the measurement at its new location.

## Annotation

An annotation is a text label that you add directly to an acquired image. Use the Annotation preferences to customize the content and style of the available annotations for a specific application package.

## Measurement Package

Use the Measurement Package section to manage your group of measurement packages. This section is similar in both the Annotation tab and the Measurement tab.


For detailed information on how to use the tools in this section see "[Measurement Package](#)" on page 98.

## Annotation Display

Use the Annotation Display preferences section to customize how you want your annotations to appear on the images you create for a specific measurement package.

You can customize the annotation style for custom measurement packages. However, you cannot customize the annotation style for the existing factory measurement packages.

### To set the annotation style for a custom measurement package

- 1 From the Study Browser, click the Preferences icon  and then click the **Annotation** tab.
- 2 In the Measurement Package section, in the drop-down list, select the custom measurement package you want to customize.

3 In the Annotation Display section, choose your style preferences as described in the following table.

Preference	Description
Show Annotations	<p>When you select the check box you can create an annotation.</p> <p>When you clear the check box Vevo LAB:</p> <ul style="list-style-type: none"><li>• Hides any annotations that have already been made.</li><li>• Prevents you from making any future annotations.</li></ul> <div style="border: 2px solid #00AEEF; border-radius: 10px; padding: 5px;"><p><b>Important:</b> You must select this check box to add annotations to your image data.</p></div>
Line Style	Select the line style that you want to apply to the line that extends from the annotation.

4 In the Measurement Package section, click **Save**.

### Annotations preferences



Use the Annotations preferences section to customize the list of available annotations you can use when you are annotating an image for a specific measurement package.

### Permissions, restrictions and exceptions

You can customize the list of annotations for custom measurement packages.

You cannot customize the list of annotations for the existing factory measurement packages.

### To customize annotations for a custom measurement package

- 1 Click the Preferences gear icon ( in the Study Browser /  tab when an image is open) and then click the **Annotation** tab.
- 2 In the Measurement Package section, in the drop-down list select the custom measurement package you want to customize.
- 3 In the Annotations section:
  - a. Select a top level list item or expand the top level item and select a second level item.
  - b. On the right side of the Annotations list, edit the annotations using the options described in the following table.

Annotation Option Descriptions

Option	Description
Add Image Group	Type the custom name for the image group and click anywhere in the application or press <b>Enter</b> on your keyboard to save. Adds an item at the bottom of the top-level list.
Add Physiological Group	Type the custom name for the image group and click anywhere in the application or press <b>Enter</b> on your keyboard to save. Adds an item at the bottom of the top-level list.
Add Annotation	Adds an annotation at the bottom of the second-level list under the selected top level item. Click anywhere in the application or press <b>Enter</b> on your keyboard to save.

### Annotation Option Descriptions

Option	Description
	<p><b>Note:</b> You cannot create a third level list by adding a sub item to a selected sub item.</p>
Edit label	<p>To rename the item, type the new name and click anywhere in the application or press <b>Enter</b> on your keyboard to save. Selects the text of the selected item in the list.</p>
Delete	<p>Deletes the selected item.</p> <p><b>Note:</b> When you delete a top-level item, Vevo LAB also deletes all the sub-items.</p>
Move Up	<p>Moves the selected item up by one.</p>
Move Down	<p>Moves the selected item down by one.</p>

4 In the Measurement Package section, click **Save**.

## PA Spectral Unmixing

Use the PA Spectral Unmixing panel to manage components from a spectral curve, import or export curves, and create new custom curves.

Custom components that you create will be displayed in the list on the left. To add your custom components, you will need to load a PA-Mode (Spectro) scan with a full spectrum acquired (680-970 nm or 1200-2000 nm), see "[PA-Mode Analysis](#)" on page 270.

Please note the following:

- Import/export your spectral curves before changing the state of UMM (User Management Mode) as curves may become unavailable.
- If importing the same spectral curve into Vevo LAB, the software may or may not overwrite the existing curve—the software will use the spectral curve that has the most recent edits, if any.
- Click a component checkbox to display its curve on the graph. Enable the Normalize option for the graph to see all curves displayed on one graph.
- For 1200-2000 nm wavelength range acquisitions, you must create a custom component as there are no default components available for this wavelength range.
- When UMM is enabled, an Administrator can see curves created by everyone, a standard user can only see their own.

### To create a group

- 1 Click on an existing group name or component and click **Create Group** or right-click then click **Create Group**.
- 2 Click **Create Group**. The new group is created in the list.
- 3 (Optional) Change the group name. Click to highlight the group, then type a new name in the Name text box.

### To manage curves

You can manage your own custom curves, but you cannot edit system default curves (ie. VsiSystem).

- 1 Click to highlight a component.

- 2 Change the name of the curves by typing a new name in the Name text box.
- 3 Change the Sensitivity setting of the component. Sensitivity enables you to give one component more visual weight over the other. Select a sensitivity setting between 0.01 to 100.00.
- 4 Select a different default color by selecting from the drop down menu.
- 5 (Optional) Delete a component. Select or highlight a component, then click **Delete**.

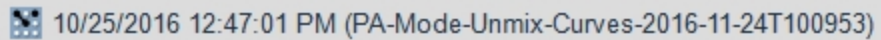
### To export spectral curves

You can select to export all of the spectral curves or just the ones that you select.

- 1 Decide if you want to export all spectral curves or just specific ones.
  - a. To export selected curves. Click to select curves from the curves list on the left, then select **Export Selected** from the drop down menu.
  - b. To export all curves. Select the **Export All** option from the drop down menu.
- 2 The Export Selected Spectral Curves window is displayed. Click to select your destination folder.
- 3 (Optional) Create a new folder. Click **New Folder**, enter a new folder name then click **OK**.
- 4 Click **OK**. The spectral curve is exported.

## To import spectral curves

- 1 Click Import.
- 2 The Import Spectral Curves window is displayed. Click to select the folder than contains your spectral curve file, the file format looks like the image below.

A screenshot of a file name displayed in a grey box. The file name is "10/25/2016 12:47:01 PM (PA-Mode-Unmix-Curves-2016-11-24T100953)". To the left of the text is a small icon representing a file or folder.

## To open source image

- 1 Click to select and highlight a component.
- 2 Click **Open Source** to open the image where the component is included.

**Important:** If you cannot open the source image, it may have been deleted or not yet imported. When exporting from the Vevo LAZR-X Imaging System, you must export both the spectral curve and the image itself.

## Maintenance

Use the Maintenance preferences to manage important system features.

## Upgrade

When a software upgrade is available, FUJIFILM VisualSonics adds the files to the Customer Site for you to download on [www.visualsonics.com](http://www.visualsonics.com).



See "[Software install/upgrade requirements](#)" on page 28 for more information.

## Monitor

Use the Monitor preferences section to calibrate the settings for the screen or monitor that displays Vevo LAB.

The objective of the calibration is to ensure that each of the two boxes (the black box on the left and the white box on the right) display the smaller box inside the larger outline.

You must use your monitor's own screen display controls as you follow the screen text instructions to calibrate your monitor properly.

## System Log

Vevo LAB creates an error log file when a significant error occurs. The log file appears as a line item in the System Log section.

You can sort this list to display only a specific log type via the Show Log Types drop down menu.


You may be requested to export and send system logs to FUJIFILM VisualSonics for troubleshooting purposes.

### To sort the System Log list

- ◆ Under the Show Log Types drop down menu, select the log type you want to display. Select between, All, Error, Exit or Terminate.

The System Log list will update and display only the log type that you selected.

## To export a System Log file

- 1 From the Study Browser, click the Preferences icon  and then click the **Maintenance** tab.
- 2 In the System Log section, select the error log you want to export from the Show Log Types drop down menu and then.
- 3 Click **Export**.
- 4 In the Export System Log window, browse to and select the folder where you want to export the log and then click **OK**.

## To delete a System Log file

**Note:** This task can only be completed by an Administrator when User Management Mode is enabled.

- 1 In the System Log section, select the error log you want to export.
- 1 Click **Delete**.
- 2 In the confirmation window, click **Yes**.

## Backup and Restore

The Backup and Restore section provides tools you can use to create and manage a backup of:

- Custom applications and presets.
- Custom measurement packages.
- The state of configurable preferences.


- The active user mode state (if User Management Mode is on or off).
- The active usage log mode state (enabled/disabled).

**Note:** This backup does not store studies.

### Permissions, restrictions and exceptions

- When User Management Mode is off (standard mode), anyone can backup and restore.
- In User Management Mode only an Administrator can restore, import, export or delete a backup.
- In User Management Mode anyone can backup, but only an Administrator can restore, export, import or delete a backup.

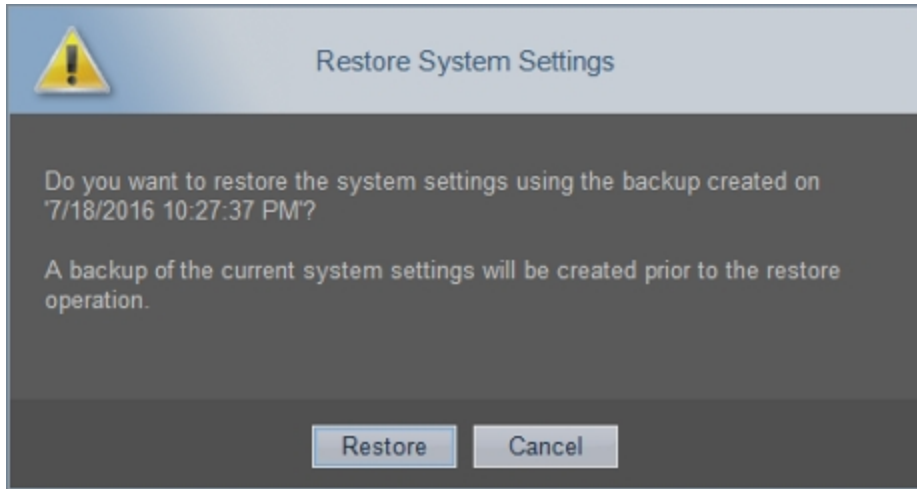
### To create a backup

- 1 From the Study Browser, click the Preferences icon  and then click the **Maintenance** tab.
- 2 In the Backup and Restore section, click **Back up now**. Vevo LAB creates a backup and lists the backup as a time-stamped item.

**Note:** When you turn User Management Mode on or off, Vevo LAB creates an automatic backup. This backup restores Vevo LAB to the user mode state that was active before the switch.

## To restore from a backup

1 Select the time-stamped backup you want to restore and then click **Restore**. The Restore System Settings dialog box explains your restore options.



2 Click **Restore**. Vevo LAB first completes an automatic backup of the current settings and then completes the restore.

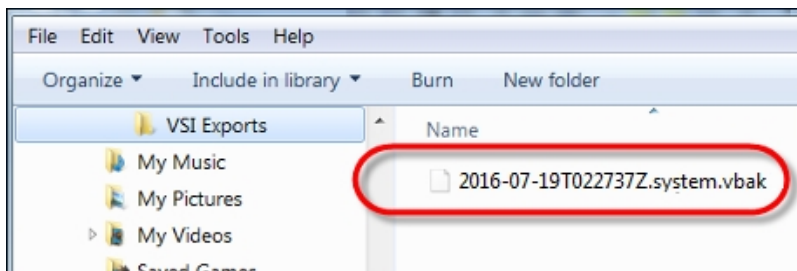
3 The Restore System Settings dialog box confirms the restore. Click **OK**.

**Note:** When you turn User Management Mode on or off, Vevo LAB creates an automatic backup. This backup restores Vevo LAB to the user mode state that was active before the switch.

## To export a backup

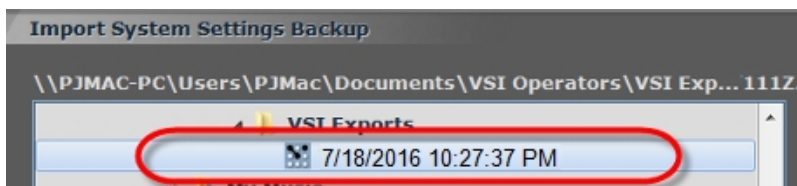
1 Select the time-stamped backup you want to export and then click **Export**.

2 In the Export System Settings Backups window, browse to the location where you want to export the backup, select the folder and then click **OK**. The backup is saved as a VBAK file.



To import a backup

- 1 Click **Import**. The Import System Settings Backup window appears.
- 2 Browse to the folder that contains the backup file you want to import. In this window, it appears as a VisualSonics file with the VisualSonics icon.



- 3 Select the backup file you want to import, click **OK**.
- 4 In the confirmation dialog box click **Yes**.

To delete a backup

- ◆ Select the time-stamped backup you want to delete and then click **Delete**.

## Managing User Access

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Vevo LAB provides tools for administrating your users' access to Vevo LAB. This section shows you how to use these tools.

### User access modes

Vevo LAB provides two user access modes:


- Standard mode (no log-in required). This is the default access mode and provides minimal user restrictions. This mode is practical for an installation that is used by a team that requires minimal administration. Each user maintains full administrative rights until someone assigns administrative rights either to themselves or to someone else.
- User Management Mode (log-in required). This is an administration option that activates advanced user account controls, user groups, user-assignable study sharing levels and Usage Log availability. This mode is practical for an installation that is used by multiple teams.

### Enabling User Management Mode

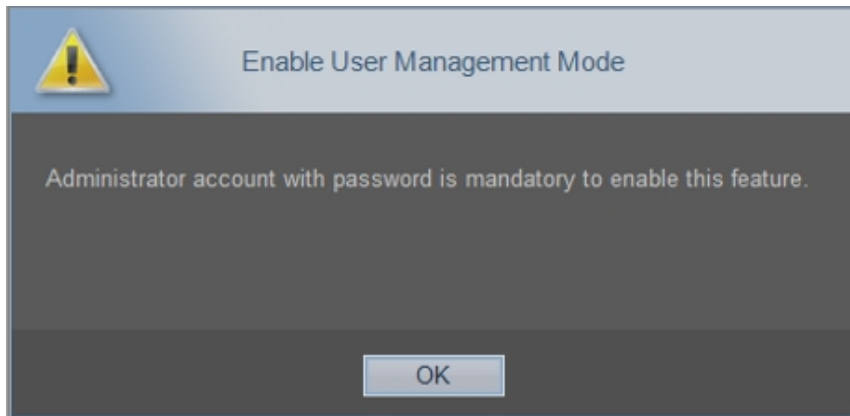
When enabling User Management Mode, please note the following:

- This task can only be completed by an Administrator.
- User Management Mode can only be enabled when all series are closed and when a password-protected Administrator exists.
- When the feature is enabled, only users with passwords can log in.
- The login window for User Management Mode appears each time a switch is made from or to User Management Mode—this ensures that the task is completed by an Administrator.

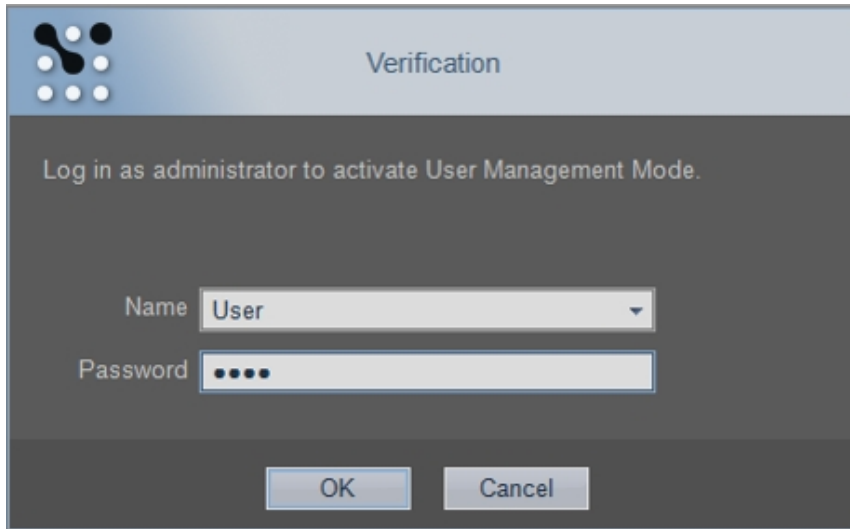
## To enable User Management Mode

1 From the Study Browser, click the Preferences icon , click the **User** tab and then in the User Management Mode section select the Enable User Management Mode check box.

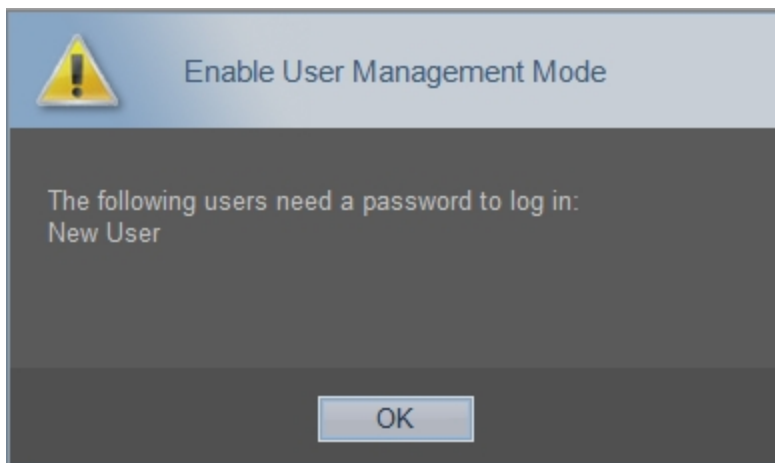
If no password-protected Administrator account exists, Vevo LAB reminds you that an Administrator must exist in order to enable User Management Mode.



To start the activation process again, add an Administrator and select the Enable User Management Mode check box. When at least one password-protected Administrator account exists, the Verification dialog box appears.



2 In the Name field select the password-protected Administrator account, in the Password field type the password and then click **OK**. Vevo LAB displays a list of all users that must add a password so they can log in while User Management Mode is enabled.






3 Note the list of names so you can inform these people if needed and click **OK**.

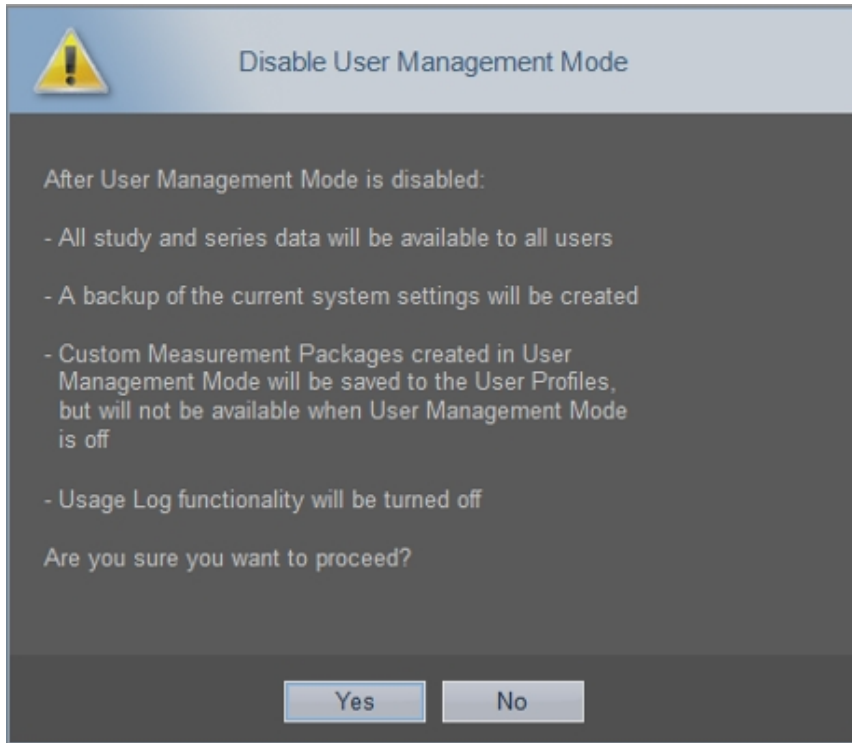
4 In the upper-right corner of the window click **OK**. Vevo LAB enables User Management Mode and creates an automatic backup. This backup restores Vevo LAB to standard mode along with the saved settings.

## Disabling User Management Mode

**Note:** This task can only be completed by an Administrator

### To disable User Management Mode

- 1 From the Study Browser, click the Preferences icon  and then click the **User** tab.
- 2 In the User Management Mode section clear the Enable User Management Mode check box.
- 3 The Disable User Management Mode dialog box appears to remind you of the operating conditions that are affected when you disable. Click **Yes**.



4 The Verification dialog appears, select your Name, type your Password and click **OK**.

5 In the upper-right corner of the window click **OK**. Vevo LAB disables User Management Mode and creates an automatic backup. This backup restores Vevo LAB to User Management Mode along with the saved settings.

## User access modes and how to switch between them.

### Administrative user controls

On Vevo LAB with User Management Mode enabled, only an Administrator can:

- Control whether User Management Mode is enabled or disabled.
- Add or delete users.
- Modify other user accounts.
- Export and import settings for other users.
- Change study owners.
- Modify user access to studies.
- Change lock state.
- Upgrade Vevo LAB.
- Export, import and delete backups.
- Restore the software.
- Change the Usage Log state.
- Purge existing Usage Log session entries.

**Note:** A best practice in Vevo LAB would be to create an Administrator as one of the first tasks.




Because each user has full administrative rights until someone assigns themselves or someone else as an Administrator, you should assign an Administrator to Vevo LAB upon installing Vevo LAB.

## User groups


A user group is a User Management Mode label that an Administrator applies to one or more users. When a user in a group creates a study and assigns the study sharing level Share with Group to that study, every user in the group can see the study.

## Study sharing levels

When User Management Mode is enabled, a user can apply one of the following three sharing levels to their own study to control who accesses it, see ["Setting the sharing levels for a study"](#) on page 170:

Study sharing level	Icon	Description
Keep Private		Provides study access to you and Administrators.
Share with Group		Provides study access to you, to all users in your group and to Administrators.
Share with Everyone		Provides study access to everyone.

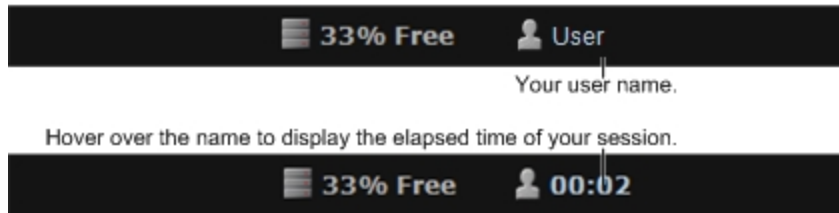
**Note:** If you have installed the Vevo Brain Neuroanatomical Atlas to use with the Vevo Brain Stereotactic Frame, you will have a fourth option—Reference Studies. See ["Vevo Brain Neuroanatomical Atlas installation"](#) on page 859 for more information.

 Reference Studies

## Identifiers that user management mode is enabled

Any of the following identifiers indicate that User Management Mode is enabled:

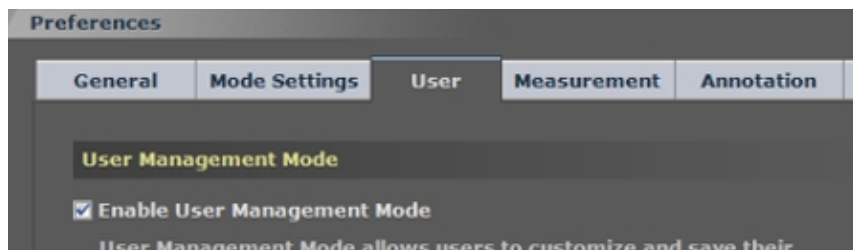
- The user icon and your user name appears in the status bar in the bottom-right corner of the window.



- The Study Browser toolbar provides the study sharing levels selector as well the Log Out button.



- In the User tab of the Preferences window, the Enable User Management Mode check box is selected.



## Managing users in standard mode

In standard mode, a user is any person who works with the image data. A user profile is the access and privilege settings that apply to a user.

This section shows you how to set up a profile in standard mode for each person who can use Vevo LAB.

### Adding an Administrator

In standard mode, because each user has full administrative rights until someone assigns themselves or someone else as an Administrator, you should add an Administrator as quickly as possible after installing Vevo LAB.

When adding an Administrator, please note the following:

- You cannot type the same name for two users.
- You cannot modify the name after you have added a user, so be sure to type the name correctly.
- User names and passwords are not case sensitive.

#### To add an Administrator

- 1 Ensure that User Management Mode is disabled, see "[Disabling User Management Mode](#)" on page 129.
- 2 Open the Preferences window and click the **User** tab.
- 3 In the Users list click **Add**.
- 4 In the Add User dialog box:

- a. In Name, type the name for the user—typically this is the user's personal name.
- b. In Type click **Administrator**.
- c. In Password type the password.
- d. In Retype Password type your password again and click **Save**.

5 In the Verification dialog, type your password as an Administrator and click **OK**.

## Adding a user

When adding a user, please note the following:

- When Administrators have been added, only an Administrator can add a user or another Administrator.
- You cannot type the same name for two users.
- You cannot modify the name after you have added a user, so be sure to type the name correctly.
- User names and passwords are not case sensitive.

### To add a user

- 1 Ensure that User Management Mode is disabled, see "[Disabling User Management Mode](#)" on page 129.
- 2 Open the Preferences window and click the **User** tab.
- 3 Select a user from the Users list and click **Add**.
- 4 In the Add User dialog box:

- a. In Name, type the name for the user—typically this is the user's personal name.
- b. In Type, select Standard.
- c. If you want to give this user password protection to prevent users without administrative privileges from deleting their locked studies, select the Password Protected check box.
- d. In Password, type the password.
- e. In Retype Password type your password again and click **Save**.

5 In the Verification dialog, type your Administrator password and click **OK**.

## Modifying a user

In standard mode, a user includes the following information properties:

- The identity of a user.
- The type of user (Standard or Administrator).
- The user's password, if they have one.

When modifying a user, please note the following:

- When Administrators have been added to Vevo LAB, only an Administrator can modify another user.
- The only setting a user can change is their own password.
- You cannot modify the name after you have added a user, so be sure to type the name correctly.



## To modify a user profile

- 1 Ensure that User Management Mode is disabled, see ["Disabling User Management Mode"](#) on page 129.
- 2 Open the Preferences window, click the **User** tab.
- 3 Select a user from the Users list and click **Modify**.
- 4 Modify the properties and click **Save**.
- 5 In the Verification dialog, type your password as an Administrator and click **OK**.

## Deleting a user

In standard mode, when you delete a user, Vevo LAB only deletes the user profile. The user's studies are not affected in any way.

**Note:** When Administrators have been added, only an Administrator can delete another user or Administrator.

## To delete a user

- 1 Ensure that User Management Mode is disabled, see ["Disabling User Management Mode"](#) on page 129.
- 2 Open the Preferences window and then click the **User** tab.
- 3 Select a user from the Users list and click **Delete**.
- 4 In the Delete Confirmation dialog, type your password as an Administrator and click **OK**.

## Changing passwords

User passwords prevent users without administrative rights from deleting studies that were created and locked by another user. If you have a password and you select the lock check box for your studies, only you or an Administrator can modify, unlock or delete those studies.

When changing passwords, please note the following:

- When Administrators have been added to Vevo LAB, only an Administrator can create or modify a password for another user.
- You can modify your own password.

### To create a password for a user

- 1 Ensure that User Management Mode is disabled, see "[Disabling User Management Mode](#)" on page 129.
- 2 Open the Preferences window and click the **User** tab.
- 3 Select the name of the user from the Users list and click **Modify**.
- 4 In the User Properties window:
  - a. Select the Password Protected check box—the password boxes appear.
  - b. In Password, type the new password.
  - c. In Retype Password type your password again and click **Save**.
  - d. In the Verification dialog, type your password as an Administrator and click **OK**.

## To change a user's password

- 1 Ensure that User Management Mode is disabled, see "[Disabling User Management Mode](#)" on page 129.
- 2 Open the Preferences window and click the **User** tab.
- 3 Select the name of the user from the Users list and click **Modify**.
- 4 In the User Properties window:
  - a. In Password, type the new password.
  - b. In Retype Password type your password again and click **Save**.
  - c. In the Verification dialog, type your password as an Administrator and click **OK**.

## To remove passwords for a user

- 1 Ensure that User Management Mode is disabled, see "[Disabling User Management Mode](#)" on page 129.
- 2 Open the Preferences window and click the **User** tab.
- 3 Select the user from the Users list and click **Modify**.
- 4 In the User Properties window:
  - a. Clear the Password Protected check box and click **Save**.
  - b. In the Verification dialog, type your password as an administrator and click **OK**.

## Importing and exporting a user

**Note:** This task can only be completed by an Administrator.

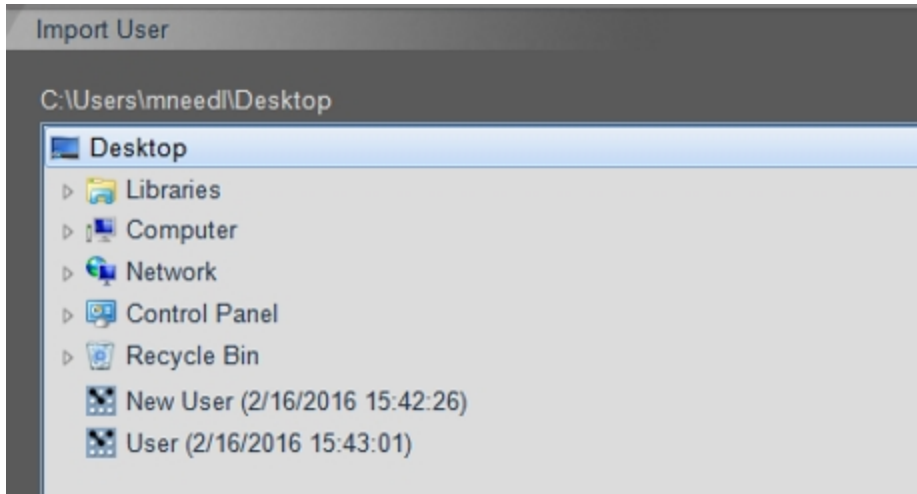
To export a user

- 1 Open the Preferences window and click the **User** tab.
- 2 Select the user from the Users list and click **Export**.
- 3 Browse to, and then select, the folder that will contain the export.
- 4 (Optional) To add a subfolder, click **New Folder**, name the folder and click **OK**.
- 5 Click **OK**. The system exports the user as a .vbak file.

Name	Size	Item type	Date modified
 New User.operator.vbak	3 KB	VBAK File	2/16/2016 15:42
 User.operator.vbak	5 KB	VBAK File	2/16/2016 15:43

To import a user

- 1 Open the Preferences window and click the **User** tab.
- 2 In the Users list, click **Import**.
- 3 Browse to the folder that contains the user file(s) and then select the user you want to import.



4 Click OK. The imported user appears in the Users list.

## Managing users in User Management Mode

User Management Mode is an administration option that activates advanced user account controls, user groups, user-assignable study sharing levels and Usage Log availability.

This section shows you how to set up and manage the account control and user group features in User Management Mode.

### Adding an Administrator

Before adding an Administrator, please note the following:

- Only an Administrator can add another Administrator.
- You can create any number of Administrators, but remember that each Administrator can modify the settings of another Administrator, so be careful.


- You cannot type the same user name for two users.
- User names are not case sensitive.
- You cannot modify the name after you have added a user, so be sure to type the name correctly.
- Administrators cannot delete their own accounts.

### To add an Administrator

- 1 Ensure that User Management Mode is enabled, see "[Enabling User Management Mode](#)" on page 126.
- 2 Open the Preferences window and click the **User** tab.
- 3 From the Users section click **Add**.
- 4 In the Add User dialog:
  - a. In Name, type a name for the user—typically this is the user's personal name.

**Note:** You cannot type the same name for two users. Also, you cannot modify the name after you have added the user, so make sure you type the correct name.

- b. In Password (mandatory), type the password, then tab to the Confirm Password box and retype it.
- c. In Copy Settings From, select the name of a user in the drop-down list if you want to apply the Preference tabs settings of another user—this can be a significant time saver when you are adding a user whose tasks on Vevo LAB will be similar to the tasks of an existing user.

- d. In Group, select the name of the group if the user belongs to an existing group.
- e. In Group, click the add-group icon  and type the name of a new group that the user belongs to and click **OK**.
- f. In Type, select the Administrator check box.

5 Click **Save**.

6 Type your Administrator password and click **OK**. Vevo LAB creates the new Administrator and displays them in the Users list.

## Adding a Standard user

Before adding a standard user, please note the following:

- Only an Administrator can add a Standard user.
- You cannot type the same user name for two users.
- User names are not case sensitive.
- You cannot modify the name after you have added a user, so be sure to type the name correctly.


### To add a Standard user

- 1 Ensure that User Management Mode is enabled, see ["Enabling User Management Mode"](#) on page 126.
- 2 Open the Preferences window and click the **User** tab.
- 3 From the Users section click **Add**.

4 In the Add User dialog:

- a. In Name (mandatory), type a name for the user—typically this is the user's personal name.

**Note:** You cannot type the same name for two users. Also, you cannot modify the name after you have added the user, so make sure you type the correct name.

- b. In Password (mandatory), type the password, then tab to the Confirm Password box and retype it.
- c. In Copy Settings From, select the name of a user in the drop-down list if you want to apply the Preference tabs settings of another user—this can be a significant time saver when you are adding a user whose tasks on Vevo LAB will be similar to the tasks of an existing user.
- d. In Group, select the name of the group if the user belongs to an existing group.
- e. In Group, click the add-group icon  and type the name of a new group in the New Group dialog and click **OK**.
- f. In Type, do not select the Administrator check box.

5 Click **Save**.

6 Type your Administrator password and click **OK**. Vevo LAB creates the new user and displays it in the Users list.

## Modifying a Standard user

In User Management Mode, a Standard user includes the following information properties:



- The identity of a user.
- The type of user (Standard or Administrator).
- The user's password.
- The assigned group.
- The default study sharing level.

When modifying a Standard user, please note the following:

- Only an Administrator can modify the profile of another user.
- A Standard user can only modify their password and their default study sharing level.

To modify a user

- 1 Ensure that User Management Mode is enabled, see ["Enabling User Management Mode"](#) on page 126.
- 2 Open the Preferences window and click the **User** tab.
- 3 Select the user from the Users list and click **Modify**.
- 4 Modify the properties, where needed, and click **Save**.

## Disabling a Standard user

A disabled Standard user cannot log in to User Management Mode, but the user's account still exists.

When disabling a Standard user, please note the following:

- This task can only be completed by an Administrator.
- You can only disable a Standard user; you cannot disable an Administrator.

### To disable a Standard user

- 1 Ensure that User Management Mode is enabled, see ["Enabling User Management Mode"](#) on page 126.
- 2 Open the Preferences window and click the **User** tab.
- 3 Select the user from the Users list and click **Modify**.
- 4 Select the Change Password check box.
- 5 In Your Password enter your Administrator password and leave the other password fields empty.
- 6 Click **Save**.

### To re-enable a disabled Standard user

- ◆ Give the user a new password and inform them what it is so that they can log in again.

## Deleting a user or Administrator

When deleting a user or Administrator, please note the following:

- This task can only be completed by an Administrator.
- An Administrator can delete another Administrator but cannot delete their own account.

## To delete a Standard user or Administrator

- 1 Ensure that User Management Mode is enabled, see ["Enabling User Management Mode"](#) on page 126.
- 2 Open the Preferences window and click the **User** tab.
- 3 Select the user from the Users list and click **Delete**.
- 4 In Delete Confirmation dialog, click **Yes**.


## Adding a group to a user

When adding a group to a user, please note the following:

- This task can only be completed by an Administrator.
- This task can only be completed when User Management Mode is enabled.

## To add a group to a user:

- 1 Ensure that User Management Mode is enabled, see ["Enabling User Management Mode"](#) on page 126.
- 2 Open the Preferences window and click the **User** tab.
- 3 In the Users section, open the user properties dialog in one of two ways:
  - a. Click **Add** to open the Add User dialog when you create a new user.
  - b. Select an existing user and click **Modify** to open the Modify User dialog.
- 4 Add the group to the user in one of two ways:

- a. To add an existing group to the user, in Group, select the name of the group.
- b. To create a new group and add the user to that group, click the add-group icon , and in the New Group dialog type the name of the group and click **OK**.

5 Click **Save**. In the Users list, the name of the assigned group appears in the Group column for that user.

**Note:** A group (for example, group A) is deleted automatically when an administrator assigns a new group (for example, group B) to a user who was the only user in the original group (for example, group A).

## Deleting a user group

Because a user group is created by creating a group name and assigning it to a user, there is no isolated way to manage groups. You manage a group by managing the relationship of a group with users.

### To delete a user group

- 1 Ensure that User Management Mode is enabled, see "[Enabling User Management Mode](#)" on page 126.
- 2 Modify each user that includes the group's name in the Group column and change the group assignment to display the blank selection.

**Note:** When you delete a user who is the only user in a particular group, Vevo LAB deletes the group.

## Changing passwords in user management mode

When changing passwords, please note the following:

- A Standard user can only change their own password.
- An Administrator can change the password of any user or Administrator.

### To change your own password in User Management Mode

- 1 Ensure that User Management Mode is enabled, see "[Enabling User Management Mode](#)" on page 126.
- 2 Open the Preferences window and click the **User** tab.
- 3 Select the user from the Users list and click **Modify**.
- 4 In the Modify User dialog:
  - a. Select the Change Password check box.
  - b. In Old Password, type your current password.
  - c. In New Password, type your new password, in Confirm Password type it again and click **Save**.

### To change another user's password in User Management Mode

**Note:** Only an Administrator can change another user's password in User Management Mode.

- 1 Ensure that User Management Mode is enabled, see "[Enabling User Management Mode](#)" on page 126.

- 2 Open the Preferences window and click the **User** tab.
- 3 Select the user from the Users list and click **Modify**.
- 4 In the Modify User dialog box:
  - a. Select the Change Password check box.
  - b. In Your Password, type your password, not the user's current password. You must add your password because you must be an Administrator to change the password of a user. Adding your password validates your role.
  - c. In New Password, type your new password, in Confirm Password type it again and click **Save**.

## Usage Log

Usage Log is a User Management Mode feature that tracks users who access Vevo LAB. The log consists of individual session entries.

- A session entry begins when the user logs in.
- A session entry ends when the user logs out.

This section describes how the usage logs work and how to manage them.

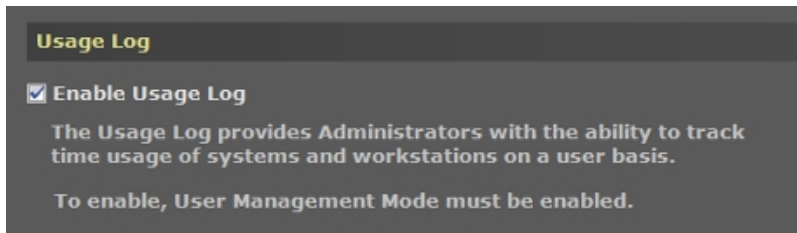
**Note:** Usage Log can only be enabled when User Management Mode is enabled.

## Enabling the Usage Log

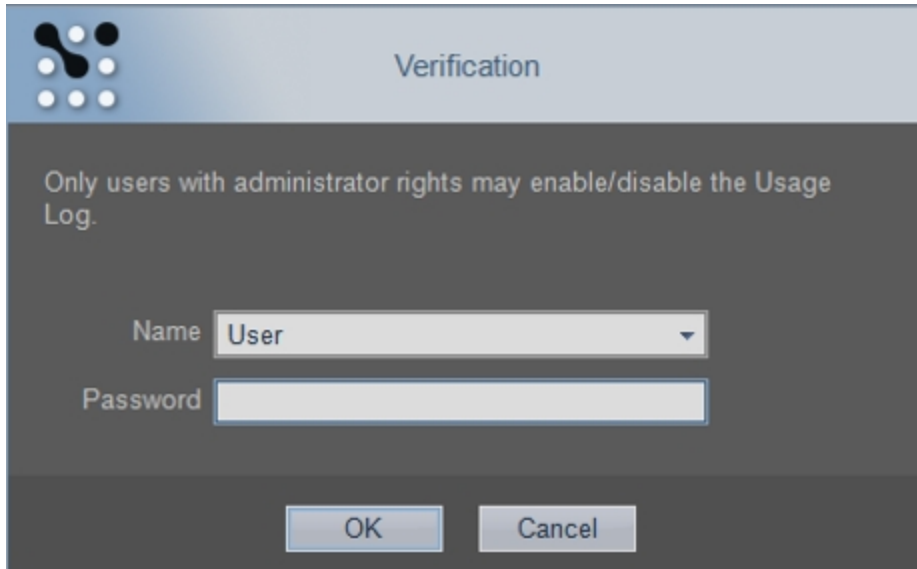
**Note:** This task can only be completed by an Administrator when User Management Mode is enabled.

## To enable the Usage Log

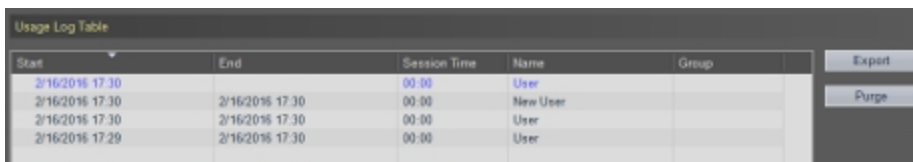
- 1 Log in as an Administrator, navigate to the Preferences window and click the **User** tab.
- 2 In the Usage Log section, select the Enable Usage Log check box if it is not selected.



The Verification dialog box appears.



3 Select your administration account, enter your password and click **OK**. The Usage Log Table displays the session entries (as shown below) if logs from previous sessions exist and have not been purged.



The screenshot shows a window titled "Usage Log Table" with a table of session entries. The table has columns for Start, End, Session Time, Name, and Group. There are four rows of data. To the right of the table are two buttons: "Export" and "Purge".

Start	End	Session Time	Name	Group
2/16/2016 17:30		00:00	User	
2/16/2016 17:30	2/16/2016 17:30	00:00	New User	
2/16/2016 17:30	2/16/2016 17:30	00:00	User	
2/16/2016 17:29	2/16/2016 17:30	00:00	User	

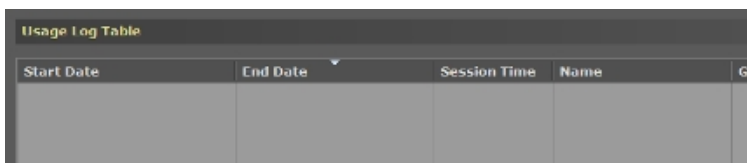
**Note:** The first time that Usage Log is enabled, the Usage Log Table displays only the in-progress usage log session

### To disable the usage log

1 Log in as an Administrator, navigate to the Preferences window and click the **User** tab.

2 In the Usage Log section, clear the Enable Usage Log check box. The Verification dialog appears.

3 Select your administration account, enter your password and click **OK**. Vevo LAB clears the session entries in Usage Log Table.



The screenshot shows a window titled "Usage Log Table" with an empty table. The table has columns for Start Date, End Date, Session Time, Name, and Group.

Start Date	End Date	Session Time	Name	Gr
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**Note:** Although Usage Log Table does not display session entries when usage log is disabled, Vevo LAB does continue to store any session entries that have been stored. These are displayed the next time the usage log is enabled.





## Exporting usage logs

You can export usage logs as a CSV file.

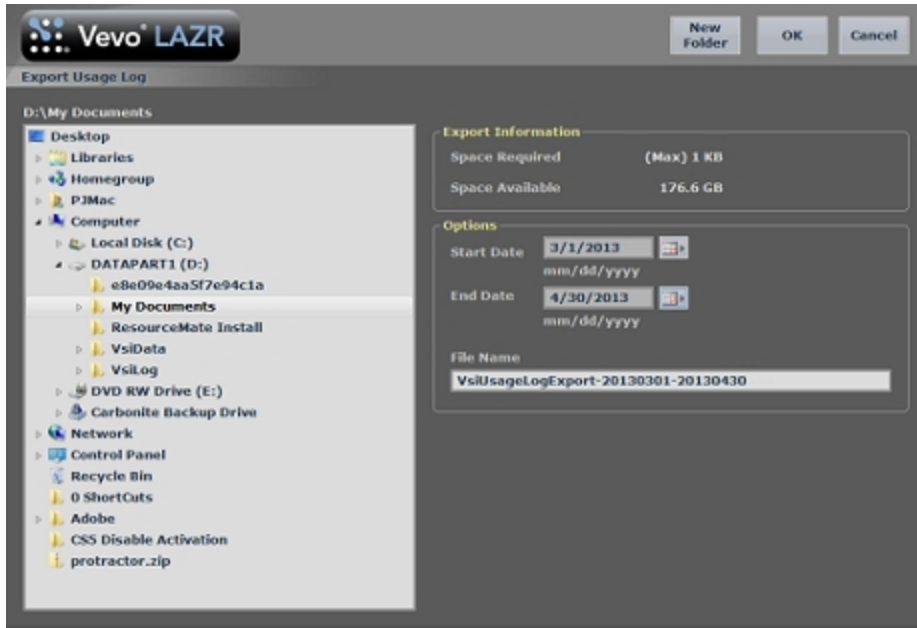
When exporting usage logs, please note the following:

- Administrators and Standard users can export usage logs, however, Standard users can only see and export their own session entries.
- Only Administrators can see and export anyone's session entries.

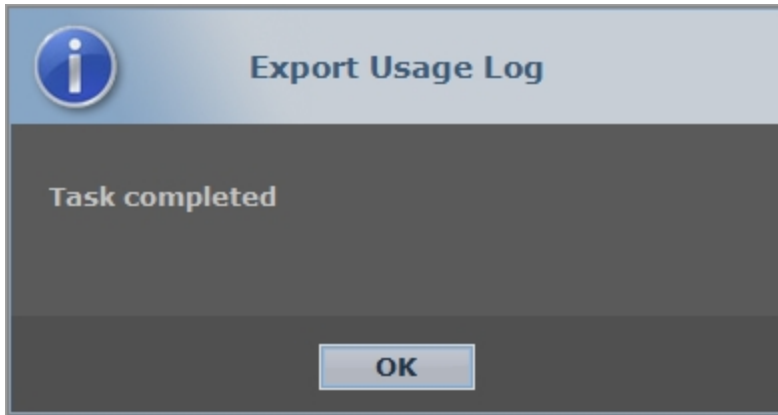
### To export usage logs

1 Log in, click the Preferences gear icon ( in the Study Browser /  tab when an image is open) to navigate to the Preferences window and click the **User** tab.

2 In the Usage Log Table section click **Export**. The Export Usage Log window appears.



- 3 Browse to, and then select, the destination folder that will contain the export.
- 4 (Optional) To add a subfolder, click **New Folder**, name the folder and click **OK**.
- 5 In the Options section:
  - Click the pop-up calendars to select the start and end dates that define the date range of your export.
  - (Optional) Modify the name in the File Name field.
- 6 Click **OK**. Vevo LAB exports the CSV file and displays a confirmation prompt.



7 Click OK.

### Usage log CSV file data features

Usage log CSV files are typically opened in a spreadsheet application such as Microsoft Excel.

The following diagram describes the additional features of the exported usage log CSV file, as compared to the information in the Usage Log Table.

	A	B	C	D						
1	Vevo Usage Log									
2										
3	Start Date	3/1/2013								
4	End Date	4/30/2013								
5										
6	Institution	Louise Temerty BCC								
7	Software	1.0.0.0002								
8	Computer	PJMAC-PC								
20	Start Date	End Date	Start Time	End Time	Session Time	Scan Time	Non-Scan Time	Name	Group	Session ID
21	3/29/2013	3/29/2013	10:37 AM	10:40 AM	0:03:25	0:00:14	0:03:10	Paul Admin	Louise Temer	S356191827841
22	3/19/2013	3/19/2013	10:36 AM	10:37 AM	0:00:56	0:00:00	0:00:56	Paul Admin		S223251824521

## Usage Log CSV File Descriptions

Area	Description
<p><b>1</b></p>	<p>Institution, in cell B6, only appears if the user who exported the usage log has already added information in the Institution field in the General tab of the Preferences window.</p> <div style="border: 1px solid gray; padding: 5px; margin: 10px 0;"> <p><b>General</b></p> <p><b>Institution</b> <input style="width: 150px;" type="text" value="Louise Temerty BCC"/></p> </div> <p><b>Note:</b> The listed Institution is the institution for the user who is currently logged in.</p> <p><b>Note:</b> If no information has been added in this field, row 6 is empty.</p>
<p><b>2</b></p>	<p>The row of session entry data headers always starts on cell A20 so that you can build macros based on fixed, predictable data locations.</p>
<p><b>3</b></p>	<p>The Scan Time spent scanning using a transducer.</p>
<p><b>4</b></p>	<p>The Non-Scan Time is determined by the total session time minus scan time.</p>
<p><b>5</b></p>	<p>A unique Session ID that Vevo LAB generates.</p> <p><b>Note:</b> When midnight occurs in the middle of a session, two session entries appear, each with the same Session ID.</p>

## Backing up the usage log feature status



Vevo LAB automatically includes the current state of the usage log, whether it is enabled or disabled, and remembers this state when a backup is performed.

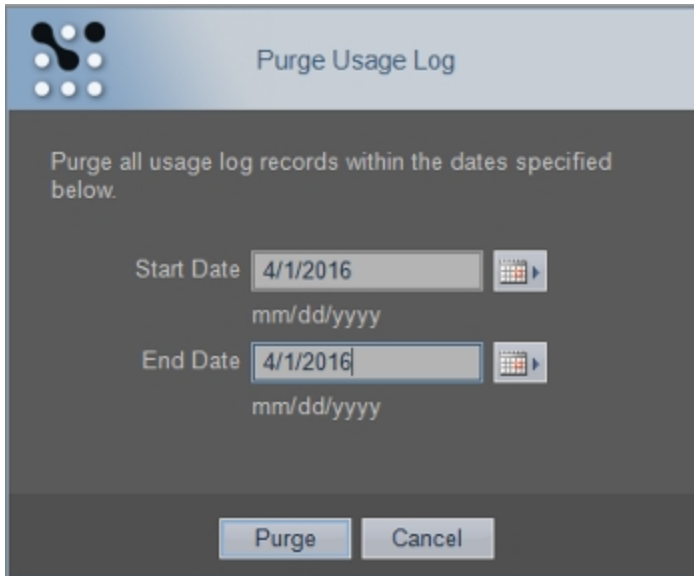
## Purge Usage Log Table

At any time, an Administrator can purge (delete) session entries from the Usage Log Table.

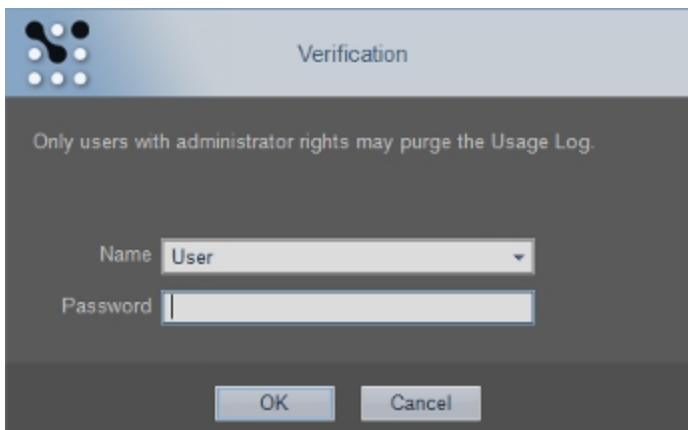
**Note:** This task can only be completed by an Administrator when User Management Mode is enabled.

### To purge the Usage Log Table

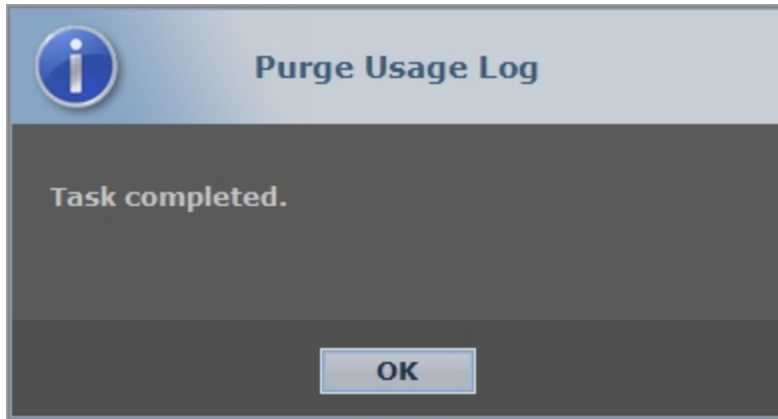
- 1 Log in as an Administrator, click the Preferences gear icon ( in the Study Browser /  tab when an image is open) to navigate to the Preferences window and then click the **User** tab.
- 2 In the Usage Log Table section click **Purge**. The Purge Usage Log box appears.



- 3 Click the pop-up calendars to select the start and end dates that define the date range of your purge.
- 4 Click **Purge**. The Verification dialog appears.



5 In Name select your Administrator account and in Password enter your password and then click **OK**. Vevo LAB purges the session entries defined by the date range you selected and displays a confirmation prompt.



6 Click **OK**.

## Usage Log Table

The Usage Log Table section displays the details of individual session entries.

### To view the Usage Log Table

Log in, navigate to the Preferences window and then click the **User** tab. The Usage Log Table section is on the right side of the screen.

The following illustration and table describes the features and behaviors of the Usage Log Table:









Start Date	End Date	Session Time	Name	Group	Export	Purge
4/7/2013 2:12 PM		8:21	Paul Admin	Louise Tem...		
4/7/2013 2:02 PM	4/7/2013 2:12 PM	00:10	Paul Admin			
4/7/2013 12:55 PM	4/7/2013 1:30 PM	00:34	Paul Admin			
4/7/2013 12:49 PM	4/7/2013 12:51 PM	00:01	Paul Admin			
4/7/2013 11:05 AM	4/7/2013 12:48 PM	01:43	Paul Admin			
3/22/2013 11:19 AM	3/22/2013 5:30 PM	06:11	Paul Admin			

### Usage Log Table Descriptions

Area	Description
1	In-progress session entry identifies that a user has logged in, but has not logged out. Distinguished from the other session entries by the blue text and no values in the End date field, as the session is still in progress.
2	Completed session entry, includes: <ul style="list-style-type: none"> <li>• Start date and time.</li> <li>• End date and time.</li> <li>• Session time.</li> <li>• Name.</li> <li>• Group (if applicable).</li> </ul> <p><b>Note:</b> When midnight occurs in the middle of a session, two session entries appear, each with the same Session ID (the unique Vevo LAB-generated session identification number).</p>



## Usage Log Table Descriptions

Area	Description
	Start date and time the user logged in.
	End date and time the user logged out.
	<p>Sort column marker appears in the header of the column that is sorting the information in the table.</p> <ul style="list-style-type: none"> <li>• To reverse the top-to-bottom order, click the same column header.</li> <li>• To sort by a different column, click a different column header.</li> </ul>
	<p>The total elapsed session time during which the user is logged in. Vevo LAB updates the usage log table every minute, from the time the user started the session. For example, if a user logs in at 2:12 PM, Vevo LAB updates the log one minute later at 2:13 PM and continues updating once per minute until the user logs out.</p>
	User name.
	The name of the user's group. This is defined in the Users section of the User tab.
	Click to export a CSV file that includes user selected logs.
	Click to purge a range of session entries, from the table. Available only to an Administrator.

## Usage Log Table Descriptions

Area	Description
11	<p>Check mark appears on a session entry that has been exported by an administrator. The check mark column is only visible to Administrators.</p> <p><b>Note:</b> In-progress session entries cannot be exported.</p>

## Managing Studies, Series and Images

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Studies in Vevo LAB are like studies in a paper based system. They work similar to a file directory and hold the collection of images that are part of your study.

Studies are composed of one or more grouped image sets called series, and the series are composed of one or more images (individual frames and/or multiple-frame cine loops).

When you save an image, Vevo LAB lists the image in the Study Browser. This section shows you how to use the Study Browser when you want to work with your saved images.

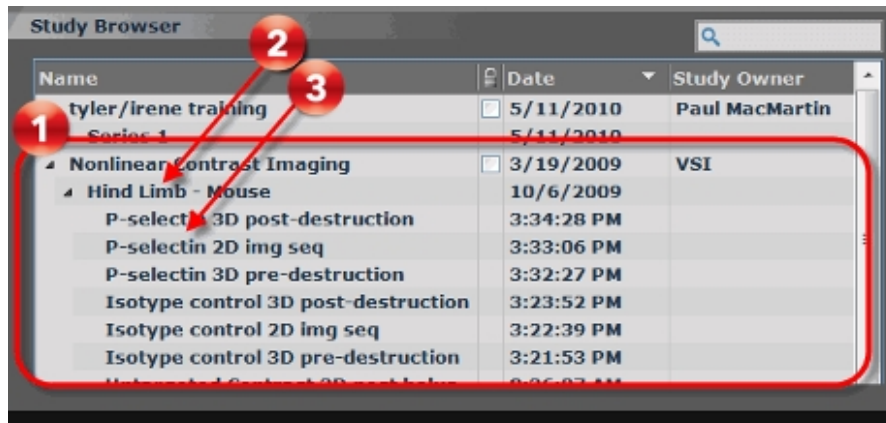
**Note:** In Vevo LAB, you can manage existing studies and series, but you cannot create a new study or a new series.

### About studies, series and images

The Study Browser organizes your work into studies, series and images and displays them in the following hierarchy:

- Study
  - Series
    - Image

The following illustration and table describes how the hierarchy of study / series / image works and how it appears in the software.



### Study/Series/Image Hierarchy

Area	Description
1	A study contains one or more image groups called series.
2	A series is the group of one or more images that were acquired during an acquisition session. A series in a study functions like a sub-folder of a parent folder.
3	An image can be either a cine loop (multiple image frames), a single image frame, or a 3D Mode image.

**Note:** In Vevo LAB, you can manage existing studies and series, but you cannot create a new study or a new series

## Working with studies

Studies are the largest grouping you can work with in the Study Browser. Studies contain your images which are grouped into series that list all the


images created during an acquisition session.

You can organize your studies how you want, based on the type of study you are working on. Sometimes you will create a study that tracks a specific set of images of one animal over a period of time. Other times you will create a study that tracks a specific set of images from a series of animals at one time.

**Note:** In Vevo LAB, you can manage existing studies and series, but you cannot create a new study or a new series.

## Finding a study

Use the Study Browser's search box or sorting features to find a study.

**Important:** When searching for data, update the Study Browser before searching for a study by first clicking the **Refresh**  button. Refreshing the Study Browser ensures studies, series or images transferred from a Vevo Imaging System using Background Data Transfer are included in your search.


### To update the Study Browser

- ◆ While viewing the Study Browser grid, click the **Refresh** button .


Vevo LAB supports Background Data Transfer of studies, series and images from a Vevo Imaging System.

**Note:** If the data being transferred was acquired by a different user than that of the current Vevo LAB user, the current Vevo LAB user will not see the transferred study if they view the Study Browser in the 'My Studies' view.

## To search the Study Browser

- 1 From an open image, click . The Study Browser appears.
- 2 In the search box, type your search phrase. Vevo LAB displays the matching results as you type.

## To sort the Study Browser

- 1 From an open image, click . The Study Browser appears.
- 2 Right click on the Study Browser heading bar. Enable/disable the column headings that you want to display—Name, Locked, Date, Mode, Length, Study Owner, Acquired By, System Model, Animal ID, Protocol ID.
- 3 Toggle a column heading to sort the list of studies according to the selected heading.
- 4 Scroll through the list to find the study.

## Customizing study information details

You can use the Study Information window to customize the property details of a study.

## To customize study information details

- 1 In the Study Browser, select the study you want to work with and then click **Info**. The Study Information window appears and displays the Study Information fields.
- 2 Add or modify content in the boxes as described in the following table.

### Study Information Box Descriptions


Box	Description
Study Name	Required. Type the information.
Owner	Read-only.
Granting Institution	Optional. Type the information. <b>Note:</b> The Granting Institution will be displayed in the mode window.
Sharing	Optional. Select from the drop-down list. <b>Note:</b> Only available when User Management Mode is on.
Study Notes	Optional. Type the information.

3 Click **OK**. The Study Browser returns.

## Locking a study

Any user can lock any study. When you lock a study, all users can still review and manage the images in the study. Before you can delete a study, series or image within a study, unlock the study. Before moving a series from one study to another, unlock the study.

### To lock a study

1 In the Study Browser, in the lock column  select the check box for the study that you want to lock.

2 If the study owner has a password, type the password.

### To unlock a study

1 In the Study Browser, in the lock column  clear the check box for the study that you want to unlock.

2 If the study owner has a password, type the password.

### To delete a locked study

1 Unlock the study, select the study and click **Delete**.

2 If the study owner has a password, type the password.

## Guidelines for study passwords and study locks

- You can review any image in any study at any time.
- If a password has been assigned to the user who owns the study, the owner must type in that password to lock the study and others must type that same password to unlock it.
- No one can delete a locked study or series.
- A study must be unlocked before you can delete it—If the owner or an Administrator added a password to their user profile, you must contact the owner or Administrator and request the password.









## Setting default study sharing levels for new studies

When setting default study sharing levels for new studies, please note the following:


- If you are a user in User Management Mode, you can set the default sharing level for the studies you create.
- If you are an Administrator in User Management Mode, you can change the default sharing level for the studies any user creates.

### To set the default sharing level for new studies

- 1 From the Study Browser, click the Preferences icon .
- 2 Click the Preferences gear icon ( in the Study Browser /  tab when an image is open) and then click the **User** tab.
- 3 From the User section, open the user profile dialog by one of the following:
  - a. If you are a user, select your name in the list and then click **Modify**. The Modify User dialog appears.
  - b. If you are an Administrator, either click **Add** to open the Add User dialog or select a user in the list and then click **Modify** to open the Modify User dialog box.
- 4 In the Default Sharing for New Studies drop-down, select the appropriate sharing level as described in the following table.

Study sharing level	Icon	Description
Keep Private		Provides study access to you and Administrators.
Share with Group		Provides study access to you, to all users in your group and to Administrators.
Share with Everyone		Provides study access to everyone.

**Note:** If you have installed the Vevo Brain Neuroanatomical Atlas to use with the Vevo Brain Stereotactic Frame, you will have a fourth option—Reference Studies. See "[Vevo Brain Neuroanatomical Atlas installation](#)" on page 859 for more information.

 Reference Studies

5 Click Save.

## Setting the sharing levels for a study

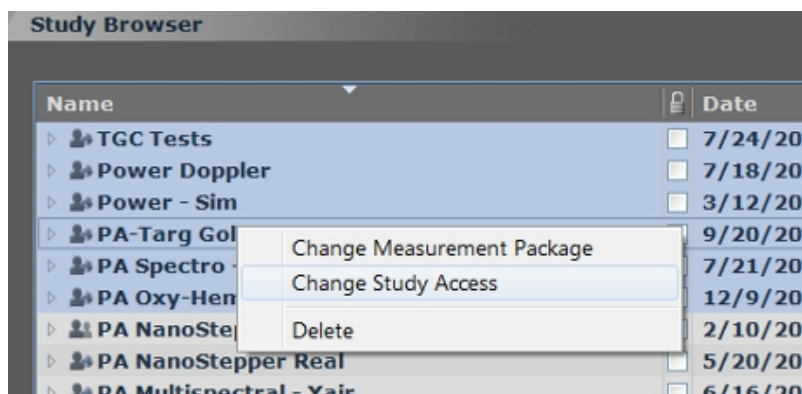
When setting the sharing levels for a study, please note the following:

- If you are a user in User Management Mode, you can change the sharing level of any studies you own.
- If you are an Administrator in User Management Mode, you can change the sharing level of any study.




To set the sharing levels for a study, there are two options:


**Option 1:** Use the drop-down list in the Change Study Access dialog

1 In the Study Browser, right-click the study and click **Change Study Access**. The Change Study Access dialog appears.



2 Select the Change Study Sharing check box. The list of study sharing levels becomes available, as described in the following table.

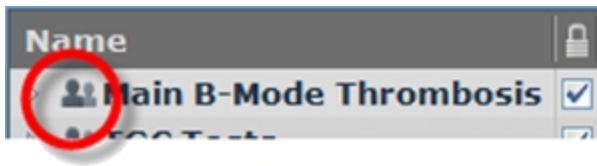
Study sharing level	Icon	Description
Keep Private		Provides study access to you and Administrators.
Share with Group		Provides study access to you, to all users in your group and to Administrators.
Share with Everyone		Provides study access to everyone.

Study sharing level	Icon	Description
<p><b>Note:</b> If you have installed the Vevo Brain Neuroanatomical Atlas to use with the Vevo Brain Stereotactic Frame, you will have a fourth option—Reference Studies. See "<a href="#">Vevo Brain Neuroanatomical Atlas installation</a>" on page 859 for more information.</p> <div style="border: 1px solid gray; padding: 5px; margin-top: 10px;">  Reference Studies </div>		

3 In the drop-down list, select the new study sharing level and click **Save**. Vevo LAB applies the changes and the updated sharing level icon appears beside the study name.

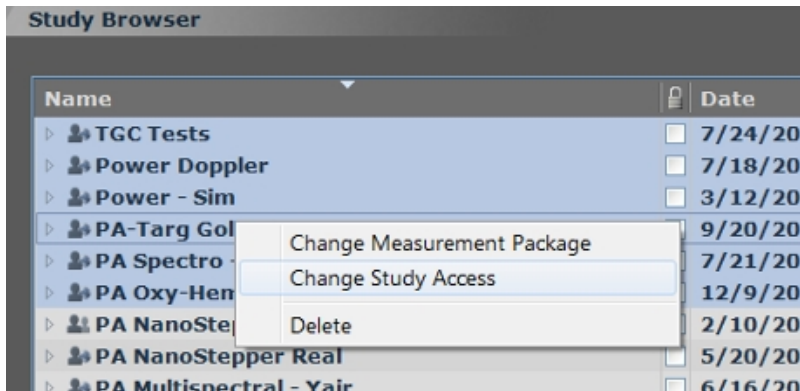
**Option 2:** Use the drop-down list in the Study Information window

- 1 In the Study Browser, select the study and click **Info**. The Study Information window appears.
- 2 In the Sharing field select the appropriate sharing level from the drop-down list.
- 3 Click **OK**. Vevo LAB applies the changes and the updated sharing level icon appears beside the study name.







## To set the sharing level for multiple studies

- 1 Open the Study Browser window and select the studies you want to work with.
- 2 Right-click one of the selected studies and click **Change Study Access**.

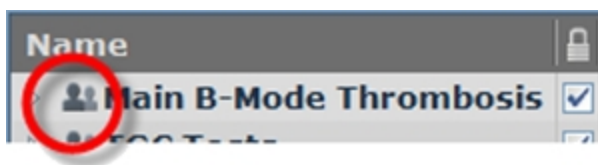


- 3 If you are an Administrator, select the Change Study Sharing check box. The list of study sharing levels becomes available, as described in the following table.

Study sharing level	Icon	Description
Keep Private		Provides study access to you and Administrators.
Share with Group		Provides study access to you, to all users in your group and to Administrators.
Share with Everyone		Provides study access to everyone.

Study sharing level	Icon	Description
<p><b>Note:</b> If you have installed the Vevo Brain Neuroanatomical Atlas to use with the Vevo Brain Stereotactic Frame, you will have a fourth option—Reference Studies. See "<a href="#">Vevo Brain Neuroanatomical Atlas installation</a>" on page 859 for more information.</p> <div style="border: 1px solid gray; padding: 5px; margin-top: 10px;">  Reference Studies </div>		

4 In the drop-down list, select the new study sharing level and click **Save**. Vevo LAB applies the changes and the updated sharing level icon appears beside the study name.



## Changing study ownership

In User Management Mode, an Administrator can change the ownership of one or more studies from one user to another user.

The ownership change applies to the study whether or not User Management Mode is enabled. However, remember that it can only be changed again when User Management Mode is enabled or if it is locked as Lock Delete Only.

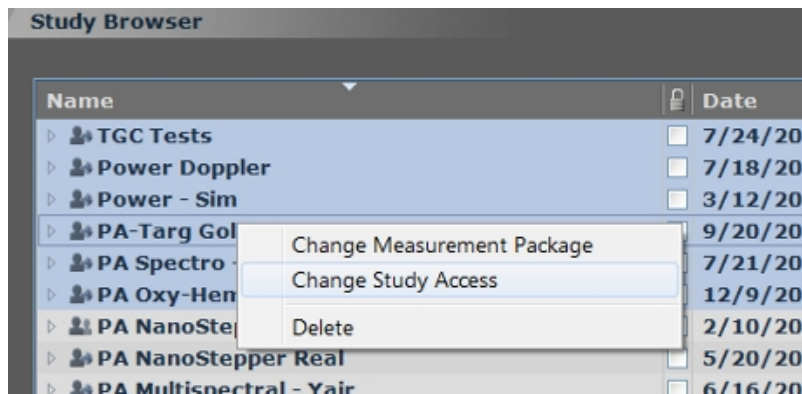
### Changing the ownership of one study

When changing the ownership of one study, please note the following:

- This task can only be completed by an Administrator when User Management Mode is enabled and the study is either unlocked or is set to Lock Delete Only.
- An Administrator cannot change the ownership of any study that is locked and is set to Lock All (set Lock All in Preferences window > General tab > Study Browser > Lock section).

### To change the ownership of a study

- 1 From the Study Browser, right-click the study you want to work with and select **Change Study Access**.



- 2 Select the Change Study Owner check box. The list of users becomes available.
- 3 Select the new user in the drop-down list and then click **Save**.

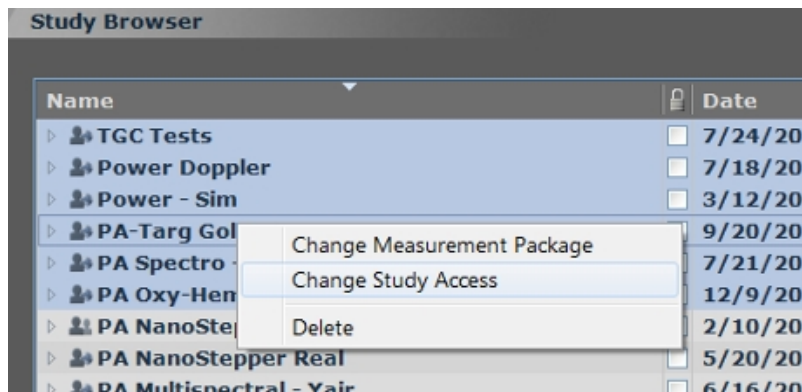
### Changing the ownership of multiple studies

When changing the ownership of multiple studies, please note the following:

- This task can only be completed by an Administrator and only when User Management Mode is enabled, and the studies are unlocked or set to Lock Delete Only.
- An Administrator cannot change the ownership of any study that is locked and is set to Lock All (set Lock All in Preferences window > General tab > Study Browser > Lock section).

### To change the ownership of a study

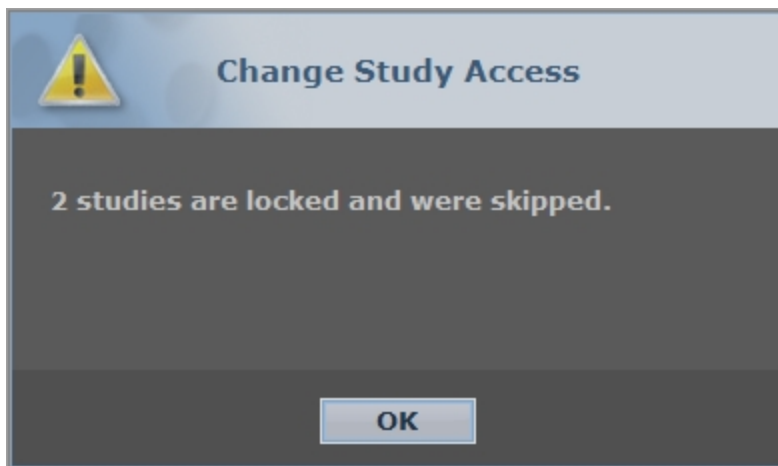
- 1 Open the Study Browser window and select the studies you want to work with.
- 2 Right-click one of the selected studies and select **Change Study Access**.



- 3 If you are an Administrator, select the **Change Study Owner** check box. The list of users becomes available.
- 4 In the drop-down list, select the user who will be the new owner of the studies and then click **Save**.



Vevo LAB makes the changes. If any of the selected studies are locked but not delete only, a notification box specifies how many locked studies were among your selections and were therefore skipped. Click **OK**.



The name of the new owner appears in the Study Owner column for each study.

## Working with series

Series are sub-groupings within studies that list all the images created during an acquisition session.

**Note:** In Vevo LAB, you can manage existing studies and series, but you cannot create a new study or a new series.

## Modifying the information properties of a series

You can use the Study Information window to customize the property details of a series within a study.

## To customize the information for a specific series

- 1 From the Study Browser, select the series row and then click **Info**. The Study Information window appears and displays information about the study and series.
- 2 Add or modify content as described in the following table.

Information Properties of a Series

Box name	Description
Series Name	Required.
Acquired By	Read-only.
Application	Optional. Type the information.
Measurement Package	Optional. Type the information.
Animal ID	Optional. Type the information.
Type	Optional. Type the information.
Color	Optional. Type the information.
Strain	Optional. Type the information.
Source	Optional. Type the information.
Weight	Optional. Type the information.
Heart Rate	Optional. Type the information.

### Information Properties of a Series

Box name	Description
Temperature	Optional. Type the information.
Date of Birth	Optional. Click the calendar icon and select the date that the animal was born.
Sex	Required. When you select Female, Vevo LAB displays the Pregnant option check box.
Pregnant	Optional. Select the check box. Vevo LAB displays a Date Mated calendar field and a Date Plugged calendar field. If you want to add that data, click the calendar icon and select the date.  <div style="background-color: #1a3d4d; color: white; padding: 5px; border-radius: 5px;"> <p><b>Note:</b> If you want to add a Uterine Horn from the Embryology Package of measurements, you must select this check box.</p> </div>
Series Notes	Optional. Type the information.
Anesthetic Type	Optional. Type the information.
Anesthetic On	Optional. Type the information.
Anesthetic Off	Optional. Type the information.
Protocol ID	Optional. Type the information.
Protocol Name	Optional. Type the information.

### Information Properties of a Series

Box name	Description
Injectable	Optional. Type the information.
Injection Site	Optional. Type the information.
Injection Amount	Optional. Type the information.

## Moving a series

You can move a closed series from one study to another study.

### To move a series

- 1 From the Study Browser, right-click the series line item and click **Move**.

**Note:** You must unlock the series before moving it.

- 2 In the Move Selected Series window, select the study where you want to move the series and click **OK**. The Study Browser highlights the series in its new study destination.

## Deleting a series

You can delete a series from any unlocked study that is backed up.

### To delete a series

- 1 In the Study Browser, select the series you want to delete.

- a. To select one item, click it.
  - b. To select a collection of individual items, press and hold **CTRL** on your keyboard and then click to select each item.
  - c. To select a consecutive group of items, click to select the first item, press and hold **SHIFT** on your keyboard and then click to select the last item in the range.
- 2 Click **Delete**. The Delete Confirmation window appears.
  - 3 Click **Yes**.

## Working with images

Images are saved cine loops and image frames that are listed within a series.

### Opening an image


#### To open an image from the Study Browser

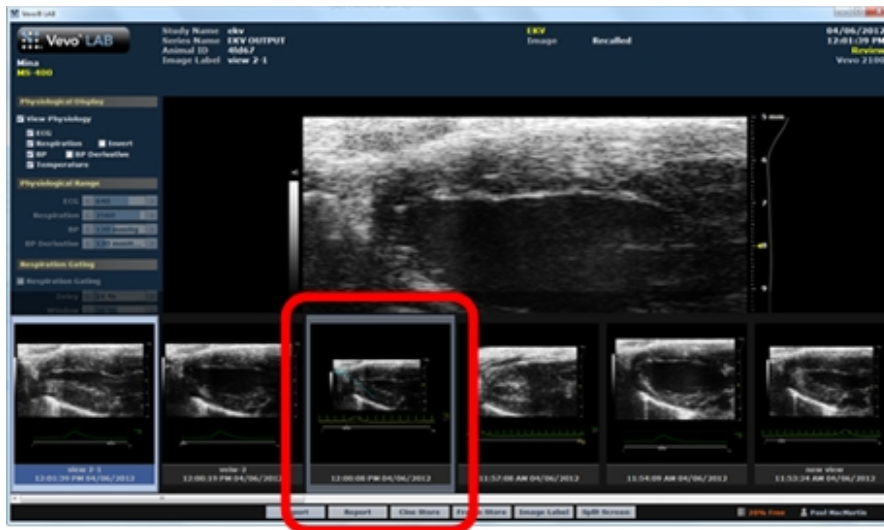
- 1 Expand the study and series that contains the image you want to open.
- 2 Select the image you want to open:
  - a. In the list of images, double-click the image row.
  - b. In the thumbnails panel, double-click the image thumbnail.

The image opens.


## Opening an image when reviewing another image

To open an image in the same series

- 1 From the mode window, click . A row of thumbnails appear that display of all images in the current series.
- 2 Scroll to the image you want and then double-click the thumbnail. The image opens.



To open an image from another series or study

- 1 From an open image, click .
- 2 Expand the study and series that contains the image you want to open.
- 3 Select the image you want to open:

- a. In the list of images, double-click the image row.
- b. In the thumbnails panel, double-click the image thumbnail.

The image opens.

## Labeling an image

You can label a saved image while you are reviewing it or when you are working with it in the Study Browser.

### To label an image from the Study Browser


- 1 In the Study Browser, right-click the image and click **Image Label**. The Image Label dialog appears.
- 2 Type the image label name and click **OK**. Vevo LAB:
  - Displays the name in the Name column.
  - Stores the image as either a cine loop or image frame if the image has not been saved previously.

### To label an image from a displayed image

- 1 From the mode window, click **Image Label**. The Image Label dialog appears.
- 2 Type the image label name and click **OK**. Vevo LAB:

- Displays the name in the Image Label field above the image.
- Stores the image as either a cine loop or image frame if the image has not been saved previously.

## Modifying a saved image

Image processing tools for modifying images are available by clicking the Image Processing tab .

The image processing tools vary depending on the imaging mode.

**Note:** Changes made in the Image Processing panel do not change the outcome for data quantification.

**Note:** The Create MIP option is not available for Nonlinear Contrast Mode if the previous cine loop was processed using MIP or if the loop contained less than five frames.

## Saving an image

To save a cine loop

- ◆ While reviewing the image, click **Cine Store**. Vevo LAB saves the cine loop frames as a single image item and lists the image in the Study Browser.

To save an image in a frame-based mode

- ◆ While reviewing the image, click **Frame Store** for a single-frame image in B-Mode, Color Doppler Mode, PA-Mode, Power Doppler Mode,



Linear Contrast Mode, Nonlinear Contrast Mode and EKV Mode. Vevo LAB saves the image and lists it in the Study Browser.

### To save an image in a time-based mode

- ◆ While reviewing the image, click **Image Store** for a single image in M-Mode, AM-Mode, PW Doppler Mode, and PW Tissue Doppler Mode. Vevo LAB saves the image and lists it in the Study Browser.


## Deleting an image

You can delete an image from the Study Browser or while you are reviewing an image.

### To delete an image from the Study Browser

- 1 In the Study Browser, expand the series that contains the image you want to delete and then select the images you want to delete:
  - a. To select one item, click it.
  - b. To select a collection of individual items, press and hold **CTRL** on your keyboard and then click to select each item.
  - c. To select a consecutive group of items, click to select the first item, press and hold **SHIFT** on your keyboard and then click to select the last item in the range.
- 2 Click **Delete**. The Delete Confirmation window appears.
- 3 Click **Yes**.

To delete an image while you are reviewing images

- ◆ While reviewing an image, click .

## Exporting image data

The export function translates your images from the Vevo Imaging System file format into industry formats you can work with on a computer.

## Exporting cine loops from the Study Browser

To export cine loops from the Study Browser

- 1 Select the cine loops you want to export.

**Note:** You cannot export loaded 3D Mode images as a cine loop.

**Note:** When you select a series or a study that includes image frames as well as cine loops, Vevo LAB only exports the selected cine loop images. You do not have to deselect the image frames. You can just select the series row or even the whole study and Vevo LAB will export only the cine loops.

- a. If you want to export a single cine loop, expand the study and series that contains the cine loop and select it.
- b. If you want to export multiple cine loops, expand and select the study rows or series rows that contain the cine loops you want to export.
- c. To select one item, click it.

- d. To select a collection of individual items, press and hold **CTRL** on your keyboard and then click to select each item.
- e. To select a consecutive group of items, click to select the first item, press and hold **SHIFT** on your keyboard and then click to select the last item in the range.

2 Click **Export**. The Export Image window appears.

3 Browse to, and then select the folder that will contain the export.

4 (Optional) To add a subfolder click **New Folder**, name the folder and then click **OK**.

5 In the Export Type section click **Cine Loop**.

6 In the Options section top box:

- a. If you are exporting a single image, the box is labeled Save As. You can keep the defined date and time stamp file name or type a new file name.
- b. If you selected to export multiple images, the box is labeled File Name Prefix. Type in text that will be added to the start of all the individual image files that you have selected to export. This way you can identify and group these exported files more easily in your export folder.

7 In the Options section File Type box, select the format based on your requirements.

**Cine Loop File Types and Descriptions**

File Type	Description
Uncompressed AVI (*.avi)	Largest file size, provides the original image quality.

### Cine Loop File Types and Descriptions

File Type	Description
Animated GIF (*.gif)	Medium file size, provides fair image quality.
MPEG (*.mp4)	Smaller file size, provides good image quality.
Windows Media Video (*.wmv)	Smallest file size, provides good image quality.
Waveform Audio File Format (*.wav)	Microsoft audio file format standard for storing audio.
IQ Data (*.iq)	Signal representation that is more precise and can determine the frequency and peak amplitude of the signal.
RAW Data (*.raw.xml)	Raw (or unprocessed) data is generated into XML interchange format to allow sharing across other applications.
RF Data (*.rf.xml)	Digital RF data is generated into XML interchange format to allow sharing across other applications.  <b>Note:</b> Available only for images that had RF enabled at the time of acquisition.

8 (Optional) Click the Hide measurements and annotations check box to export your cine loop with image data only.

9 Click **OK**. Vevo LAB exports the images to the folder you selected and then presents the Image Export Report.

10 Click **OK**.

## Exporting a cine loop from the mode window

If you are analyzing a cine loop in the mode window, you do not have to return to the Study Browser to export it. You can export it directly from the mode window.

### To export a cine loop from the mode window

- 1 While reviewing an image, click **Export**. The Export Image window appears.
- 2 Continue the export procedure as detailed in ["Exporting cine loops from the Study Browser"](#) on page 186.

## Exporting image frames from the Study Browser

### To export image frames from the Study Browser

- 1 Select the image frames you want to export.
  - a. If you want to export a single image frame, expand the study and series that contains the image frame and select it.
  - b. If you want to export multiple image frames, expand and select the study rows or series rows that contain the image frames you want to export.
  - c. To select one item, click it.

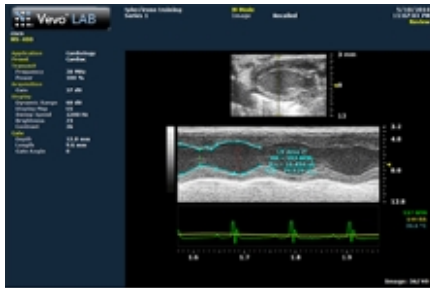
- d. To select a collection of individual items, press and hold **CTRL** on your keyboard and then click to select each item.
- e. To select a consecutive group of items, click to select the first item, press and hold **SHIFT** on your keyboard and then click to select the last item in the range.

**Note:** When you select a series or a study that includes cine loops as well as image frames, Vevo LAB exports the last frame of any cine loop as an image frame. Or, if you have added a measurement, Vevo LAB exports the frame that includes the measurement. This means that if you want to export the entire cine loop, you must click to deselect the cine loop items from your multiple selections, then configure another export to export them as cine loops.

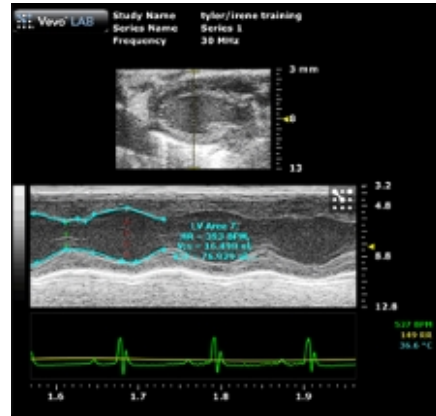
- 2 (Optional) Click the Hide measurements and annotations check box to export your cine loop with image data only.
- 3 Click **Export**. The Export Report window appears.
- 4 Browse to, and then select, the folder that will contain the export.
- 5 (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
- 6 In the Export Type section click **Image**.
- 7 In the Options section top box:
  - a. If you are exporting a single image, the box is labeled Save As. You can keep the defined date and time stamp file name or type a new file name.
  - b. If you selected to export multiple images, the box is labeled File Name Prefix. Type in text that will be added to the start of all the individual

image files that you have selected to export. This way you can identify and group these exported files more easily in your export folder.

8 In the Options section File Type box, select the TIFF (full screen or image area), BMP (full screen or image area) or RAW file format.



*Image exported as full screen  
BMP file*



*Image exported as image area BMP*

9 If the file names of any images you selected for export are identical to any file names in your export folder, a prompt box appears and asks you how you would like to proceed:

- a. Click **Yes** to overwrite the files.
- b. Click **No** to return to the Export Image window.

10 Click **OK**. Vevo LAB exports the images to the folder you selected and then presents the Image Export Report.

11 Click **OK**. Vevo LAB returns you to the Study Browser.

## Exporting an image frame from the mode window

If you are analyzing an image frame, you don't have to return to the Study Browser to export it. You can export it directly from the mode window.

To export image frames that you are analyzing in the mode window

- 1 Click **Export**. The Export Report window appears.
- 2 Complete the export procedure as detailed in "[Exporting image frames from the Study Browser](#)" on page 189.

## Exporting an image from the 3D/4D-Mode view window

If you are analyzing an image from the 3D/4D-Mode view window, you do not have to return to the Study Browser to export it. You can export it directly from the 3D/4D-Mode view window.

**Note:** When exporting 3D/4D-Mode images as 3D Volume slices, each individual 3D/4D slice is saved in a separate TIFF file. All TIFF files are numbered sequentially in Z direction (slice in volume) and also in the T direction (Time). The number of TIFF files generated shall equal the number of frames acquired for the 3D/4D-Mode image.

To export an image from the 3D/4D-Mode view window

- 1 Load a 3D/4D-Mode image into review.
- 2 From the Image Processing panel, click **Load into 3D/4D**.
- 3 From the 3D/4D-Mode view window, click **Export**. The Export Image window is displayed.
- 4 Browse to and then select the folder that will contain the export.



5 (Optional) To add a subfolder click **New Folder**, name the folder and then click **OK**.

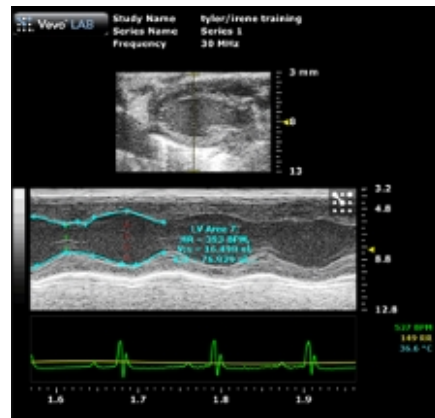
6 In the Export Type section, click **Image**.

7 (Optional) Name the file by typing text in the Save As text box.

8 Select the File Type based on your requirements. TIFF (full screen or image area) or BMP (full screen or image area).



*Image exported as full screen  
BMP file*



*Image exported as image area BMP*

3D/4D-Mode images have an additional TIFF for 3D Volume Slices (\*.tif) file type to choose from. Use this export type when you want high quality raster graphics for the individual slices of a 3D/4D volume.

9 Click **OK**. The software exports the image.

## Exporting physiological data from the Study Browser

To export physiological data from the Study Browser

- 1 In the Study Browser, select the cine loops and/or image frames that contain the physiological data you want to export.
  - a. To select one item, click it.
  - b. To select a collection of individual items, press and hold **CTRL** on your keyboard and then click to select each item.
  - c. To select a consecutive group of items, click to select the first item, press and hold **SHIFT** on your keyboard and then click to select the last item in the range.
- 2 Click **Export**. The Export Report window appears.
- 3 Browse to, and then select, the folder that will contain the export.
- 4 (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
- 5 In the Export Type section click **Physiological Data**.
- 6 Click **OK**. Vevo LAB exports the physiological data as a CSV file to the folder you selected and then presents the Image Export Report. The file name ends with physio.csv.
- 7 Click **OK**. Vevo LAB returns you to the Study Browser.

## Exporting images to DICOM from the Study Browser

You can export saved cine loop and frame images as DCM files that you can import into a DICOM compatible workstation.

You can export your saved images from the Study Browser or while you are reviewing them in the Mode window.

### To export images to DICOM format from the Study Browser

- 1 Select the image frames you want to export.
  - a. If you want to export a single cine loop image or image frame image, expand the study and series that contains the image and select it.
  - b. If you want to export multiple single cine loop images or image frame images or a combination of both image types, expand and select the study rows or series rows that contain the images you want to export.
  - c. To select one item, click it.
  - d. To select a collection of individual items, press and hold **CTRL** and then click to select each item.
  - e. To select a consecutive group of items, click to select the first item, press and hold **SHIFT** and then click to select the last item in the range.
- 2 Click **Export**. The Export Report window appears.
- 3 Browse to, and then select, the folder that will contain the export.
- 4 (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
- 5 In the Export Type section click **DICOM**.

6 In the Options section top box:

- a. If you are exporting a single image, the box is labeled Save As. You can keep the defined date and time stamp file name or type a new file name.
- b. If you selected to export multiple images, the box is labeled File Name Prefix. Type in text that will be added to the start of all the individual image files that you have selected to export. This way you can identify and group these exported files more easily in your export folder.

7 In the Options section File Type box, select the compression level for your DCM export file, as described in the following table.

**DICOM Export Type Descriptions**

<b>Header text</b>	<b>Header text</b>
Implicit VR Little Endian	Image pixel data is not compressed. The Tag type is determined by the context.
Explicit VR Little Endian	Image pixel data is not compressed. The Tag type is explicitly defined in the file.
JPEG Baseline	An image created using the JPEG compression algorithm that starts displaying the image as the data is made available—line by line.
RLE Lossless	Run Length Encoding. A lossless compression algorithm that provides decent compression ratios in specific types of image file types such as TIFF and PDF.

8 (Optional) Click the Hide measurements and annotations check box to export your cine loop with image data only.

9 If your DICOM system supports regions:

- a. Select the Export regions check box to export the file with separate calibration data for the main image area as well as the B-Mode scout window.
- b. Clear the Export regions check box to export the file with only the calibration data for the main image area.

10 If the file names of any images you selected for export are identical to any file names in your export folder, a prompt box appears and asks you how you would like to proceed:

- Click **Yes** to overwrite the files.
- Click **No** to return to the Export Image window.

11 Click **OK**. Vevo LAB exports the images as individual DCM files to the folder you selected and then presents the Image Export Report.

12 Click **OK**. Vevo LAB returns you to the Study Browser.

## Exporting images to DICOM from the mode window

If you are analyzing either a cine loop or an image frame in the mode window, you don't have to return to the Study Browser to export it to DICOM. You can export it directly from the mode window.

### To export an image to DICOM from the mode window

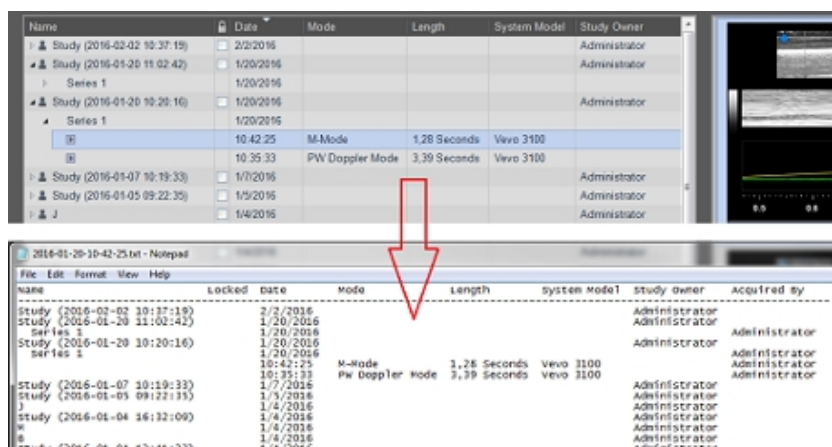
1 Click **Export**. The Export Report window appears.

2 Complete the export procedure as detailed in "Exporting images to DICOM from the Study Browser" on page 195.

## Exporting the Study Browser list as a text file

The Export Type Table option exports the Study Browser window content precisely as it appears, as a VSI Table File (\*.txt) that you can open in a text editor.

For example, if the Study Browser includes 50 studies and you expand only the sixth study and its series and images, your export will include all the listing information for the one study that you expanded completely, and include only the study rows for the other 49 studies.



To export the Study Browser list as a text file

- 1 In the Study Browser, expand the study rows and series rows as required to create the precise view you want to export.
- 2 Click **Export**. The Export window appears.
- 3 Browse to, and then select, the folder that will contain the export.

- 4 In the Export Type section click to select **Table**.
- 5 (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
- 6 In the Options section, complete any changes you want to make and click **OK**.

## Copying, deleting and importing studies

Vevo LAB provides a range of features for copying, deleting and importing study data.

### Copying studies, series or images

You can copy any number of studies to a location on your network or to an external storage device.

#### To copy a study to a folder

- 1 In the Study Browser, select the studies that you want to copy.
  - a. To select one item, click it.
  - b. To select a collection of individual items, press and hold **CTRL** and then click to select each item.
  - c. To select a consecutive group of items, click to select the first item, press and hold **SHIFT** and then click to select the last item in the range.
- 2 Click **Copy To**. The Copy Study To window appears.
- 3 In the folder browser, browse to the location where you want to copy the study and select the folder.

4 (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.

5 In the Options section, in the Save As box, if you want to change the name of the study, type the new name.

6 Click **OK**.

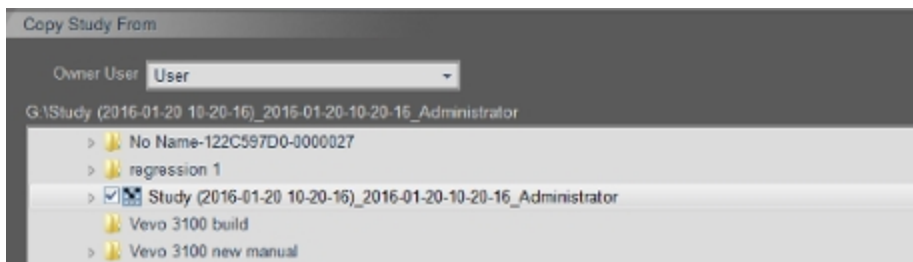
7 Vevo LAB copies the study to the folder you selected and displays the Copy Study Report box to summarize the details of the copy process. Click **OK** to complete the process.

8 Vevo LAB returns you to the Study Browser.

### To copy a study from a folder

1 In the Study Browser, click **Copy From**. The Copy Study From window appears.

2 In the folder browser, browse to the folder that contains the study you want to copy and select the check box of the study/studies you want to copy.



The study/studies appear in the Studies Selected list.

3 Click **OK**.



4 Vevo Lab copies the study to Vevo LAB and displays the Data Transfer Report dialog summarizing the details of the copy process. Click **OK** to complete the process.

5 Vevo LAB returns you to the Study Browser. The copied study appears in the list of studies.

## Deleting studies, series or images

In the Study Browser, you can delete any combination of list items.

### To delete studies, series or images

- 1 In the Study Browser, select the studies that you want to delete.
  - a. Expand the individual study rows and then series rows if you need to view images.
  - b. Select the study, series or images you want to delete.
    - c. To select one item, click it.
    - d. To select a collection of individual items, press and hold **CTRL** and then click to select each item.
    - e. To select a consecutive group of items, click to select the first item, press and hold **SHIFT** and then click to select the last item in the range.

- 2 Click **Delete**.

**Important:** When you delete items from the Study Browser, the data is completely removed. You cannot retrieve it.

Vevo LAB deletes the studies you selected and displays the Delete Confirmation dialog summarizing the details of the deletion process.

**Note:** If one or more of the studies are locked, Vevo LAB does not delete them.

3 Click **Yes**. Vevo LAB returns to the Study Browser.

## Importing studies

You can import studies that were acquired on a Vevo Imaging System or stored on an external data storage device.

You can also choose to have image data automatically import to Vevo LAB from a Vevo Imaging System.

### To import a study manually

1 From the Study Browser, click **Copy From**. The **Copy Study From** window appears.

2 In the **Owner User** box, select your name.

**Note:** If you do not select your name in the list, Vevo LAB disables the **OK** button.

3 Select the studies you want to import by using one of the following two options:

- a. If you want to preview the images in an external study, browse to the folder that contains the study, expand the folder, expand the study and then select a series—Vevo LAB displays the image thumbnails.
- b. If you want to select an individual study, browse to the folder that contains the study, expand that folder and select the check box for the study.

4 If you want to remove a study from the Selected Studies list, select the study and then click **Remove**.

5 Click **OK**. If your import includes a series that already exists for which you are the owner, Vevo LAB prompts you to choose one of the following actions:

- a. Overwrite the series.
- b. Skip the series.
- c. Create a new study for the series.

6 Select the appropriate option and then click **OK**. Vevo LAB displays the Copy Study Report dialog so you can review the details of the import.

7 Click **OK**.

### To import a study, series or image automatically


**Note:** In order to import studies, series or images automatically to Vevo LAB, you must have a Vevo Imaging System that includes Background Data Transfer.

1 Add your Vevo Imaging System to a network.

2 Add your PC that has Vevo LAB installed to the same network.

3 On your Vevo Imaging System turn on Background Data Transfer from the Export tab in System Settings, then enter the Target Location of your PC.

**Important:** Once Background Data Transfer is turned on and a location specified, all closed studies and series from the Vevo Imaging System will automatically be transferred to the selected target location.

4 On Vevo LAB, click the refresh  button in the Study Browser to update the list and to view your newly imported studies, series or images.

## Analyzing Images

---

This section walks you through the typical tasks you will complete when you analyze images.

### Working with cine loops

A cine loop is the series of acquired images that Vevo LAB holds in its memory buffer when the image data was originally acquired.

- In frame-based modes, the cine loop is comprised of a set of frames.
- In non frame-based modes, the cine loop is comprised of the data acquired over a defined time interval.

### Cine loops (multiple-frame animations)

A cine loop is a multiple-frame animation of image frames. B-Mode based cine loops are measured by number of frames. M-Mode, AM-Mode, PW Doppler Mode and PW Tissue Doppler Mode cine loops are measured in seconds.

#### How cine loops work

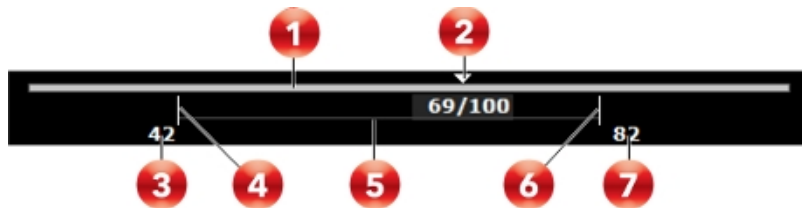
During image acquisition on a Vevo Imaging System, playback memory holds the most recent image data in a buffer. The buffer size is defined on the Vevo Imaging System.

When the Vevo Imaging System saves image data as a cine loop, the system saves the buffered data as an image. The buffer saves the latest acquired data.

You cannot acquire original image data with Vevo LAB, however, you can work with existing cine loops to create new cine loops.

### Cine loop controls



The following diagram summarizes the controls you can use to adjust a cine loop for a frame-based image.



Cine Loop Controls Descriptions

Area	Descriptions
<b>1</b>	The cine loop length bar represents the full length of the cine loop.
<b>2</b>	The frame counter indicates the location of the current frame. The counter indicates the frame number and the total number of frames within the buffer.  To display another frame in the cine loop, drag the triangular frame indicator to the desired frame number.
<b>3</b>	Range start frame number.
<b>4</b>	The start bracket defines the start of the cine loop you want to review. You can create a range within the full cine loop by clicking and dragging the bracket to define the start of a range.
<b>5</b>	The range length bar represents the full length of the defined range.

## Cine Loop Controls Descriptions

Area	Descriptions
	The range end bracket defines the end of the cine loop you want to review. You can create a range within the full cine loop by dragging the bracket to define the end of a range.
	Range end frame number.

### *Playing back a cine loop on Vevo LAB*



Cine loop controls include standard playback controls plus additional controls for either frame-based or time-based images.

- Playback controls for frame-based images

You can select the playback speed (via slider or - / + controls) and what image frame is being displayed in the mode window.



- Playback controls for time-based images


You can select playback speed (via slider or increase  /decrease  controls), volume levels, and what data is being displayed in the region of interest window.



## Creating a cine loop range from a full cine loop

You can use the start and end brackets to create a cine loop range from a full cine loop. This is useful when you want to review only a portion of the original cine loop.

### To create a cine loop range from a full cine loop

- 1 From an open image, click  to open the Study Browser.
- 2 Open a cine loop.
- 3 Drag the start bracket and the end bracket to define the range.
- 4 To store the cine loop range, click **Cine Store**. The playback range can be changed and then stored again. The original data is unaffected.

## Viewing saved physiological data

When you are analyzing your saved images, you can view the heart rate, temperature, respiration rate and blood pressure data that were recorded along with the image data if this data was recorded during the image acquisition.


Vevo LAB displays physiological data in two areas of the mode window.





Area	Description
1	Physiological data trace.
2	Physiological data values.

### To show or hide individual traces in the graph

- 1 In the mode window, click the Physiological tab .
- 2 In the Physiological Display section:
  - a. To show or hide the entire graph, select or clear the View Physiology check box.
  - b. To show or hide individual traces in the graph, select or clear the check boxes for the required traces.

**Note:** The physiological trace panel only displays the traces that are selected in the Physiological Display section of the Physiological panel.

### Saving an image frame

An image frame is a single non-animated image. You can only save an image frame in frame-based image modes.

## To save an image as an image frame on Vevo LAB

- 1 Open a frame-based image and then use the playback controls to display the frame you want to store.
- 2 Click **Frame Store**.
- 3 Vevo LAB saves the current image frame as a new image and adds it as an unnamed list item within the active series row in the selected study.


## Measurement basics

This section describes where to find measurement tools, and what types of measurements you can add to an image.

### Measurements panel

The Measurements panel is where you can add measurements to an acquired image.

### To view the Measurements panel

- 1 Open a stored image from the Study Browser or if you are reviewing an image in the mode window, pause image playback.
- 2 Click the Measurements panel icon . The Measurements panel appears.

### Measurements panel workspace

The following illustration describes the Measurements panel features.



### Measurements Panel Descriptions

Area	Description
1	Each imaging mode provides a unique set of generic measurements and tools. Click a tool or measurement icon, then add it to your image.

## Measurements Panel Descriptions

Area	Description
<b>2</b>	Select the appropriate measurement package from the drop-down box.
<b>3</b>	The protocols list displays the list of protocols included in the selected measurement package.
<b>4</b>	The protocols list item displays the list of measurements within that protocol. Click a protocol to display the measurements.
<b>5</b>	<p>The protocol measurement item for a specific protocol. Each protocol measurement uses one of the generic measurement tools that are displayed for the active imaging mode.</p> <p>Click the measurement and then add the measurement to the image.</p>
<b>6</b>	<p>Displays the index of the embryo specified by the Horn field when the Show Embryo Index check box is selected in the Measurement tab of the Preferences window.</p> <div style="background-color: #1a3d4d; color: white; padding: 5px; border-radius: 5px;"> <p><b>Note:</b> Available only when the Embryology package is selected and if the animal is pregnant (enable pregnant checkbox in Series Information).</p> </div>
<b>7</b>	Displays the measurements and values that have been added to the image.
<b>8</b>	<p>Show Values and Labels.</p> <p style="margin-left: 20px;">a. Select the check box.</p>

## Measurements Panel Descriptions

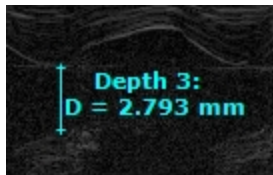
Area	Description
	<p>When you add a measurement, Vevo LAB displays the name and values on the image.</p> <p>You can specify what parameters are displayed for protocol measurements by editing the Measurement Parameters section on the Measurement tab in Preferences.</p> <p>b. Clear the check box.</p> <p>When you add a measurement, Vevo LAB displays only the measurement index number on the image. The measurement name and value are still displayed in the Measured Values list in the mode window.</p>

### Generic measurements

You can add generic measurements to an image that does not belong to a protocol in a measurement package.


The label for each generic measurement consists of the generic measurement name and a number suffix that shows the chronological order of that measurement type on any image in that series.

See an example of a generic Depth measurement below.



## Complete procedure for adding a generic measurement

### To add a generic measurement:

- 1 While viewing a saved image, click Measurements  to view the Measurements panel.
- 2 Click the measurement tool you want to use. If you are not sure which button you need, hover your cursor over the button to view the pop-up button label.

While you apply the measurement, you can see a magnified view of your cursor area in the Measured Values list area of the Measurements panel.

- 3 Click to apply your caliper points.

For example, for a Linear measurement, click on your image to place the initial caliper, then drag to the location where you want to end your measurement, then click a final time to place the end caliper.

- 4 If you want to rename the label, type a new name while the label text is selected, and then click outside the label to commit your changes.
- 5 If you want to move the measurement or the label, select it, drag it and drop it.

### Adding sequential same-type generic measurements

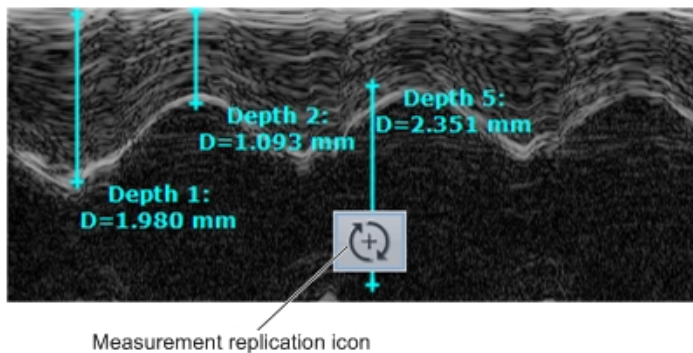
Sequential same-type measurements is a feature that helps you save time when you add measurements.

For most generic measurement types, you can select the measurement type, add the measurement and then immediately add another measurement of

the same type without selecting the measurement type again from the Measurements panel.

### To add sequential same-type measurements

1 In the Measurements panel, click the generic measurement tool and then add the measurement to the image. If the measurement can be replicated in sequence, the replication symbol appears.



2 Click the replication icon, then add the second same type measurement.

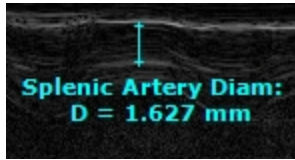
3 Add as many measurements of the same generic measurement type as you want.

**Note:** This also applies to protocol measurements.

### Protocol measurements

Protocol measurements are uniquely labeled measurements that belong to a set of measurements that are required for a particular protocol. Each protocol measurement use a generic measurement tool, but uses its unique name to label it.


Below is an example of a Splenic Artery Diam measurement; it uses the generic Linear measurement tool but with its unique name as the label.



## Adding protocol measurements

To add protocol measurements

Protocol measurements are labeled uniquely for a specific measurement protocol.

- 1 From the Study Browser, select and open an image.
- 2 Click Measurements  to display the Measurements panel.
- 3 In the measurement packages drop-down list, click the appropriate package.
- 4 In the list of protocols, select the appropriate protocol.
- 5 In the list of measurements, select the measurement you want to add.
- 6 Add your measurement to the image.

## Measurement units

Vevo LAB includes the following measurement types and units:



### Measurement Units

Measurement type	Measurement unit
Length / Distance	millimeters (mm)
Area	square millimeters (mm <sup>2</sup> )
Velocity	millimeters per second (mm/s)
Acceleration	millimeters per second per second (mm/s <sup>2</sup> )
Time	milliseconds (ms)
Heart rate	Beats Per Minute (BPM)
Respiration	Respiration Rate—number of breathing cycles per minute (RR)
Velocity Time Integral (VTI)	millimeters per second integrated over the time interval in seconds (mm)
Volume	millimeters cubed (mm <sup>3</sup> )
RR Interval	milliseconds (ms)
Pressure gradient	millimeters of Mercury (mmHg)
Temperature	Degrees Celsius
Radius	Length of radius in millimeters (mm) - available in Ophthalmology Package

**Note:** If the unit value includes more than four digits before the decimal point, the unit of measure will change automatically.

## Working with measurements

This section describes how to complete measurement tasks that are used for measurements in imaging modes.

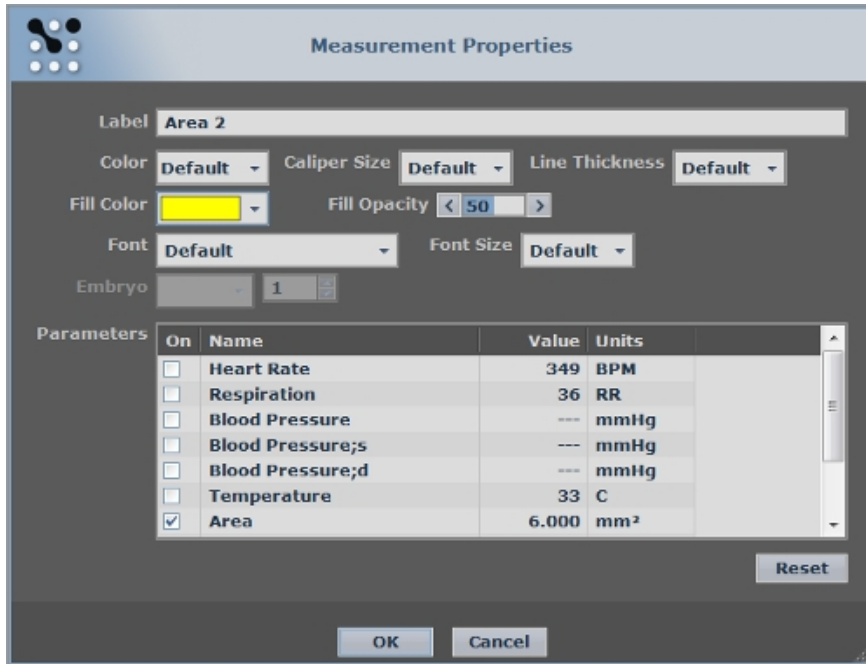
You can make protocol measurements on all frame based images and spectrum based images but not on 3D Mode or PA-Mode images.

### Modifying the properties of a measurement

The properties of a measurement are initially defined by the settings you configure in the "Measurement Display" on page 108 on the Measurement tab in Preferences. You can override these settings for individual measurements.

#### To modify the properties of an individual measurement

- 1 Right-click the measurement and click **Properties**. The Measurement Properties dialog appears.



2 Modify the properties as required and click OK.

## Coloring a measured area

You can add color to measurements that create an observable area. These include:

- 2D Area
- Angle
- Contrast Region
- Cardiac Region
- Ellipse


- LV Area - Long Axis
- LV Area - Short Axis
- PA Region
- Traced Distance
- VTI

### To add a color to a measurement


- 1 Add your measurement.
- 2 Right-click the measurement and click **Properties**.
- 3 In Fill Color, select the color you want to add.
- 4 In Fill Opacity, set the percentage of "see-through" you want for the entire color area.
  - 0 = totally invisible
  - 50 = half see-through
  - 100 = totally opaque

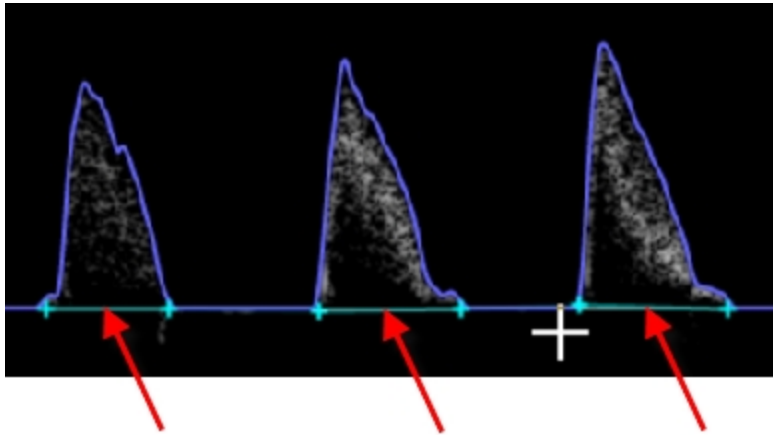
### Coloring areas in a VTI trace

You can use the Measurement Properties color tools to add color to areas in a VTI trace.

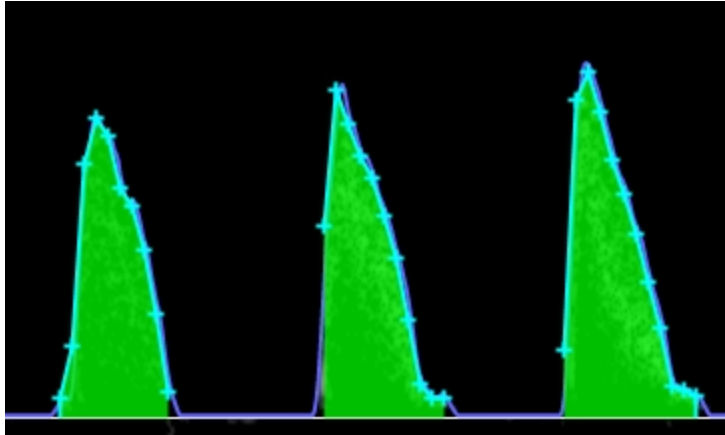
**Note:** You can only color areas in a VTI trace if Vevo Color is activated. To determine this go to the Study Browser, click Help  and then click **About**. Within the list of System Features check to see if Vevo Color is activated.

### To add color to an area in a VTI trace

- 1 While reviewing a cine loop, pause playback where it includes the peaks you want to color and then click the VTI tool .
- 2 Click at the start and finish of the peaks and right-click to commit.



- 3 Right-click the trace and click **Properties**. The Measurement Properties box appears.
- 4 Set the Fill Color and Fill Opacity values and then click **OK**. Vevo LAB applies the color to the peaks.



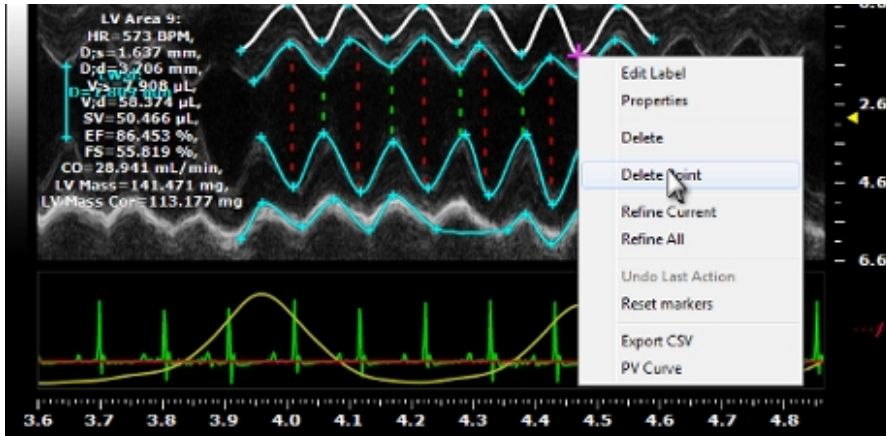
## Modifying points on a contour measurement

To modify points on a contour

- To move a point, drag it to a new position and click again to commit the point.
- To add a point, click the contour, move the cursor to a new position and click again to commit the new point.
- To delete a contour, right-click the contour and click **Delete**.

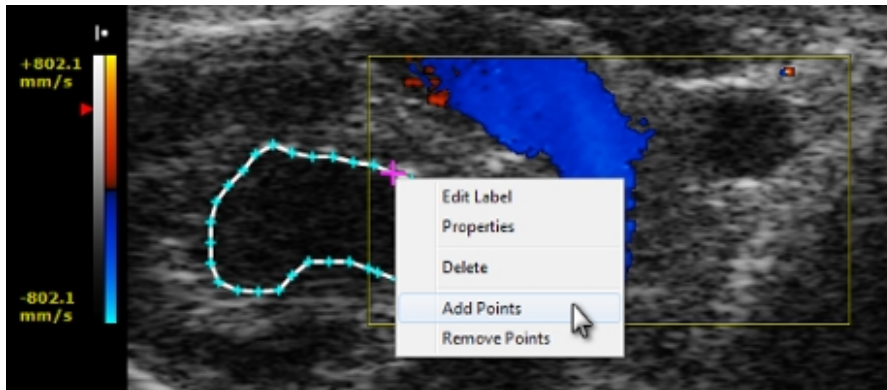
To modify points on an LV Wall measurement

- ◆ Right-click a point and then select the modify command you want to apply.



To modify points on an area measurement such as 2D Area

- ◆ Right-click a point and then select the modify command you want to apply.




## Adding embryo measurements

A pregnant animal typically carries multiple embryos. The same measurement can be applied to each embryo in utero when performing developmental studies. By default, Vevo LAB assumes that these embryos are enumerated along the left and right uterine horns.

When you add an embryonic measurement, the measurement label includes an embryo index that follows the View suffix. For example, for a crown rump length measurement on the third embryo on the left uterine horn, Vevo LAB labels this Crown Rump Length: Left: 3.

To disable the suffix, clear the Show Embryo Index check box in the "[Measurement Display](#)" on page 108 in the Measurement tab in Preferences. The change must be saved as a new custom measurement package.

### To add an embryo measurement

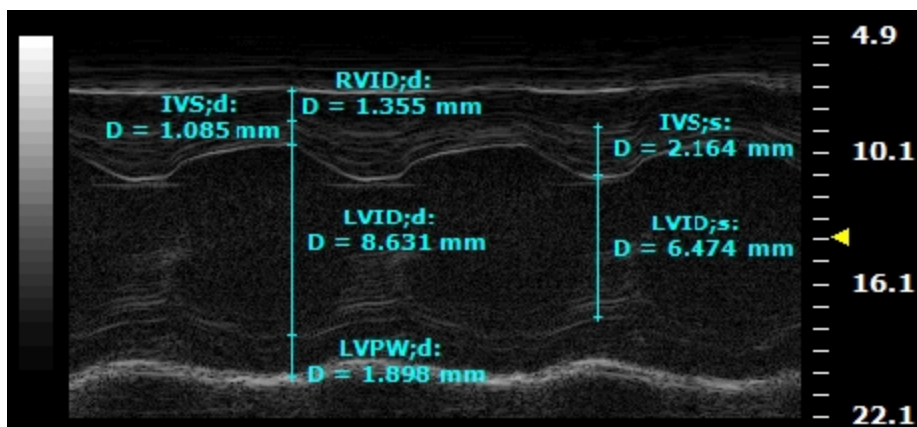
- 1 Ensure that the Study Information window specifies that the animal is pregnant, see "[Study Information workspace](#)" on page 70.
- 2 From the Study Browser, open the image that includes the embryo image data.
- 3 Click Measurements .
- 4 In the measurement packages list, click **Embryology Package**.
- 5 In the protocols list, click **Uterine Horn**.
- 6 In the Horn drop-down, select which horn you are analyzing—Left or Right.
- 7 In the Number box, select the embryo number.



8 In the protocols list, select the protocol measurement you want to work with and then add the measurement on the image.

## Adding measurement chains to B-Mode and M-Mode images

In B-Mode and M-Mode, you can complete the following sequenced measurements in automatic chains, as shown in the following diagram:



*M-Mode image example, displaying the measurement chains beginning with RVID;d and IVS;s.*

In the sequence of chained measurements, the final caliper of the first measurement in the chain automatically becomes the first caliper of the second measurement. This linking continues for the remainder of the caliper points.

The labeling for all measurements occur at the same time and only when you add the last caliper of the final measurement in the chain. Vevo LAB saves the image each time you complete a measurement.

## To complete an M-Mode chained measurement

- 1 In the measurement packages list, click **Cardiac Package**.
- 2 In the protocols list, click the protocol and then click the first measurement in the chain. For example, click **PSLAX > RVID;d**.
- 3 Click the top point of the first measurement of the chain and move the cursor toward the bottom point. For example, click the top point of the RVID;d measurement. If the Show Values and Labels option is selected in the measurement panel in the mode window, Vevo LAB displays and labels the measurement.
- 4 Click the bottom point of the first measurement. Vevo LAB commits the measurement value for the first measurement and stores the image. This bottom point of the first measurement automatically becomes the top point of the second measurement in the chain, for example, the IVS;d measurement.
- 5 Click the bottom point of the second measurement. Vevo LAB measures and labels the second measurement and stores the image.
- 6 Click the remaining bottom points of the next measurements in the chain. Vevo LAB measures and labels each measurement until the final measurement is completed.

## Copying and pasting measurements

You can copy contrast region measurements, cardiac region measurements and PA region measurements on Linear Contrast Mode, Nonlinear Contrast Mode and PA-Mode images, respectively.


## To copy a Linear or Nonlinear Contrast Mode contour measurement

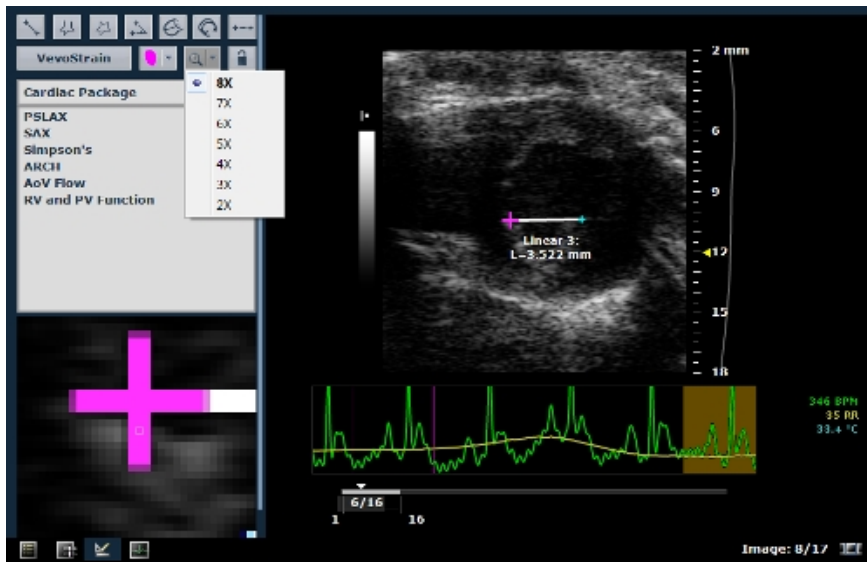
- 1 Right-click a measurement and click **Copy**.

2 Right-click anywhere on the image and click **Paste**. The copied measurement is applied directly over the existing measurement.

3 Modify the contour measurement as required.


## Zooming into a measurement location

The zoom tool  in the Generic measurement tools group provides a range of preset zoom levels—2X, 3X, 4X, 5X, 6X, 7X, 8X. The following diagram illustrates the primary features of the zoom process.




**Note:** Zoom is always activated when placing a measurement—it cannot be turned off.


## To zoom in to a measurement location

- 1 Click the down-arrow on the zoom tool  and select a zoom level.
- 2 Click the magnifying glass area on the zoom tool to activate the zoom function. The zoom tool becomes blue and the zoom view pane displays the magnified area around the current position of the cursor. You can hover over the image and highlight anything on the image without placing a measurement.
- 3 Select the measurement tool you want to use and then use a combination of the zoom view pane and the main image pane to locate and apply the precise points for your measurement.
- 4 To turn zoom off, click the magnifying glass area on the zoom tool again.

## Locking measurements

### To lock a measurement

- 1 Open the image that contains the measurement you want to lock.
- 2 Select the measurement and then click the lock measurement icon .

The icon becomes blue and displays the closed lock . Vevo LAB locks all the measurements on the image.

### To unlock a measurement

- ◆ Click the lock icon. Vevo LAB unlocks all the measurements.

## Deleting measurements

### To delete a measurement

- 1 Hover over a measurement until the measurement is active (contour changes from green to white).
- 2 Right-click. A menu will be displayed.
- 3 Select **Delete**.
- 4 (Optional) Select a measurement in the Measured Values list and press **Delete** on your keyboard.

## Working with annotations

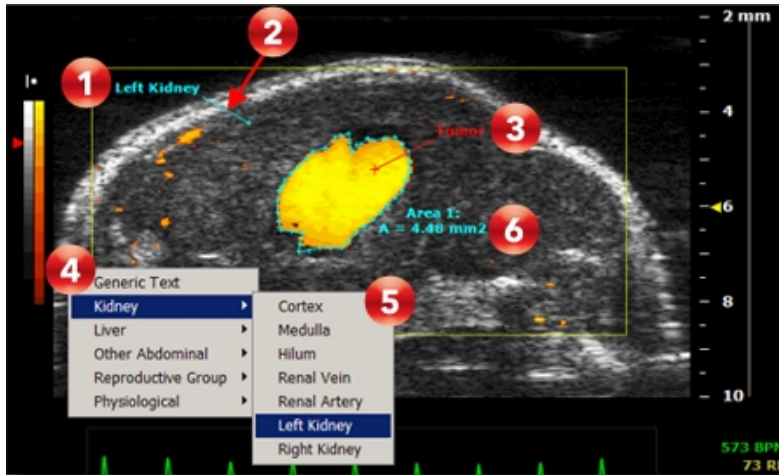
Annotations are text labels that you can add to any ultrasound image.

When you store an annotated frame or cine loop, Vevo LAB stores the annotations along with the image.

This section describes how to work with annotations when you are analyzing an image in the mode window.

### Annotation workspace



The following illustration describes the information and features you use when you add an annotation to the image area.



### Annotation Workspace Descriptions

Area	Description
<b>1</b>	A predefined annotation is a default or custom annotation. To add a predefined annotation right-click on the image, click a package category, then click an annotation.
<b>2</b>	An anchor line appears when you drag the annotation text; it visually links the annotation text to the caliper point on the image where you added the annotation.
<b>3</b>	A generic text annotation that you typed in manually and then modified. To add a generic annotation right-click on the image, click <b>Generic Text</b> and type your custom annotation.  You can also modify the properties of any annotation, see " <a href="#">Modifying annotations</a> " on page 241.
<b>4</b>	A unique list of package categories that are set for the measurement package you select in the drop-down list. To display this list, right-

## Annotation Workspace Descriptions

Area	Description
	click on the image.
	A unique list of predefined annotations that are set for a package category. To display this list, right-click on the image, then select a package category.
	The label for a measurement. Vevo Lab assigns a default numbered label and measurement name. To add a custom label, right-click the measurement, click <b>Edit Label</b> , and type the label name. You can also customize the name in the Measurement Properties box. For more information, see " <a href="#">Modifying annotations</a> " on page 241.

### Predefined annotations

Vevo LAB activates a unique set of predefined annotations when you select a measurement package in the measurement panel. You can add, reorder or delete annotation categories and annotation names, see "[Annotations preferences](#)" on page 115.

This section lists the available default predefined annotations.

#### Abdominal package

##### Abdominal Package Annotations

Category	Annotation text
Generic	Annotation text
Kidney	Cortex

### Abdominal Package Annotations

Category	Annotation text
	Medulla Hilum Renal Vein Renal Artery Left Kidney Right Kidney
Liver	Hepatic Artery Hepatic Vein Portal Vein Lobe Right Lobe Left Lobe Liver
Other Abdominal	Adrenal Gland Intestines Bladder
Reproductive Group	Ovary



### Abdominal Package Annotations

Category	Annotation text
	Uterus Uterine Horn Testicle Seminal Vesicle Prostate
Physiological	Inspiration Expiration Electrical Systole Electrical Diastole Mechanical Systole Mechanical Diastole Max dP/dT

## Cardiac package

Cardiac Package Annotations

Category	Annotation text
Generic Text	Annotation text
Cardiology	Left Ventricle LV PW Right Ventricle RV AW Left Atrium Right Atrium Intra-Ventricular Septum Infarct Respiratory Motion Coronary Artery Aortic Valve Mitral Valve Tricuspid Valve Pulmonary Artery Pulmonary Valve

### Cardiac Package Annotations

Category	Annotation text
	Aorta Pulmonary Vein Superior Vena Cava
Physiological	Inspiration Expiration Electrical Systole Electrical Diastole Mechanical Systole Mechanical Diastole Max dP/dT

### Embryology package

#### Embryology Package Annotations

Category	Annotation text
Generic text	Annotation text
Embryology	Placenta Umbilical Cord Embryo

### Embryology Package Annotations

Category	Annotation text
	Neural Tube Heart Tube Heart Aorta Eye Lens Retina Liver Somite Lungs Lateral Ventricle Third Ventricle Fourth Ventricle
Fetal/Maternal Blood Flow	Umbilical Vein Umbilical Artery Vitelline Artery Vitelline Vein

### Embryology Package Annotations

Category	Annotation text
	Placenta
Reproductive	Ovary Uterus Uterine Horn Testicle Seminal Vesicle Prostate
Physiological	Inspiration Expiration Electrical Systole Electrical Diastole Mechanical Systole Mechanical Diastole Max dP/dT

## Ophthalmology package

Ophthalmology Package Annotations

Category	Annotation text
Generic Text	Annotation text
Ophthalmology	Cornea Iris Lens Sclera Corneo-scleral junction Cataract Normal angle
Physiological	Inspiration Expiration Electrical Systole Electrical Diastole Mechanical Systole Mechanical Diastole Max dP/dT

## Vascular package

Vascular Package Annotations

Category	Annotation text
Generic Text	Annotation text
Vascular Group	Innominate Artery Right Common Carotid Artery Left Common Carotid Artery Left Subclavian Artery Abdominal Aorta Inferior Vena Cava
Physiological	Inspiration Expiration Electrical Systole Electrical Diastole Mechanical Systole Mechanical Diastole Max dP/dT

## Adding annotations

You can add custom annotations in addition to predefined annotations.

### To add a custom annotation

- 1 Right-click on the ultrasound image.
- 2 Click **Generic Text**. Vevo LAB adds an editable text field.



- 3 Type your custom annotation.
- 4 Click anywhere in the application or press **Enter** on your keyboard to save.

### To add a predefined annotation

- 1 Right-click on the ultrasound image.
- 2 Select an annotation category.
- 3 Select an annotation.



## Modifying annotations

### To move an annotation label and line

- 1 Select the middle of the line.
- 2 Click and drag the label and line to the new position.
- 3 Click again to commit the move.

### To move an annotation label

- 1 Click and drag the label to the new position.
- 2 Click again to commit the move.


### To move the origin of the annotation line

- 1 Click and drag the end of the line to the new position.
- 2 Click again to commit the move.

### To delete an annotation

- ◆ Right-click the annotation and click **Delete**.

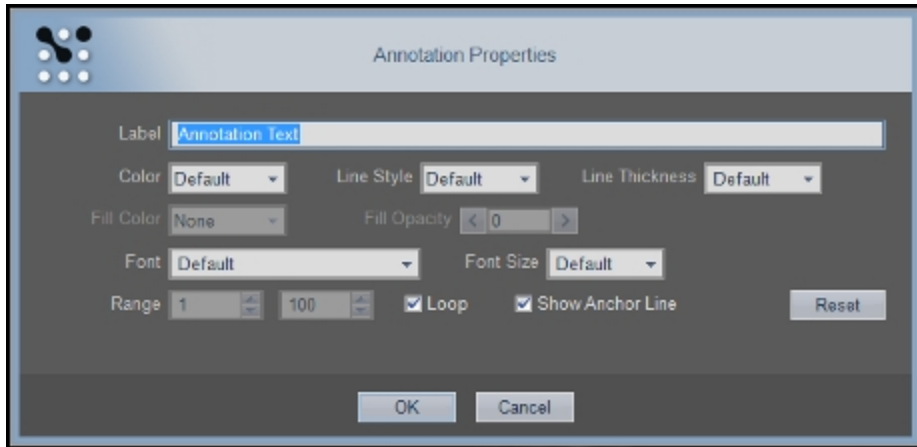
### To show or hide annotations

- 1 From the Study Browser, click the Preferences icon  and then click the **Annotation** tab.

2 In the Annotation Display section, select or deselect the Show Annotations check box.

### To modify the properties of an annotation

1 Right-click the annotation and click **Properties**. The Annotation Properties dialog appears.



2 Modify the properties as described in the following table.

Annotation Properties Descriptions


Property	Description
Label	Annotation text. Type in new text.
Color	In the drop-down box select one of 25 colors.
Line Style	Select from a plain line or three arrow-head lines.

### Annotation Properties Descriptions

Property	Description
	<b>Note:</b> Not available for 3D annotations.
Line Thickness	Modifies the thickness of the anchor line. Select from Thin, Medium, Heavy.
Fill Color	Disabled.  <b>Note:</b> Not available for annotations in 2D or 3D.
Fill Opacity	Disabled.  <b>Note:</b> Not available for annotations in 2D or 3D.
Font	Select from the available fonts.
Font Size	Select a font size between 6-48 points.
Range	Specifies the range of frames in the cine loop that display the annotation. Only available if you deselect the Loop check box.
Loop	Applies the annotation to the entire cine loop or to a specific frame range in the loop.
Show Anchor Line	Select or deselect the check box to show or hide the anchor line between the annotation text and the initial caliper point.
Reset	Click to return all properties to the default values.

3 Click OK.

### To modify the list of predefined annotations

1 From the Study Browser, click the Preferences icon  and then click the **Annotation** tab.

2 Add, reorder or delete package categories and category annotations as detailed in "[Annotations preferences](#)" on page 115.

### Vevo Color area tool

Vevo Color is a tool you can use to:

- Add color to any area of interest on an image frame.
- Add color to any area on any frame in a cine loop so you can track how the area morphs over the period between the frames on the cine loop.

**Note:** The tool does not provide area measurements.

### To add a Vevo Color area to an image

1 Click the Vevo Color tool .

2 (Optional) To change the area color, click the drop-down arrow and select the color you want to apply.

3 Click on the image to place the initial caliper along the boundary of the region you want to define.

4 Click approximately one-third the way around the boundary of the region and then click across to another point on the boundary. At this point, you have created a defined region. Typically, you will continue to click to add a few more points to define the boundary of your region more precisely.

5 To complete the region, right-click your final point. Vevo LAB applies the color area to all frames in the cine loop.

6 (Optional) To move the entire area, place the cursor near the center of the area until the cursor changes to a cross and then drag the area.

7 (Optional) To add a label or modify the area properties, right-click the area, click **Properties** and complete your changes.

### To morph a Vevo Color area over a range of frames

1 Move the cine loop to a frame where you can start a range of frames. Then add your first Vevo Color area.

2 Move the cine loop to an end frame for the range.

3 Move the area or change the boundary points to define the changed area.

4 Repeat the area redefinition procedures on any frame in the cine loop. Vevo LAB will apply the morphing between each of the frames where you have defined the area properties.

To view the area morphing, drag the triangular frame indicator on the cine loop control between any area that you have defined.

## Reporting your analysis results

This section describes how to work with the measurements, calculations and annotations that you add to the image data.

## Creating a Report

A Report is the collection of measurements, calculations and graphs for a collection of series or studies.

You cannot create a Report for an individual cine loop or image frame. If you select an image row in the Study Browser and try to create a report for it, the report built will contain data for the entire series that includes that one image.

Report guidelines:

- You can create a report for studies or individual series.
- You cannot create a report for an individual image.
- When you select a study for a report, it will include all the measurements for all the series in the study.
- When you select multiple studies for a report, it will include all of the measurements from all of the studies you selected.

### To prepare your Report from the Study Browser

1 Select the images, series or studies that contain the measurements you want to include. If you want to report the measurements and calculations for a combination of items, select the rows that contain the items you want to export:

- a. To select one item, click it.
- b. To select a collection of individual items, press and hold **CTRL** on your keyboard and then click to select each item.

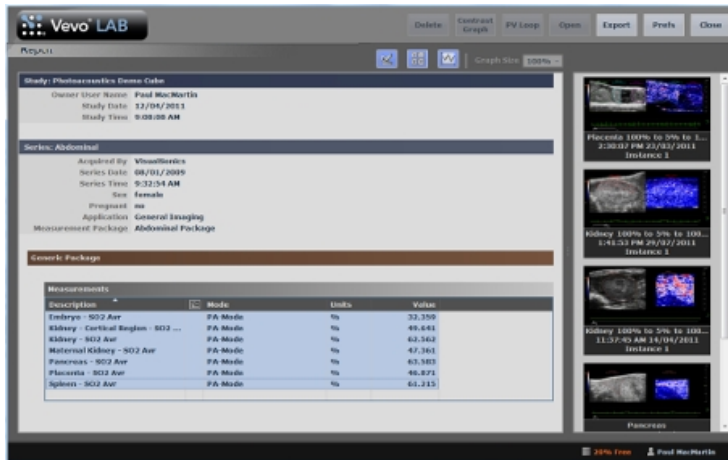
- c. To select a consecutive group of items, click to select the first item, press and hold **SHIFT** on your keyboard and then click to select the last item in the range.

2 Click **Report**. Vevo LAB compiles your selections into a single Report.



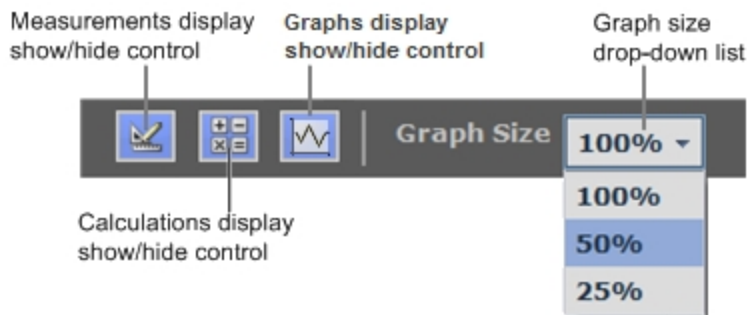
To prepare your Report from the mode window

- ◆ From an open image, click **Report**. A Report is displayed for the series and study that includes the image you are viewing in the mode window.



To configure your Report properties

Use the measurement or calculation display controls to modify your view of the Report.



**Note:** If User Management Mode is enabled, these settings are user specific.

1 Use the Measurements/Calculations/Graphs display controls to show or hide data. Click one or all of the controls.



- Blue icon = displayed/enabled
- Gray icon = not displayed/disabled

**Note:** These controls do not affect the source data if you export it. If you want to apply show/hide for data export, complete this in the Options section when you export the data.

2 Select the output size for the graph in the report (100%, 50%, 25%) from the graph size drop-down list.

## Reviewing the image that contains a Report measurement

To review the image that contains a Report measurement

1 In the Report, select a measurement row. In the right column, Vevo LAB displays the thumbnails for all the images that contains the measurements and highlights the thumbnail for the selected measurement. It also displays thumbnails for each measurement in the series.

2 Click **Open**, double-click the measurement or double-click the thumbnail. Vevo LAB displays the image that contains the selected measurement.

## Exporting a Report

You can export Reports as well as the physiological data for any combination of studies, series and images.

Vevo LAB exports your Report as a CSV file which you can load into third-party tools such as spreadsheet software so you can complete additional statistical analysis.

Vevo LAB allows the export of your Report from the following locations:

- Study Browser
- Report window
- Mode window

## To export a Report from the Study Browser

1 Select the study, series and images you want to include in your Report.

**Note:** All the measurements for the entire series are reported, not just the measurements for the selected images.

- a. If you want to export a single cine loop, expand the study and series that contains the cine loop and select it.
- b. If you want to export multiple cine loops, expand and select the study rows or series rows that contain the cine loops you want to export.
- c. To select one item, click it.
- d. To select a collection of individual items, press and hold **CTRL** on your keyboard and then click to select each item.
- e. To select a consecutive group of items, click to select the first item, press and hold **SHIFT** on your keyboard and then click to select the last item in the range.

2 Click **Export**. The Export Image window appears.

3 Under Export Type, click **Report**. The Export Report window appears.

4 Browse to, and then select, the destination folder that will contain the analysis report.

- 5 (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
- 6 (Optional) In the Options section, rename the report and select whether or not to include measurements and/or calculations.
- 7 Click **OK**.

### To export from the Report

- 1 From the Study Browser, select the studies, series and images you want to include in your Report.
- 2 Click **Report**. The Report appears and displays a preview.
- 3 Click **Export**. The Export Report window appears.
- 4 Browse to, and then select, the folder that will contain the export.
- 5 (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
- 6 (Optional) In the Options section, rename the report and select whether or not to include measurements and/or calculations.
- 7 Click **OK**.

### To export an analysis report from the mode window

- 1 From the mode window, click **Report**. The Report appears and displays a preview.
- 2 Click **Export**. The Export Report window appears.
- 3 Browse to, and then select, the folder that will contain the export.

- 4 (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
- 5 (Optional) In the Options section, rename the report and select whether or not to include measurements and/or calculations.
- 6 Click **OK**.

## Post-capture analysis packages

FUJIFILM VisualSonics offers post-capture analysis packages.

**Note:** Image data acquired on the Vevo 1100 Image System are not supported for any of the analysis packages.

### Vevo CQ

Vevo CQ Analysis is a software application that quantifies perfusion in small-animal models through contrast-enhanced ultrasound imaging. See PN52810 Vevo CQ User Guide.

### Vevo Strain

Vevo Strain Analysis is a software application that assesses 2D myocardial mechanics, heart wall motion abnormalities and heart wall synchronicity. Vevo Strain Analysis is typically used with B-Mode images of the long or short axis of the left ventricle. See PN51064 Vevo Strain User Guide.

**Note:** Only B-Mode and EKV images are available for Vevo Strain processing. (EKV images must be acquired using a Vevo 3100 at V2.1.x or later or using a Vevo 2100 at V2.1.x or later. EKV images must also be acquired at 700 Hz).

## Vevo Vasc

Vevo Vasc Analysis is a software application for tracking motion, and analyzing motion of blood vessel walls. Vevo Vasc Analysis may be used with either longitudinal or transverse B-Mode and EKV images of vessels. See PN50699 Vevo Vasc User Guide.

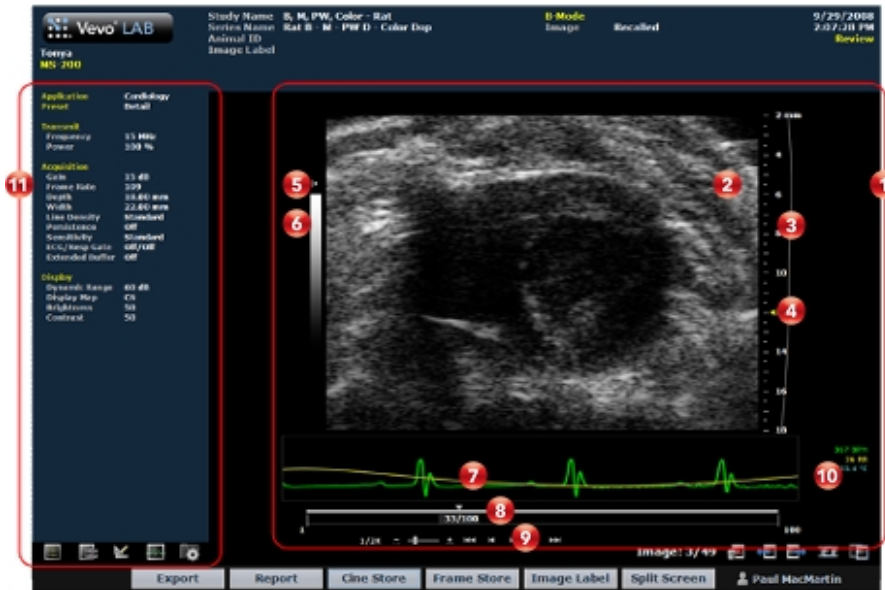
## B-Mode Analysis

B-Mode is the imaging mode you will work with most often because it is the most effective mode for locating anatomical structures. If you have seen a conventional ultrasound image then you are already familiar with B-Mode.

Many other Vevo imaging modes use B-Mode as the background orientation image over which the active mode data is applied.

### B-Mode window workspace

The B-Mode window is the workspace you use when you work with B-Mode image data. The following illustration identifies the key features.



## 1 B-Mode image area

- Displays image data.
- Displays physiological data for the animal (if recorded during image acquisition).
- Provides cine loop range controls for acquired cine loops.
- Provides Browse Images controls for scrolling through an inset gallery of images without having to return to the Study Browser.

If you export an image and select Image as your export type, Vevo LAB includes the image area content along with header information.

## 2 Image data panel

The image data that the transducer acquires. This is where you do the majority of work with images such as reviewing, adding measurements and annotations, post-processing and more.

## 3 Image scale


Indicates the distance from the transducer face to the tissue being imaged at the moment of acquisition. The image scale units are displayed in mm.

## 4 Focus depth indicator

Indicates the distance from the transducer face where Vevo LAB maximizes image resolutions. The triangular arrow indicates the focal zone depth of the transducer.

## 5 Transducer orientation indicator

The orientation icon indicates the orientation of the transducer during acquisition in relation to the image.

For Vevo 3100 and Vevo LAZR-X image data, you can change the orientation in Vevo LAB via the Image Processing panel , under the Display Settings section in the Orientation drop down menu. Choose between Upper Left, Upper Right, Lower Left, and Lower Right.

## 6 Display map scale

Indicates the dynamic range of the display. The contrast of the image is measured in dB and is adjusted at time of acquisition.

## 7 Physiological data trace panel

Displays the animal's recorded dynamic heart rate, temperature, respiration rate and blood pressure data during acquisition.

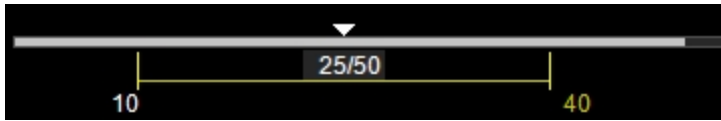
## 8 Cine loop control

Displays the length of the cine loop. The triangular white marker identifies the individual frame number within the cine loop.



To create a range within the loop, drag the left and right vertical markers.





## 9 Playback control

You can select the playback speed (via slider or - / + controls) and what image frame is being displayed in the mode window.







## 10 Physiological data values

Displays the recorded numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature.

## 11 Image mode management panel


Displays a unique set of controls and information depending on the image management panel tab you click:

- Click the Mode Settings tab icon  to open the Mode Settings panel and display a read-only list of Mode Settings for the image. This is the default panel when you open a mode window.
- Click the Image Processing tab icon  to open the Image Processing panel and to display the following:
  - Any available mode-specific image controls you can apply to the image.

- Read-only image control settings that were applied during acquisition.
- Click the Measurements tab icon  to open the Measurements panel and display the available measurement tools.
- Click the Physiological tab icon  to open the Physiological panel and display the following, (if physiological data was recorded during acquisition):
  - The Physiological Display options that you can apply to the image.
  - Physiological Display settings and Respiration Gating settings that were recorded during acquisition.


**Note:** This panel is always available and editable.

You can clear the View Physiology check box to hide the data from the image. Hiding the data will increase the size of the image.

- Click the Preferences tab icon  to open the Preferences window. This window provides a series of tabs you can use to customize the way you work with a range of Vevo LAB features, see "[Preferences](#)" on page 93.

## B-Mode settings

To view the B-Mode settings

- ◆ Open a B-Mode image and click the Mode Settings tab icon . The Mode Settings panel displays the following list of parameters:

### Transmit

Parameter	Description
Frequency	The ultrasound frequency used during acquisition, measured in MHz.
Power	The transmission power level of the ultrasound signal during acquisition, displayed as a percentage of the maximum power.

### Acquisition

Parameter	Description
Gain	The strength of the ultrasound signal during acquisition, specified in dB increments.
Frame Rate	The number of image frames per second recorded during acquisition.
Extended Buffer	The state of the option to increase the size of the cine buffer or cine loop during acquisition—On or Off.  <b>Note:</b> Extended Buffer is only available for Vevo 3100 systems with software V2.0.0 or earlier.

### Acquisition

Parameter	Description
Depth	The distance, measured in mm, from the face of the transducer during acquisition.
Width	The width of the acquired image area during acquisition, measured in mm.
Line Density	The line density level during acquisition—Quarter, Third, Half or Full.
Persistence	The state of the Persistence feature during acquisition—Standard or High.
Sensitivity	The level of detail at deeper distances from the transducer head during acquisition.
ECG/Resp Gate	The state of the ECG trigger and Respiration Gating during acquisition—On or Off.

### Display

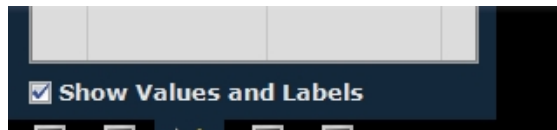
Parameter	Description
Dynamic Range	The contrast of the image during acquisition, measured in dB.
Display Map	The selected predefined display map applied during acquisition from the predefined set of maps.
Brightness	The image brightness level during acquisition.
Contrast	The image contrast level during acquisition.

## Adding generic B-Mode measurements


B-Mode provides a range of generic measurement tools you can use to add measurements that are not part of a measurement protocol.

### Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want to hide the measurement values and labels, clear the Show Values and Labels check box in the Measurement tab in Preferences under a custom measurement package.
- If you want to temporarily override the default, check/uncheck the Show Values and Labels check box at the bottom of the measurement panel.



To access the generic measurement tools for B-Mode

- ◆ Open an image and then click Measurements . Vevo LAB displays the measurement tools at the top of the Measurements panel. Hover over a tool to see the description label.

### Generic B-Mode measurements


All generic measurements are described in "[Generic Measurements](#)" on page 465. The following generic measurements are available for B-Mode images:

- ["2D Area measurement"](#) on page 467
- ["Angle measurement"](#) on page 471
- ["Ellipse measurement"](#) on page 495
- ["Linear measurement"](#) on page 498
- ["LV Area Long Axis measurement"](#) on page 498
- ["LV Area Short Axis measurement"](#) on page 502
- ["Time measurement for physiological display"](#) on page 512
- ["Traced Distance measurement"](#) on page 515
- ["Vevo Color tool"](#) on page 516

## Adding protocol measurements

Protocol measurements are labeled uniquely for a specific measurement protocol.

### To place the protocol measurement

- 1 Open an image and click Measurements .
- 2 In the measurement packages drop-down list, click the appropriate package.
- 3 In the list of protocols, select the appropriate protocol.
- 4 In the list of measurements, select the measurement you want to add.


5 On the image, add your measurement. If you selected the Show Values and Labels option in the measurement panel in the mode window, the measurement value and an editable label for the measurement appear.

**Note:** This option is on by default for all default measurements

## Adding a Lens Radius measurement

The Lens Radius measurement is only available in the Ophthalmology measurement package for B-Mode images. Lens Radius is measured in mm.

### To place a Lens Radius measurement

- 1 Open an existing eye image and click Measurements .
- 2 In the drop-down list of measurement packages click **Ophthalmology**.
- 3 In the list of measurements click **Lens Radius**.
- 4 Click on your image to place the initial caliper at one end of the radius.
- 5 Move the cursor along the contour of the lens to the center of your radius and then click to place your second (center) caliper.
- 6 Move the cursor to a point at the end of the radius and click to place the final caliper. Vevo LAB transforms the angle rays to a curve. When you complete the measurement, Vevo LAB stores it.
- 7 If you need to move an entire measurement, click on the measurement line, then drag and drop it into position.

## Creating Pressure-Volume loop measurements in B-Mode

Pressure-Volume (PV) loop measurements provide a graphical method of identifying and evaluating LV Pressure-Volume relationship changes related to dynamic levels of cardiac stress.

You can generate PV loops from LV area measurements on B-Mode or M-Mode images that include continuous blood pressure trace data. These traces have typically been acquired from a blood pressure catheter during image acquisition.

Within a study, you can also display PV loops from different cine loops from different series.

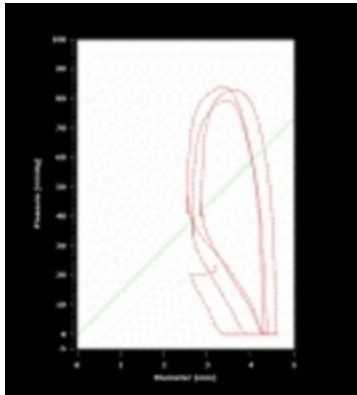
### To obtain PV loops from a B-Mode image

- 1 Open a B-Mode image and complete an LV Area measurement that includes at least two cardiac cycles.
- 2 Right-click the measurement and click **PV Curve**.

**Note:** The PV Curve menu command is not available if the image does not include blood pressure data.

- 3 Vevo LAB calculates the Pressure-Volume of the cardiac cycles and plots them as a graph on the Pressure-Volume Relationship window.





To save a TIFF image of the PV Relationship graph to a report

- ◆ Click **Save** when viewing the graph in the Pressure-Volume Relationship window.

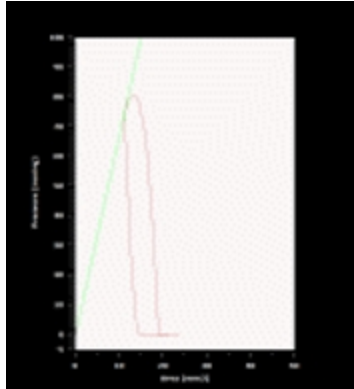
## Pressure-Volume Relationship graphs

After you have generated pressure volume graph data, you can use the tools on the Pressure Volume Relationship window to:

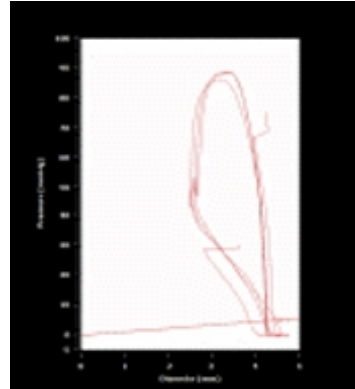
- Display the ESPVR (End Systolic Pressure Volume Relationship).
- Display the EDPVR (End Diastolic Pressure Volume Relationship).
- Display a loop that represents a virtual or averaged cardiac cycle.
- Toggle the horizontal dimension between Volume and the basic dimension of the loops.
- Export the Pressure-Volume Relationship data.

## ESPVR check box

Check this box to display the End Systolic Pressure-Volume Relationship.



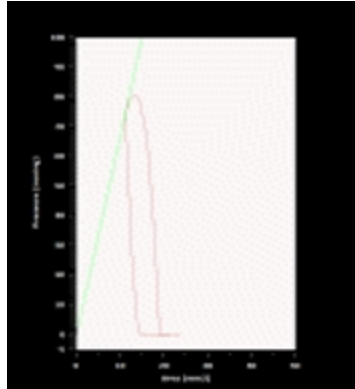
*If the graph displays one measurement over one cycle, a green dot is placed on the curve at the end systolic point.*



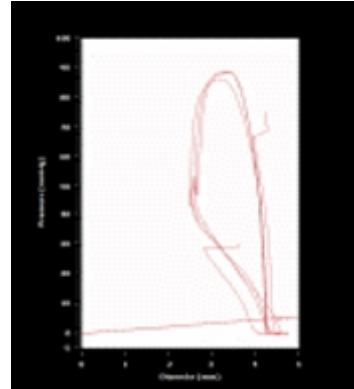
*If the graph displays one measurement over multiple cycles, a best-fit line is placed through the end systolic points.*

## EDPVR check box

Check this box to display the End Diastolic Pressure-Volume Relationship.



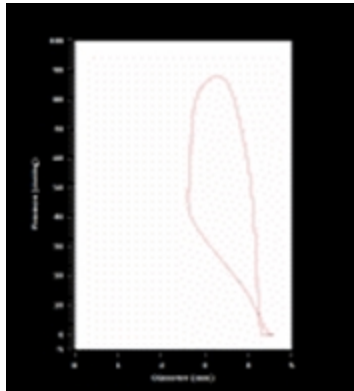
*If the graph displays one measurement over one cycle, a red dot is placed on the curve at the end diastolic point.*



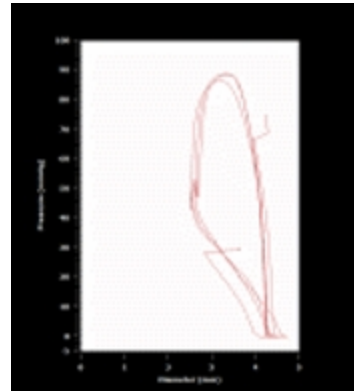
*If the graph displays one measurement over multiple cycles, a best-fit line is placed through the end diastolic points.*

## Average check box

Check this box to display a loop that represents a virtual or averaged cardiac cycle, calculated from the aggregate cycles defined by each LV wall trace. Clear the check box to display all cardiac cycle instances. This check box is selected by default.



*When the Average option is selected, the graph displays a single smooth loop derived from the data from all measurements over all cardiac cycles.*



*When the Average option is cleared, the graph displays the loops derived from each measurement over all the cardiac cycles.*

## Volume command

Click this command to toggle the horizontal dimension between Volume and the basic dimension of the loops. For measurements made in M-Mode, the dimension is Diameter in millimeters. For measurements made in B-Mode, the dimension is Area in square millimeters.

## Export command

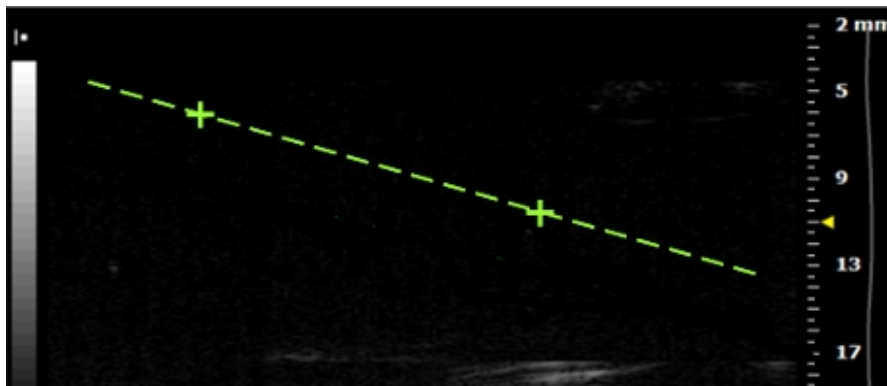
Click this command to export the data in one of three file formats:

- CSV - can be imported into a spreadsheet or database.
- BMP - exports the graph data as a bitmap image.
- TIFF - exports the graph data as a vector based image.

## Needle Guide overlay

During an acquisition, when a user needs to inject a needle to a specific region, the user can apply the green Needle Guide overlay feature to help visualize the alignment of the needle with the injection target.

If the user saves an image that includes the Needle Guide overlay, the green overlay is permanently included. You will be able to see the Needle Guide in Vevo LAB, but you will not be able to edit it.



# PA-Mode Analysis

PA-Mode (Photoacoustic Mode) is a method for obtaining optical contrast from biological tissues and detecting it with ultrasound. A PA-Mode image is acquired by illuminating tissue with pulsed laser light; thermoelastic expansion occurs and this expansion creates an ultrasound wave which can be detected with an ultrasound transducer.

## PA-Mode window workspace

The PA-Mode window is the workspace you use when you work with PA-Mode image data. The following illustration identifies the key features.



## 1 PA-Mode image area

- Displays image data.
- Displays physiological data for the animal (if recorded during image acquisition).
- Provides cine loop range controls for acquired cine loops.
- Provides Browse Images controls for scrolling through an inset gallery of images without having to return to the Study Browser.

If you export an image and select Image as your export type, Vevo LAB includes the image area content along with header information.


## 2 Image scale

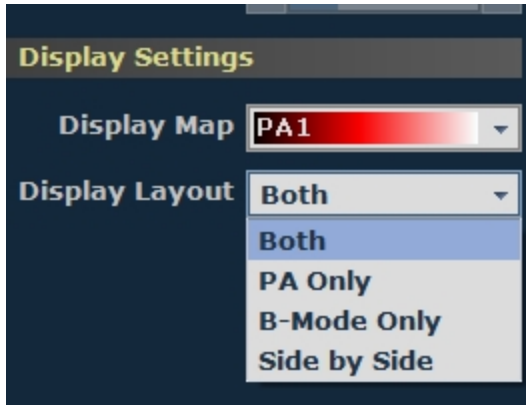
Indicates the distance from the transducer face to the tissue being imaged at the moment of acquisition. The image scale units are displayed in mm.

## 3 Focus depth indicator

The triangular arrow indicates the focal depth of the transducer.

## 4 PA-Mode (Photoacoustic) image data

Displays the image that was generated from ultrasound signals received from the laser light that excited the tissue of interest. The Side by Side view with the PA data beside the B-Mode data is the default layout. To select another layout, click the Image Processing tab  and then select an option in the Display Layout list.



**5** B-Mode image data

Displays the B-Mode data that was acquired by the transducer.

**6** Display map scale and photoacoustic scale

The right column of the scale is the photoacoustic scale. The left column of the scale is the display map for the acquired B-Mode background image.

**7** Ultrasound signal intensity histogram

Displays the intensity of the acquired signal along the vertical line extending down from the red cross-section indicator above the B-Mode image. This histogram is only displayed if RF data was applied during acquisition.

**8** Physiological data values

Displays the recorded numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature.



## 9 Physiological data trace panel

Displays the animal's recorded dynamic heart rate, temperature, respiration rate and blood pressure data during acquisition.

## 10 Cine loop controls

Displays the length of the cine loop. The triangular white marker identifies the individual frame number within the cine loop.



To create a range within the loop, drag the left and right vertical markers.







## 11 Playback control

You can select the playback speed (via slider or - / + controls) and what image frame is being displayed in the mode window.




## 12 Image mode management panel


Displays a unique set of controls and information depending on the image management panel tab you click:

- Click the Mode Settings tab icon  to open the Mode Settings panel and display a read-only list of Mode Settings for the image. This is the default panel when you open a mode window.
- Click the Image Processing tab icon  to open the Image Processing panel and to display the following:
  - Any available mode-specific image controls you can apply to the image.
  - Read-only image control settings that were applied during acquisition.
- Click the Measurements tab icon  to open the Measurements panel and display the available measurement tools.
- Click the Physiological tab icon  to open the Physiological panel and display the following, (if physiological data was recorded during acquisition):
  - The Physiological Display options that you can apply to the image.
  - Physiological Display settings and Respiration Gating settings that were recorded during acquisition.

**Note:** This panel is always available and editable.


You can clear the View Physiology check box to hide the data from the image. Hiding the data will increase the size of the image.

- Click the Preferences tab icon  to open the Preferences window. This window provides a series of tabs you can use to customize the way you work with a range of Vevo LAB features, see "[Preferences](#)" on page 93.

- Click the Multiplexer Control tab icon  to open the Multiplexer panel and display tools you can use to assign color and other visual properties to each wavelength image series in your acquisition so you can view layers as individual or combined views of the data. Only available when you are reviewing a PA-Mode (Multi-wavelength/NanoStepper), PA-Mode (Spectro) or PA-Mode (Unmixing) image. See "[Multiplexer Control](#)" on page 283.

## PA-Mode settings

To view the PA-Mode settings

- ◆ Open a PA-Mode image and click the Mode Settings tab icon . The Mode Settings panel displays the following list of parameters:

### Transmit

Parameter	Description
Frequency	The ultrasound frequency during acquisition, measured in MHz.
2D Power	The transmission power level of the ultrasound signal during acquisition in B-Mode, displayed as a percentage of the maximum power.
PA Power	PA Power is not adjustable during acquisition. The power level is always 100%.

### Acquisition

Parameter	Description
Wavelength Range	If you are using the Vevo LAZR-X Imaging System, this parameter displays which wavelength range the image was acquired with—either the Signal port 680-970 nm or the Idler port 1200-2000 nm.
PA Gain	The strength of the photoacoustic signal, in dB increments, when it returns to the face of the transducer during acquisition.
2D Gain	The strength of the ultrasound signal, in dB increments, when it returns to the face of the transducer during acquisition.
Frame Rate	The number of image frames per second recorded during acquisition. Only available in PA-Mode Single sub-mode.
Depth	The distance, measured in mm, from the face of the transducer during acquisition.
Width	The width of the acquired image area during acquisition, measured in mm.
Sensitivity	The PA-Mode image quality setting applied during acquisition—High or Low.
Resp Gate	The state of Respiration Gating during acquisition—High or Low.
Extended Buffer	The state of the option to increase the size of the cine buffer or cine loop during acquisition—High or Low.

### Acquisition

Parameter	Description
Persistence	The state of the Persistence feature during acquisition—Off, Low, Med, High or Max.
PA Acquisition	The PA-Mode acquisition sub-mode during acquisition or process—Single, Multi-wavelength/NanoStepper, Oxy-Hemo (sO <sub>2</sub> /HbT) , Spectro or Unmixing.  <b>Note:</b> PA-Mode (NanoStepper) images are acquired on the Vevo LAZR Imaging System, while similar images acquired on the Vevo LAZR-X Imaging System are labeled PA-Mode (Multi-wavelength/NanoStepper).
Wavelength	The photoacoustic laser output wavelength during acquisition, measured in nm.
Components	Lists the components used for spectral unmixing of an image. For PA-Mode (Unmixing) images only.
Correct Energy	The state of the Correct Energy option during acquisition—On or Off.

### Display

Parameter	Description
Display Type	Displays either OxyZated (helps to calculate and quantify oxygen saturation) or HemoMeaZure (helps to measure and quantify hemoglobin content). For PA-Mode (Oxy-Hemo) images only.

Parameter	Description
Display Map	The selected predefined display map, applied during acquisition, from the predefined set of maps.
Priority	<p>Displays the amount of transparency of the PA-Mode data displayed when PA-Mode data overlaps with B-Mode data.</p> <ul style="list-style-type: none"> <li>• 0 = Fully transparent</li> <li>• 100 = Fully opaque</li> </ul> <p><b>Note:</b> Priority does not apply when viewing an image that is Multiplexed (ie. Multi-wavelength/NanoStepper, Spectro).</p>
Threshold HbT	Applies only to PA-Mode (Oxy-Hemo) when the OxyZated display type is selected. Sets the point at which the image data appears during acquisition.
Brightness	The image brightness level of the B-Mode image during acquisition.
Contrast	The image contrast level of the B-Mode image during acquisition.
PA Brightness	<p>The image brightness level of the photoacoustics signal during acquisition.</p> <p><b>Note:</b> Not available for a PA-Mode (Oxy-Hemo) image.</p>
PA Contrast	The image contrast level of the photoacoustics signal

Parameter	Description
	<p>during acquisition.</p> <p><b>Note:</b> Not available for a PA-Mode (Oxy-Hemo) image.</p>

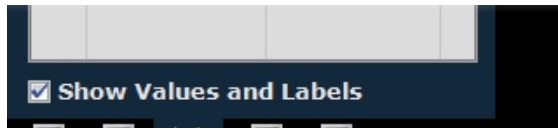
## Adding generic PA-Mode measurements

PA-Mode provides a range of generic measurement tools you can use to add measurements that are not part of a measurement protocol.


**Note:** PA-Mode does not support protocol measurements.

## Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want to hide the measurement values and labels, clear the Show Values and Labels check box in the Measurement tab in Preferences under a custom measurement package.
- If you want to temporarily override the default, check/uncheck the Show Values and Labels check box at the bottom of the measurement panel.



## To access the generic measurement tools for PA-Mode

◆ Open an image and then click Measurements . Vevo LAB displays the measurement tools at the top of the Measurements panel. Hover over a tool to see the description label.

## Generic PA-Mode measurements

All generic measurements are described in "[Generic Measurements](#)" on page 465. The following generic measurements are available for PA-Mode images:

- "[2D Area measurement](#)" on page 467
- "[Angle measurement](#)" on page 471
- "[Ellipse measurement](#)" on page 495
- "[Linear measurement](#)" on page 498
- "[PA 3D Region measurement](#)" on page 505
- "[PA Region measurement](#)" on page 507
- "[Time measurement for physiological display](#)" on page 512
- "[Traced Distance measurement](#)" on page 515
- "[Vevo Color tool](#)" on page 516

## Measuring blood oxygenation

When you are analyzing an Oxy-Hemo sub-mode image, you can select specific regions of interest and precisely measure the percentage level of






blood oxygenation in that region.

Vevo LAB provides two measuring tools to measure Oxy-Hemo images. Choose the appropriate display before making measurements:

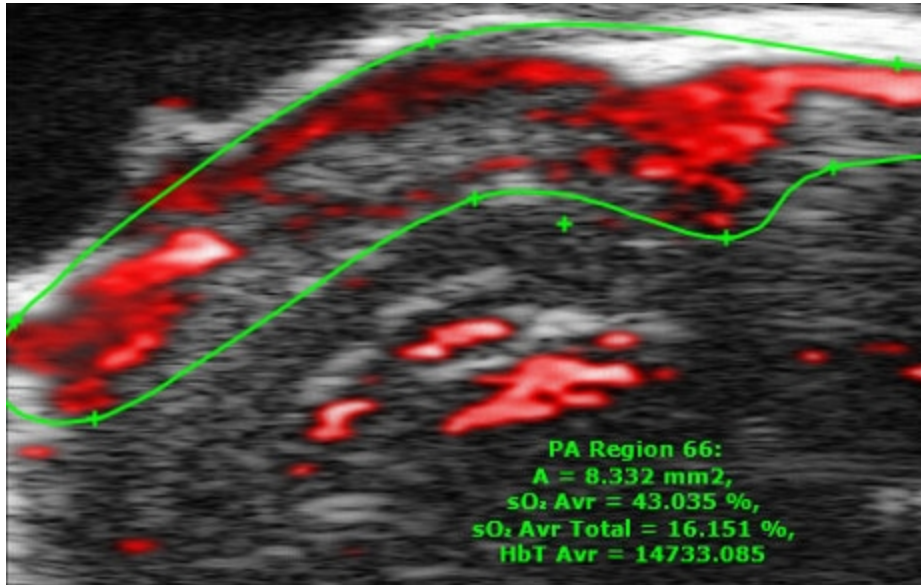
- a. The OxyZated tool calculates and quantifies oxygen saturation. This tool is particularly useful for studying the hypoxic state of tumor microenvironment to predict disease burden, studying fetal/maternal physiology, and studying stroke/ischemia.
- b. The HemoMeaZure tool measures and quantifies hemoglobin content. This tool is particularly useful for studying anemia.

### To complete an oxygenation measurement

- 1 Load an Oxy-Hemo image into review.
- 2 Go to the Image Processing panel .
- 3 Select a Display Map.
- 4 Select a Display Layout—Both, PA Only, B-Mode Only or Side by Side.
- 5 Select your Display Type—OxyZated or HemoMeaZure.
- 6 Click Measurements , then PA Region measurement .
- 7 Left-click on the image to place the initial caliper on the boundary of the region you want to define.
- 8 Click approximately one-third of the way around the boundary of the region and then click across to another point on the boundary. You have now

created a defined region. Typically, you will continue to click to add more points to define the boundary of your region more precisely.

9 To complete the region, right-click your final point. The completed Oxy-Hemo measurement appears.



To export a PA Region measurement

- 1 Right-click the measurement and click **Export Region Values**.
- 2 In the Export PA Region window, browse to the folder where you want to export the data.
- 3 (Optional) Create a new folder by clicking **New Folder**, typing a name and then click **OK**.

4 (Optional) In the Options section, type a name of the region other than the default name given by Vevo LAB software.

5 Click **OK**. The region measurement values are exported. The values displayed in the exported Report correspond to the measurements on the frame as saved in the thumbnail image.

## Multiplexer Control

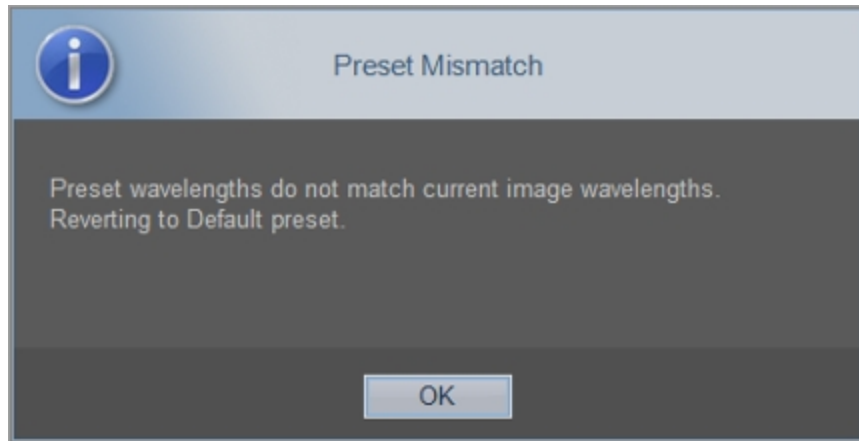
Use the Multiplex control to combine groups/sets of wavelengths or components into a single frame. The wavelengths or components can be displayed on the frame in different layers. Up to five layers can be added and each layer can be customized (display map, brightness, contrast, opacity, threshold)—for instance, a 20 frame PA-Mode (Multi-wavelength/NanoStepper) image acquired with 5 frames with each frame showing the data of all 5 wavelengths.

Available for PA-Mode (Multi-wavelength/NanoStepper), PA-Mode (Spectro) and PA-Mode (Unmixing) images.

Use the Multiplexer Control to:


- Add up to 5 layers to your image that you can view enable/disable.
- Apply unique colors to each layer so you can identify layers easily.
- Display or hide wavelengths as layers.
- Save a custom preset.

**Note:** If you load a preset with wavelengths that do not match the wavelengths in the current image, a **Preset Mismatch** dialog will appear.



To apply a valid preset, click **OK**, create a new preset with the appropriate wavelengths for the image you want to work with, then apply that preset.

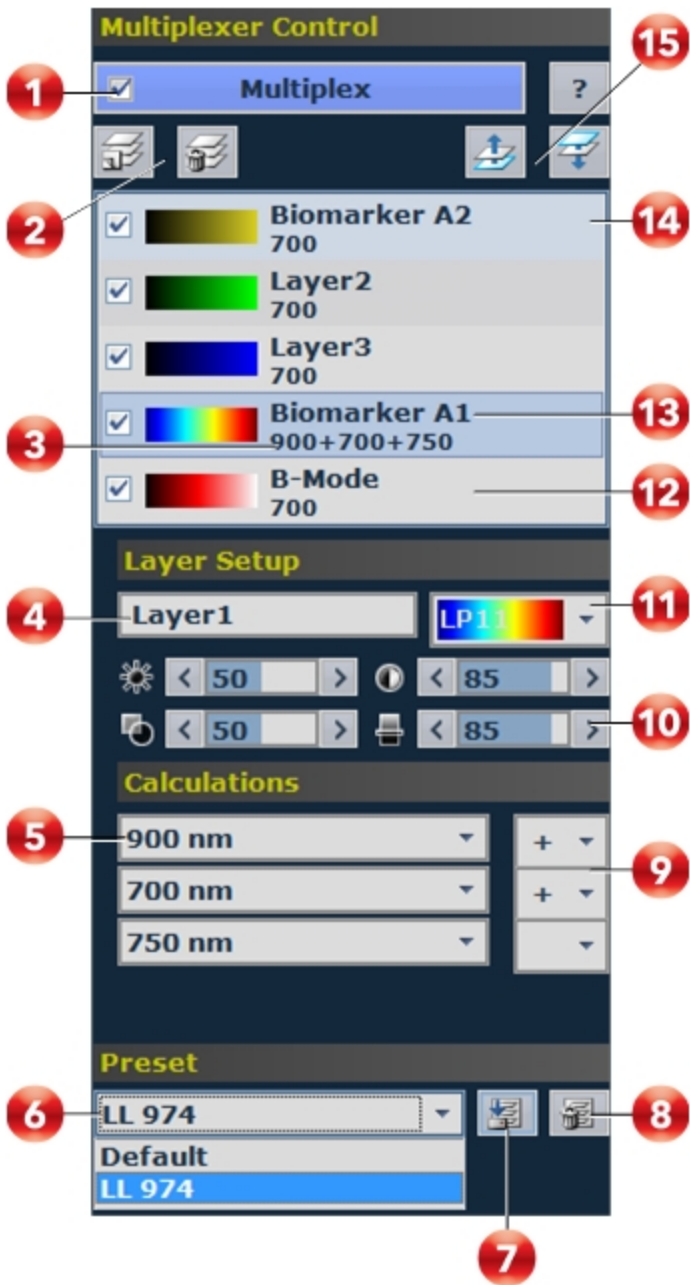
### To apply the Multiplexer Control to a PA-Mode image

- 1 Open a PA-Mode (Multi-wavelength/NanoStepper), PA-Mode (Spectro) or PA-Mode (Unmixing) image and go to the Multiplexer Control panel .
- 2 Click the Multiplex checkbox.





- 3 The image area refreshes and displays the default layer data in red for wavelength 1.
- 4 Configure different layers of the image data using the tools in the Multiplexer Control panel to see the layers in the mode window.

The following diagram describes how to use the Multiplexer Control panel:



## Multiplexer Control Descriptions

<p><b>1</b></p>	<p>To apply the Multiplexer Control settings to a PA-Mode image, click the Multiplex check box.</p>
<p><b>2</b></p>	<p>To add a layer to the top of the layers list, click the Add Layer icon  . A maximum of five layers can be added.</p> <p>To delete a layer, click the layer and then click the Delete Layer icon  .</p> <p><b>Note:</b> The B-Mode layer cannot be deleted.</p>
<p><b>3</b></p>	<p>Underneath the layer label are the actual layer nm calculation created in the Calculations section.</p>
<p><b>4</b></p>	<p>To change the layer name, select the layer then type the new name in this text box.</p>
<p><b>5</b></p>	<p>To change the primary wavelength of a layer, click the wavelength in the drop-down list.</p>
<p><b>6</b></p>	<p>Select a preset from the list to apply all the configurations saved for that preset. The default preset includes a layer that displays only the B-Mode data, and a layer that displays the image data from the first wavelength.</p>
<p><b>7</b></p>	<p>To create a multiplex preset, click <b>Save</b> and type the name.</p> <p>To update a preset, select the preset, make your changes, click <b>Save</b>, then select the preset in the drop-down list.</p>
<p><b>8</b></p>	<p>To delete a preset, select it in the drop-down list, then click <b>Delete</b>.</p>

## Multiplexer Control Descriptions

<b>9</b>	To add or subtract wavelengths to a layer, click the add or subtract operator, then click a wavelength from the wavelength list. Maximum operations per layer is five.
<b>10</b>	To change a layer's brightness, contrast, opacity or threshold values, drag the slider or click the + or - controls.
<b>11</b>	To change a layer's overlay color, click a color in the drop-down list.
<b>12</b>	The B-Mode layer cannot be deleted, moved, recalculated or re-colored.
<b>13</b>	The name of the layer.
<b>14</b>	To configure a layer, click the layer, then use the controls in the Layer Setup section and Calculations section.  To hide a layer, clear the check box.
<b>15</b>	To move layers up and down, click a layer and then click the up or down control to move it.  <b>Note:</b> The B-Mode layer cannot be deleted.


## Measuring region changes in a PA-Mode loop

Use the PA Region Graph to measure and graph the changes in PA-Mode data across wavelengths or frames in a defined region. Define the region of interest, then generate a graph that measures the energy changes that appear in that region over your PA-Mode cine loop.

Quantification is available for the average threshold signal power of each PA Region measurement. Displayed by the label 'PA Thresh', quantification values represent the average maximum intensity and applies only to the frame on which it appears (expect this value to change from frame to frame within a cine loop). This quantification is available for PA-Mode (Single), PA-Mode (Multi-wavelength/NanoStepper), PA-Mode 3D (Multi-wavelength/NanoStepper), and PA-Mode (Spectro).

Quantification is also available for the average signal power and the average threshold signal power for Multiplexed PA Region measurements. Displayed by the label 'Avr' and 'Thresh' preceded by the Layer name, quantification values calculate the average based on calculations described on the multiplexer panel. This quantification is available for PA-Mode (Multi-wavelength/NanoStepper), PA-Mode 3D (Multi-wavelength/NanoStepper) and PA-Mode (Spectro).

### To measure region changes in a PA-Mode (Multi-wavelength/NanoStepper) loop

1 Open a PA-Mode (Multi-wavelength/NanoStepper) image and on the Measurements panel, click the PA Region measurement tool . Place your measurement, as described in "[PA Region measurement](#)" on page 507.

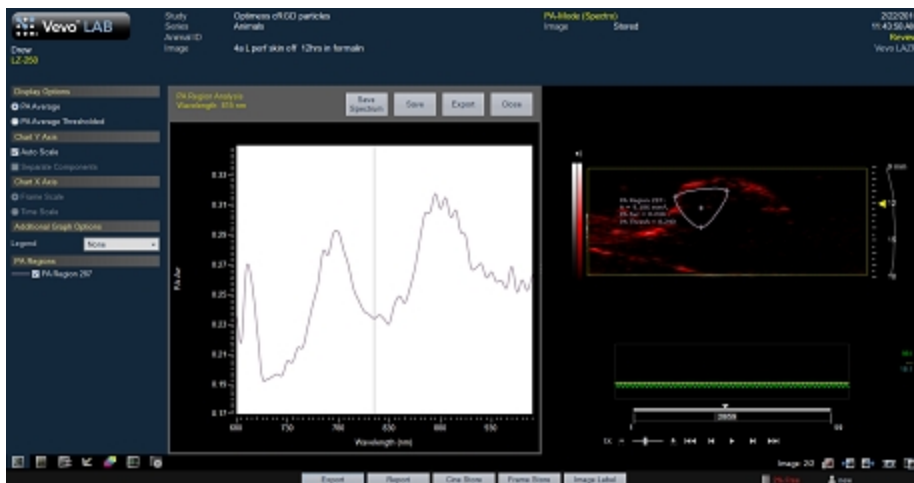
2 Choose to enable or disable Multiplex by checking or unchecking the Multiplex option on the Multiplexer Control panel.

If you choose to Multiplex your image, you will see additional measurement information for the PA Region measurement for each layer added on the Multiplex Control panel. A PA Average (Calculation) and PA Average Threshold (Calculation) will now be displayed for each layer that you add.

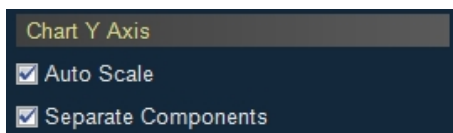
3 On the PA-Mode image, right-click the contour or the image label and click **PA Region Graph**.



4 Vevo LAB calculates the PA signal within the boundaries of the region curve and displays the data in the PA Region Analysis window.



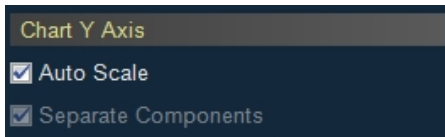
5 If you chose not to Multiplex your image, a Separate Components option is available in the PA Region Analysis window under the Chart Y Axis section. Check the Separate Components checkbox to allow separation of the curve based on wavelength.



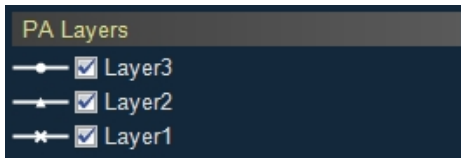
Once the Separate Components option is checked, all of the wavelengths used to acquire the image are displayed. Uncheck the wavelengths that you do not want displayed on your graph.



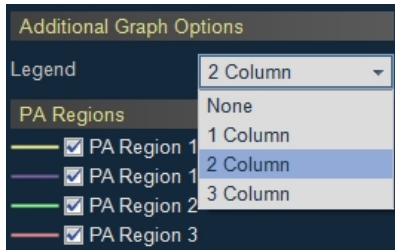
If you chose to Multiplex your image, the layers will automatically be separated and the Separate Components checkbox will be disabled. Select what layers to be displayed by checking or unchecking the layers listed in the PA Layers section of the PA Region Analysis window. Toggle to display the additional measurement options, PA Average (Calculation) and PA Average Threshold (Calculation), from the Display Options section.



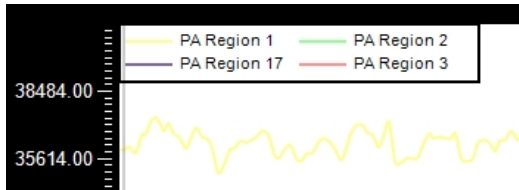
When an image is Multiplexed, the Separate Components is enabled automatically. The PA Layers list is populated with the layers you created in the Multiplex Control panel. Uncheck the layers that you do not want displayed on your graph.



6 (Optional) Display a legend with the names of the region measurements. Under the Additional Graph Options section, choose the column width for the legend from the Legend drop down menu.




Hover over the legend until the hand cursor appears. Left-click and drag to move the legend anywhere on the image. You can also resize the legend by hovering over a corner until the double arrow cursor appears, then left-click and drag to resize.

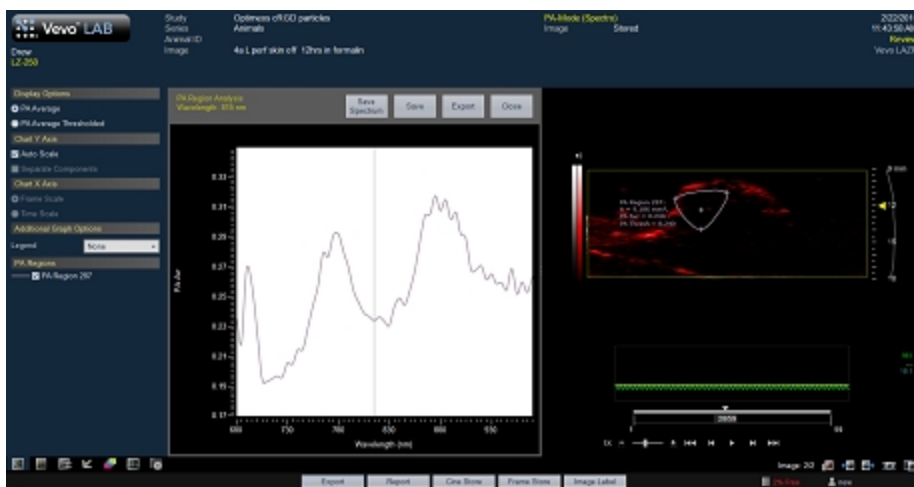


*2 Column Legend for four PA Regions, displayed in a PA Region Analysis graph*

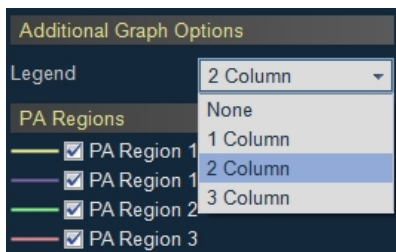
To measure signal changes in a PA-Mode (Spectro) loop

**Note:** You viewing a PA-Mode (Spectro) image, you must have Multiplex unchecked (disabled) in order to see the PA Region Graph Option.

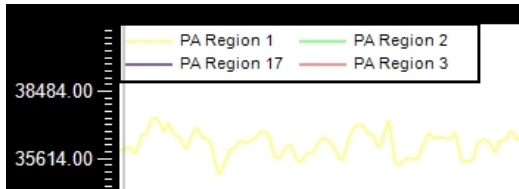
- 1 Open a PA-Mode (Multi-wavelength/NanoStepper) image and on the Measurements panel, click the PA Region measurement tool . Place your measurement, as described in "PA Region measurement" on page 507.
- 2 On the PA-Mode image, right-click the contour or the image label and click PA Region Graph.
- 3 Vevo LAB calculates the PA signal within the boundaries of the region curve and displays the data in the PA Region Analysis window.



- 4 (Optional) Display a legend with the names of the region measurements. Under the Additional Graph Options section, choose the column width for the legend from the Legend drop down menu.

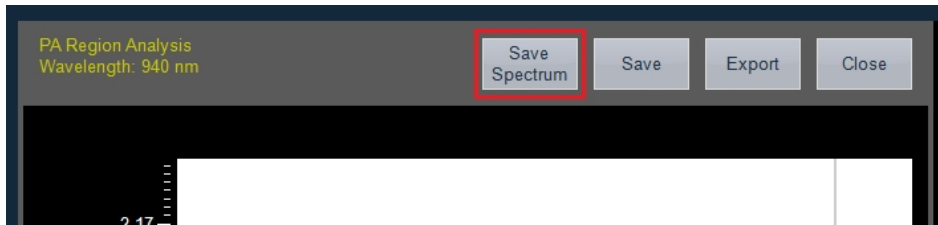


Hover over the legend until the hand cursor appears. Left-click and drag to move the legend anywhere on the image. You can also resize the legend by hovering over a corner until the double arrow cursor appears, then left-click and drag to resize.

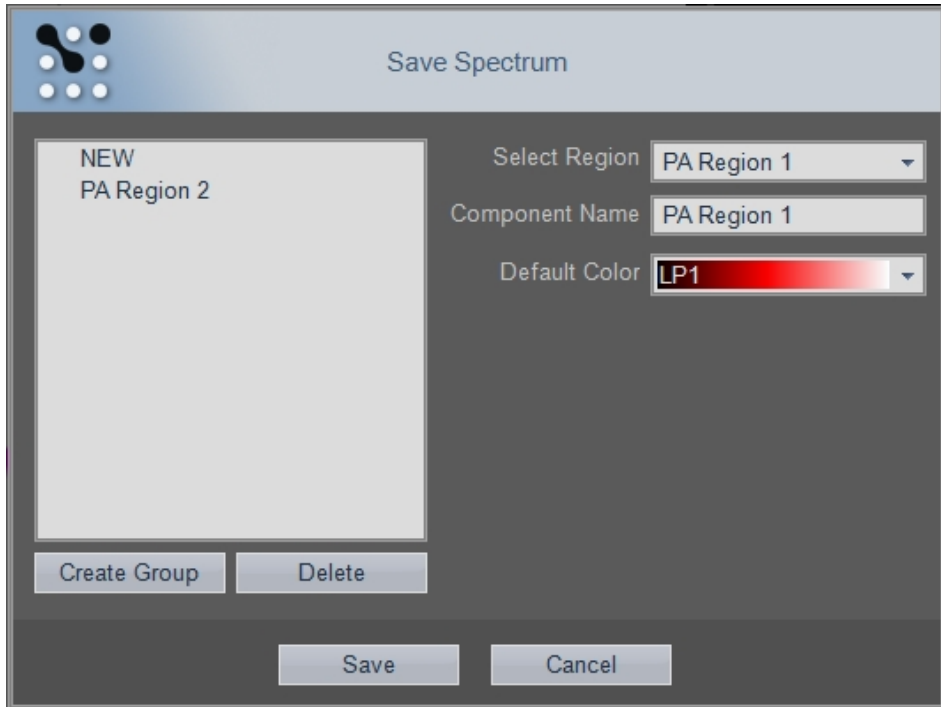


*2 Column Legend for four PA Regions, displayed in a PA Region Analysis graph*

5 If the PA-Mode (Spectro) image you are reviewing has had the full wavelength spectrum, you will also have a Save Spectrum button available.



Tap **Save Spectrum**, the Save Spectrum panel will be displayed.



Within the Save Spectrum panel, you can perform the following:

- Create and delete groups. See ["To create a group"](#) on page 118. To delete, highlight a group or component from the list on the left and then click **Delete**.
- Select a region. All PA Region measurements on the image are listed in the drop down list. Once selected, you can change the name and color for that region.
- Change a component name. Highlight a component from the list on the left and then type in a new name in the Component Name text box.
- Change a component color. Select a color for the component from the drop down menu.

- Save the spectrum. When you tap **Save**, the spectrum is saved to the PA Spectral Unmixing panel in Preferences. See "[PA Spectral Unmixing](#)" on page 117 for more details.

### To save a TIFF image of the chart to a report

- ◆ Click **Save**.

### To export the PA Region Analysis

- 1 Click **Export** from the top of the analysis graph. The Export Graph window appears.
- 2 In the folder browser, browse to the location where you want to export the data and select the folder.
- 3 (Optional) Create a new folder by clicking **New Folder**, typing a name and then clicking **OK**.
- 4 In the Export Type section, click **Graph**.
- 5 In the Options section, select the file type(s) you want to export (CSV, BMP, TIFF).
- 6 (Optional) Rename the graph by typing a new name in Save As box.
- 7 Click **OK**. Vevo LAB exports the graph.

## Vevo Spectral Unmixing

Use Vevo Spectral Unmixing to separate wavelengths or components. The number of components that can be used to unmix is either the number of wavelengths that were used during acquisition or 15 components, whichever is smaller.


Before using Vevo Spectral Unmixing, please keep the following in mind:

- Unmixing is not an acquisition sub-mode.
- When a PA-Mode (Spectro) or PA-Mode (Multi-wavelength/NanoStepper) image has manual unmixing applied, the software will automatically save the original data and a new PA-Mode (Unmixing) image.

### To unmix PA-Mode data

1 Load a PA-Mode (Spectro) or PA-Mode (Multi-wavelength/NanoStepper) image.

**Note:** If using a PA-Mode (Spectro) image, the full wavelength spectrum (680-970 nm or 1200-2000 nm) must be acquired in order to use the Vevo Spectral Unmixing process.

- 2 Click  to open the Spectral Unmixing Control tab.
- 3 Under the Wavelength Select section, select the Mode—Auto or Custom.
- a. Auto will automatically select all the wavelengths that were used during acquisition.



- b. Custom will allow you to select which wavelengths to unmix via an Available drop down menu—the wavelengths listed are those that were used during acquisition.

**4** Under the Wavelength Selection section, select the Wavelength Count. The count available matches the number of wavelengths used during acquisition. The wavelength count represents the wavelengths in sequential order.

**5** Select components from the Compounds list on the left to include when processing unmixing.

**6** (Optional) Save a new preset, load an existing preset and/or delete a custom preset.

- a. Save a new preset. Click **Save Preset** and enter a name in the Save Preset text box. Click **OK** when you are done.
- b. Load a preset. To load an existing preset, click the Presets drop down menu and select a preset.
- c. Delete Preset. Select a preset from the Preset drop down menu, then click **Delete Presets** to delete the preset.

**7** Click **Process**. A processing message will be displayed on the bottom left of the image display.

The original PA-Mode image will be saved and a new PA-Mode (Unmixing) image will be generated. The generated unmixed data will be loaded into the mode window with the Multiplexer control panel displayed.

## M-Mode Analysis

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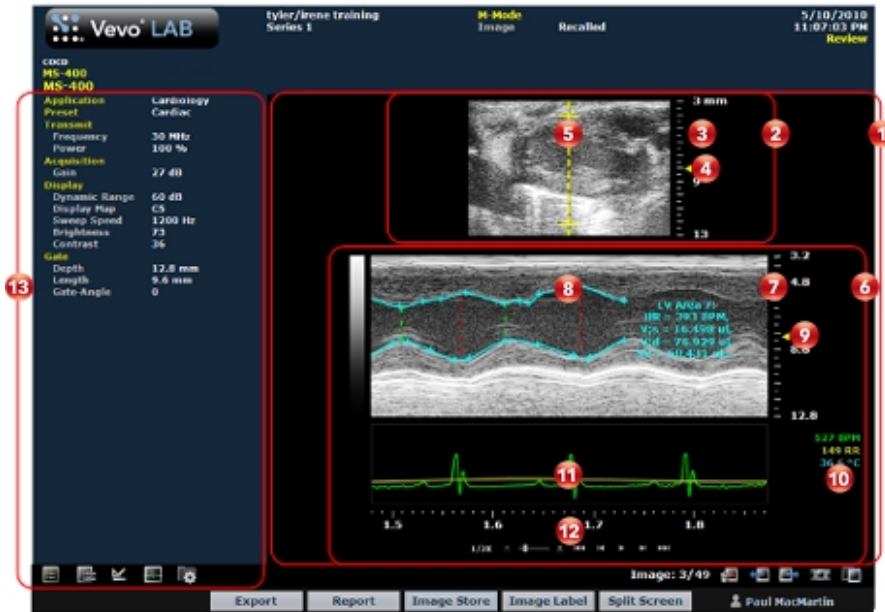
M-Mode is used primarily to measure the movement and dimensions of cardiac structures such as chambers and walls.

M-Mode works in a fundamentally different way than B-Mode. Where B-Mode is a frame-based image that uses multiple scanning beams to create its image, M-Mode is a time-based image that is created by the movement of the heart structure as it moves up and down one single beam line. The movements are the wave-like image cycles that are visible in the M-Mode image.

After an image is saved, open the image and take measurements along the single beam line.

### M-Mode window workspace

The M-Mode window is the workspace you use when you work with M-Mode image data. The following illustration identifies the key features.



## 1 M-Mode image area

- Displays image data.
- Displays physiological data for the animal (if recorded during image acquisition).
- Provides cine loop range controls for acquired cine loops.
- Provides Browse Images controls for scrolling through an inset gallery of images without having to return to the Study Browser.

If you export an image and select Image as your export type, Vevo LAB includes the image area content along with header information.

## B-Mode scout window

Shows you precisely where the region of interest is. The region of interest is located between the yellow wireframe brackets.

You can change the size of the scout window relative to the spectrum data. Choose your setting from the Display Layout drop down menu in the Display Settings section of the Image Processing panel. Select between Full Trace, 2/3 Trace, 1/2 Trace and 1/3 Trace.

For images acquired on a Vevo 3100 Imaging System, you will also be able to change the horizontal orientation of the scout window. Choose your setting from the Orientation drop down menu in the Display settings section of the Image Processing panel. Select between Upper Left, Upper Right, Lower Left and Lower Right.

## Image scale

Indicates the distance from the transducer face to the tissue being imaged at the moment of acquisition. The image scale units are displayed in mm.

## Focus depth indicator

The triangular arrow indicates the focal depth of the transducer.

## Sample gate overlay

The sample gate overlay is the vertical line between the brackets in the small B-Mode scout window that relates to the content in the M-Mode region of interest window. The image data that the transducer acquires along this line is presented in the region of interest window.

Unlike M-Mode, where the gate overlay angle is always 0°, in AM-Mode, the sample gate overlay angle can be set from -89° to 90° in 1 degree steps.

### M-Mode image data

Displays the data acquired along the sample gate line in the B-Mode scout window. When you review an image, this is the workspace where you use the image measurement tools to apply measurements.

### Image scale

Indicates in mm the distance from the face of the transducer at that moment of acquisition.

### Region of interest image window

Displays the sample volume image data that is defined in the B-Mode scout window above. The most current data begins at the right side of the window. The trailing data in the cine loop acquisition buffer extends to the left.

### Focus depth scale

Indicates the distance from the transducer face where Vevo LAB maximizes image resolutions. The triangular arrow indicates the focal length(s) of the transducer.



### Physiological data values

Displays the recorded numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature.

## 11 Physiological data trace panel

Displays the animal's recorded dynamic heart rate, temperature, respiration rate and blood pressure data during acquisition.

## 12 Playback control



You can select playback speed (via slider or increase  /decrease  controls) and what data is displayed in the region of interest window.





**Note:** When playback is paused, you will be able to scroll through the image using your mouse wheel.

## 13 Image mode management panel


Displays a unique set of controls and information depending on the image management panel tab you click:

- Click the Mode Settings tab icon  to open the Mode Settings panel and display a read-only list of Mode Settings for the image. This is the default panel when you open a mode window.
- Click the Image Processing tab icon  to open the Image Processing panel and to display the following:
  - Any available mode-specific image controls you can apply to the image.

- Read-only image control settings that were applied during acquisition.
- Click the Measurements tab icon  to open the Measurements panel and display the available measurement tools.
- Click the Physiological tab icon  to open the Physiological panel and display the following, (if physiological data was recorded during acquisition):
  - The Physiological Display options that you can apply to the image.
  - Physiological Display settings and Respiration Gating settings that were recorded during acquisition.


**Note:** This panel is always available and editable.

You can clear the View Physiology check box to hide the data from the image. Hiding the data will increase the size of the image.

- Click the Preferences tab icon  to open the Preferences window. This window provides a series of tabs you can use to customize the way you work with a range of Vevo LAB features, see "[Preferences](#)" on page 93.

## M-Mode settings

To view the M-Mode settings

- ◆ Open an M-Mode image and click the Mode Settings tab icon . The Mode Settings panel displays the following list of parameters:

### Transmit

Parameter	Description
Frequency	The ultrasound frequency during acquisition, measured in MHz.
Power	The transmission power level of the ultrasound signal during acquisition, displayed as a percentage of the maximum power.

### Acquisition

Parameter	Description
Gain	The strength of the ultrasound signal during acquisition, specified in dB increments.

### Display

Parameter	Description
Dynamic Range	The contrast of the image, measured in dB.
Display Map	The selected predefined display map, applied during acquisition, from the predefined set of maps.
Sweep Speed	Adjustable cine loop playback speed, measured in Hz.
Brightness	The image brightness level during acquisition.
Contrast	The image contrast level during acquisition.



## Gate

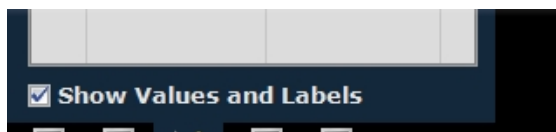
Parameter	Description
Depth	The distance, in mm, from the face of the transducer during acquisition. Displayed in M-Mode only.
Size	The length, measured in mm, of the gate during acquisition. Displayed in M-Mode and AM-Mode.
Angle	Number of degrees away from 0° (the current position of the transducer) that the cross-section data through the B-Mode image was acquired. Displayed in AM-Mode only.

## Adding generic M-Mode measurements


M-Mode provides a range of generic measurement tools you can use to add measurements that are not part of a measurement protocol.

### Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want to hide the measurement values and labels, clear the Show Values and Labels check box in the Measurement tab in Preferences under a custom measurement package.
- If you want to temporarily override the default, check/uncheck the Show Values and Labels check box at the bottom of the measurement panel.



## To access the generic measurement tools for M-Mode

◆ Open an image and then click Measurements . Vevo LAB displays the measurement tools at the top of the Measurements panel. Hover over a tool to see the description label.

## Generic M-Mode measurements

All generic measurements are described in "[Generic Measurements](#)" on page 465. The following generic measurements are available for M-Mode images:

- "[Depth measurement](#)" on page 494
- "[Heart Rate measurement](#)" on page 496
- "[M-Mode LV Wall measurements](#)" on page 503
- "[Time measurement for M-Mode images](#)" on page 513
- "[Time measurement for physiological display](#)" on page 512
- "[Velocity measurement](#)" on page 515

## Adding protocol measurements

Protocol measurements are labeled uniquely for a specific measurement protocol.

## To place the protocol measurement

1 Open an image and click Measurements .

- 2 In the measurement packages drop-down list, click the appropriate package.
- 3 In the list of protocols, select the appropriate protocol.
- 4 In the list of measurements, select the measurement you want to add.
- 5 On the image, add your measurement. If you selected the Show Values and Labels option in the measurement panel in the mode window, the measurement value and an editable label for the measurement appear.

**Note:** This option is on by default for all default measurements

## Adding M-Mode measurement chains

In M-Mode, the most precise way to create diastole and systole measurement sets is to stack your measurements.

To automate this procedure, Vevo LAB automatically links the following measurements into chained sequences. For example, if you select the Cardiac Package and then select the SAX (short axis) protocol, you can create the following diastole and systole measurement chains:

### Diastole measurement chains

- IVS → LVID → LVPW
- LVAW → LVID → LVPW

## Systole measurement chains

- IVS → LVID → LVPW
- LVAW → LVID → LVPW

### To add a complete chained measurement

- 1 In the protocol measurements list, click the first measurement in the chain.
- 2 Click the top point of the first measurement of the chain and move the cursor toward the bottom point. An image label is applied to the measurement and displays the measurement value dynamically as the cursor is moved toward the bottom point.
- 3 Click the bottom point of the first measurement. The measurement value for the first measurement is committed. This bottom point of the first measurement automatically becomes the top point of the second measurement in the chain.
- 4 Click the bottom point of the second measurement. The measurement value is committed and a label is applied to the second measurement.
- 5 Click the remaining bottom points of the next measurements in the chain. The measurement values are committed and labels applied to them until the final measurement is completed.

### To add individual measurements from a chain

- 1 In the protocol measurements list, click any one of the measurements in the chain.
- 2 Begin placing points along the measurement.

3 Before you complete the measurement, press **ESC** on your keyboard to cancel the chain but keep the measurements that have been placed thus far.

### To delete individual measurements from a chain

- 1 Select an individual measurement within a chain on the image.
- 2 Right-click. A menu will be displayed.
- 3 Click **Delete**.
- 4 (Optional) Select an individual measurement within a chain on the Measured Values list and then press **Delete** on your keyboard.

### To see the label for any measurement

Complete one of the following:

- Complete the remaining measurements in the chain.
- Complete another measurement.
- Return to the Study Browser and open the image.

**Note:** These procedures also apply to AM-Mode images.

## Creating Pressure-Volume loop measurements in M-Mode

Pressure-Volume (PV) loop measurements provide a graphical method of identifying and evaluating LV Pressure-Volume relationship changes related to dynamic levels of cardiac stress.

You can generate PV loops from LV area measurements on B-Mode or M-Mode images that include continuous blood pressure trace data. These traces have typically been acquired from a blood pressure catheter during image acquisition.

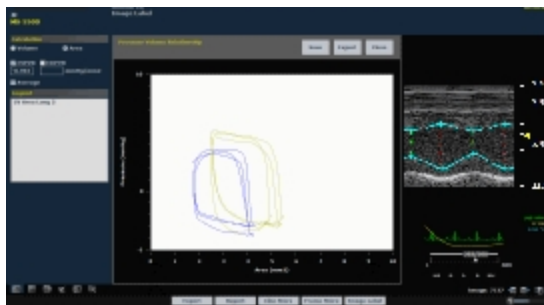
Within a study, you can also display PV loops from different cine loops from different series.

### To obtain PV loops from an M-Mode image

- 1 From the Study Browser, open an M-Mode cine loop of the heart in a long-axis orientation.
- 2 Complete an M-Mode LV wall trace measurement that includes at least two cardiac cycles. See "[M-Mode LV Wall measurements](#)" on page 503.
- 3 Right-click the measurement and click **PV Curve**.

**Note:** The PV Curve menu command is not available if the image does not include blood pressure data.

- 4 Vevo LAB calculates the Pressure-Volume of the cardiac cycles and plots them as a graph on the Pressure-Volume Relationship window.



To save a TIFF image of the PV Relationship graph to a report

- ◆ Click **Save** when viewing the graph in the Pressure-Volume Relationship window.

## Pressure Volume Relationship graphs

See "[Pressure-Volume Relationship graphs](#)" on page 265 for more details.

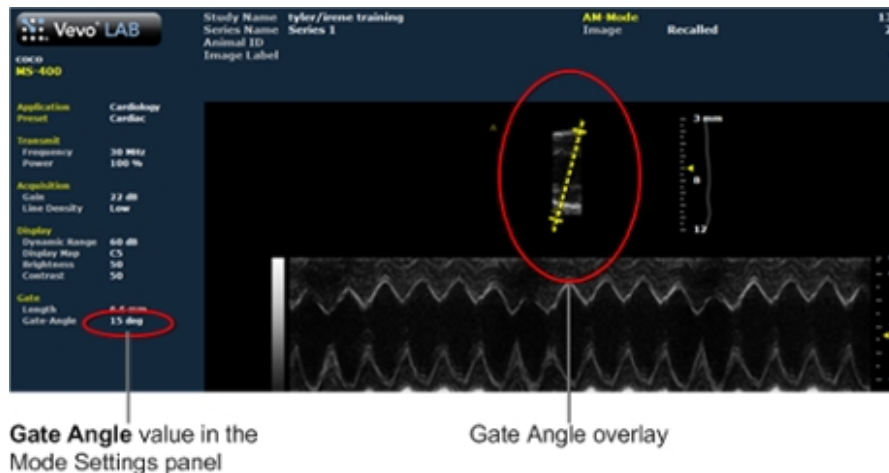
## Anatomical M-Mode Analysis

AM-Mode (Anatomical M-Mode), is a modification to standard M-Mode typically used in echocardiography in order to steer the sample volume to any angle during acquisition, rather than positioning the sample volume in a strict vertical position.

### AM-Mode image analysis

AM-Mode images have all the tools, measurements, display and export functionality that are already available in M-Mode. See "[M-Mode Analysis](#)" on page 298.

In AM-Mode, the angle is displayed differently than in M-Mode. The sample gate overlay angle is displayed, and the actual gate angle value is displayed in the parameters.



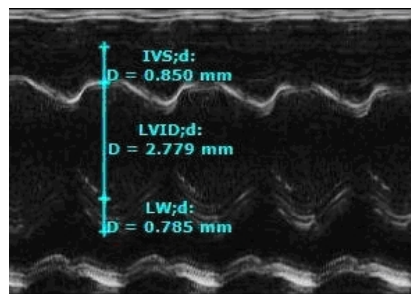
Measurements specific to this mode are available for the short axis view as this is the imaging view that benefits most from this tool.



When reviewing an AM-Mode cine loop for the short axis view, the protocols available in the Cardiac Measurement Package and available tools are:

- LV Mass protocol - Has LV trace measurements identical to M-Mode functionality.
- Anatomical M-Mode protocol - Which contains the following list of measurements:
  - IVS (for systole and diastole)
  - LVID (for systole and diastole)
  - Lateral Wall (for systole and diastole)

The measurements listed are depth measurements and chained such that by selecting one of them the user is pointed to the following measurement in order to avoid errors in tracing the sequence. Tracing the chained measurements is similar to the SAX protocol from M-Mode, described in "[Protocol measurements](#)" on page 215.



*AM-Mode chained measurements  
traced at the diastole: IVS;d, LVID;d,  
LW;d.*

## Reconstructing AM-Mode images from B-Mode or EKV Mode

AM-Mode cine loops can be reconstructed from B-Mode or EKV Mode cine loops.

AM-Mode reconstruction is not available in the following acquisition scenarios:

- For B-Mode cine loops acquired using ECG or Respiration Gating.
- For B-Mode cine loops acquired with less than 50 frames.
- For B-Mode cine loops acquired with a Frame Rate of less than 20 fps.
- For B-Mode cine loop acquired with Zoom on.
- From 3D-Mode (B-Mode 3D) or RF B-Mode 3D cine loops.

### To reconstruct an AM-Mode image from B-Mode or EKV Mode

1 From the Study Browser, open a B-Mode cine loop or an EKV Mode cine loop.

2 Click the Image Processing tab .

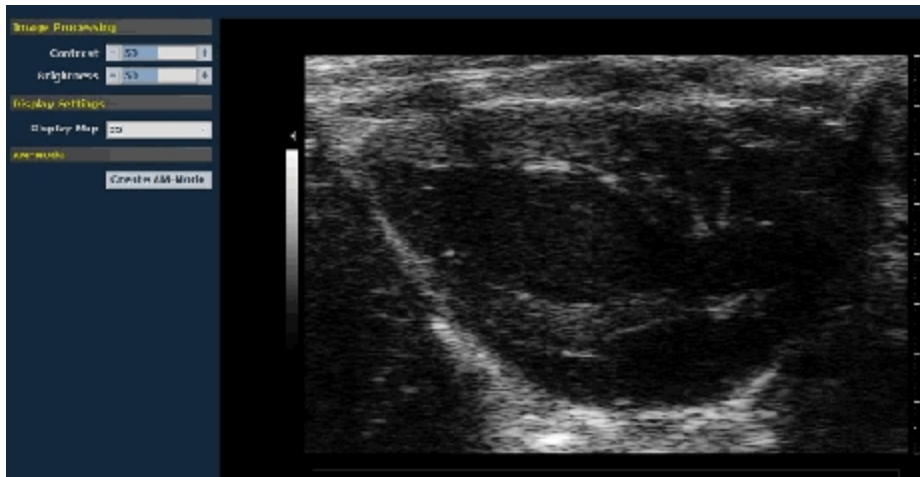
3 In the AM-Mode section, click **Create AM-Mode**. The screen switches to the AM-Mode image area with the status of the image labeled as Regenerated.

4 In the AM-Mode image area you can change the orientation, depth and position of the sample volume at their discretion in order to reconstruct the desired motion profile. These changes are reflected on the AM-Mode image scale.

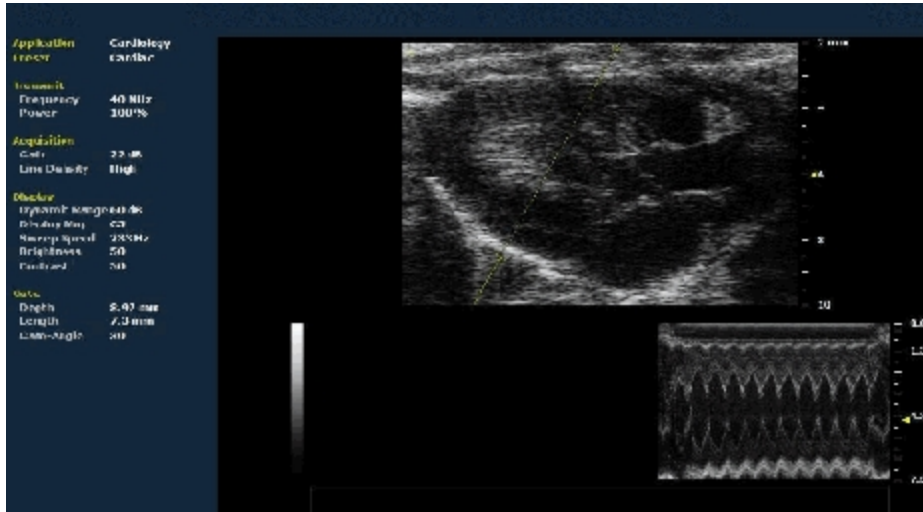
**Note:** If you change the AM-Mode angle in a recreated image, Vevo LAB deletes all the measurements. If you make a new measurement, Vevo LAB resaves the image.

5 If you are satisfied with the cine loop or an individual image frame, store your image data.

- a. To save a cine loop click **Cine Store**.
- b. To save and label a cine loop, click **Image Label**.



*B-Mode image with the Image Processing panel displayed. Click **Create AM-Mode** to reconstruct the AM-Mode from this B-Mode cine loop.*



*AM-Mode reconstructed image from a 300 frame B-Mode cine loop. The Size, Angle and position of the AM-Mode sample volume can be changed as required for the desired motion profile.*

## PW Doppler Mode and PW Tissue Doppler Mode Analysis

---

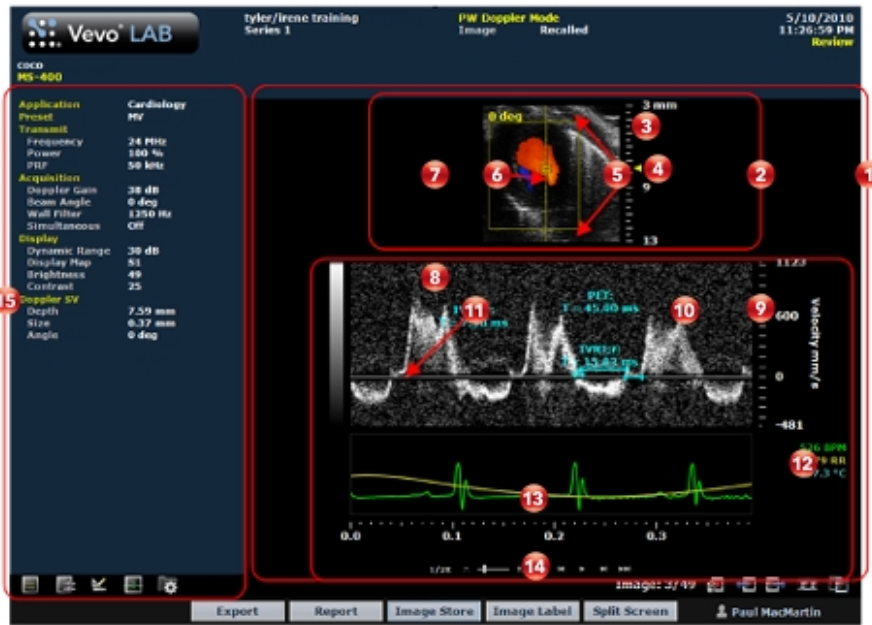
PW Doppler Mode (Pulsed Wave Doppler) is an ultrasound mode that is used to measure the velocity and direction of flow. Vevo LAB presents the detected PW Doppler signal as both a spectral image in the display window as well as an audio output through your computer's speakers.

PW Tissue Doppler mode images provide all the measurement and analysis tools that are provided in PW Doppler mode analysis.

**Note:** Wall Filter is the only tool that is not available in PW Tissue Doppler Mode.

### PW Doppler Mode window workspace

The PW Doppler Mode window is the workspace you use when you work with PW Doppler Mode image data. The following illustration identifies the key features.



## 1 PW Doppler Mode image area

- Displays image data.
- Displays physiological data for the animal (if recorded during image acquisition).
- Provides cine loop range controls for acquired cine loops.
- Provides Browse Images controls for scrolling through an inset gallery of images without having to return to the Study Browser.

If you export an image and select Image as your export type, Vevo LAB includes the image area content along with header information.

## B-Mode scout window

Shows you precisely where the region of interest is. The region of interest is located between the yellow wireframe brackets.

You can change the size of the scout window relative to the spectrum data. Choose your setting from the Display Layout drop down menu in the Display Settings section of the Image Processing panel. Select between Full Trace, 2/3 Trace, 1/2 Trace and 1/3 Trace.

For images acquired on a Vevo 3100 Imaging System, you will also be able to change the horizontal orientation of the scout window. Choose your setting from the Orientation drop down menu in the Display settings section of the Image Processing panel. Select between Upper Left, Upper Right, Lower Left and Lower Right.

## Image scale

Indicates the distance from the transducer face to the tissue being imaged at the moment of acquisition. The image scale units are displayed in mm.

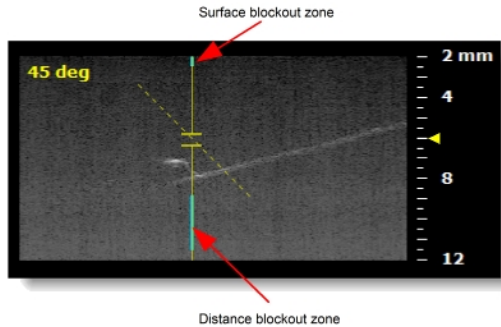
## Focus depth indicator

The triangular arrow indicates the focal depth of the transducer.

## Blockout zones

In PW Doppler Mode, Vevo LAB processes reliable ultrasound signals it receives from just beyond the face of the transducer and extending until the distance is too far to produce reliable data.

The surface blockout zone is the very small distance just beyond the transducer face. The distance blockout zone is the region beyond the sample zone where, during acquisition, the signal data was not sufficiently processed.



If you set the sample volume in a blockout zone the acquisition system moves it out of the blockout zone and positions it as close as possible to your target location.

## 6 Sample volume

This region of interest is the image data that the transducer acquires along the vertical line between the yellow wireframe brackets in the B-Mode image.

## 7 Scout window B-Mode sample gate

Displays a smaller scale version of the complete B-Mode image, along with the yellow wireframe brackets.

## 8 PW Doppler Mode data

Displays the spectral display of the Velocity/Frequency data.



## **9** Scale indicator

Indicates the velocity of blood flow. You can set it to Velocity or Frequency in the General tab of the Preferences window.

Invert the scale displayed by using the Invert checkbox under Display Settings in the Image Processing panel.

## **10** Region of interest image window

Displays the sample volume image data that is defined in the B-Mode scout window above. The most current data begins at the right side of the window. The trailing data in the cine loop acquisition buffer extends to the left.

## **11** Baseline

The horizontal zero line that divides the spectral display into positive velocities (flow moving toward the transducer) and negative velocities (flow moving away from the transducer).



## **12** Physiological data values

Displays the recorded numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature.

## **13** Physiological data trace panel

Displays the animal's recorded dynamic heart rate, temperature, respiration rate and blood pressure data during acquisition.

## **14** Playback control




You can select playback speed (via slider or increase  /decrease  controls), volume levels, and what data is being displayed in the region of interest window.




**Note:** When playback is paused, you will be able to scroll through the image using your mouse wheel.

## Image mode management panel


Displays a unique set of controls and information depending on the image management panel tab you click:

- Click the Mode Settings tab icon  to open the Mode Settings panel and display a read-only list of Mode Settings for the image. This is the default panel when you open a mode window.
- Click the Image Processing tab icon  to open the Image Processing panel and to display the following:
  - Any available mode-specific image controls you can apply to the image.
  - Read-only image control settings that were applied during acquisition.
- Click the Measurements tab icon  to open the Measurements panel and display the available measurement tools.

- Click the Physiological tab icon  to open the Physiological panel and display the following, (if physiological data was recorded during acquisition):
  - The Physiological Display options that you can apply to the image.
  - Physiological Display settings and Respiration Gating settings that were recorded during acquisition.


**Note:** This panel is always available and editable.

You can clear the View Physiology check box to hide the data from the image. Hiding the data will increase the size of the image.

- Click the Preferences tab icon  to open the Preferences window. This window provides a series of tabs you can use to customize the way you work with a range of Vevo LAB features, see "[Preferences](#)" on page 93.

## PW Doppler Mode settings

To view the PW Doppler Mode settings

- ◆ Open a PW Doppler Mode image and click the Mode Settings tab icon . The Mode Settings panel displays the following list of parameters:

Transmit	
Parameter	Description
Frequency	The ultrasound frequency during acquisition, measured in MHz.

Parameter	Description
Power	The transmission power level of the ultrasound signal during acquisition, displayed as a percentage of the maximum power.
PRF	The Pulse Repetition Frequency (PRF) of the transmitted PW Doppler signal, measured in kilohertz (kHz). This parameter defines the maximum observable PW Doppler frequency shift and flow velocity.

#### Acquisition

Parameter	Description
Doppler Gain	The PW Doppler frequency, measured in dB.
Beam Angle	The number of degrees of steer to the ultrasound beam.
Wall Filter	The level of low velocity signals, measured in Hz, filtered out of the spectral display.
Simultaneous	The state of the simultaneous display of acquisition data in both the B-Mode scout window and the PW Doppler Mode image window during acquisition—On or Off.

#### Display

Parameter	Description
Dynamic Range	The contrast of the image during acquisition, measured in dB.
Display Map	The selected predefined display map, applied during acquisition, from the predefined set of maps.

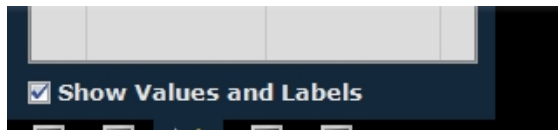
Parameter	Description
Brightness	The image brightness level during acquisition.
Contrast	The image contrast level during acquisition.

## Adding generic PW Doppler Mode measurements

PW Doppler Mode provides a range of generic measurement tools you can use to add measurements that are not part of a measurement protocol.

### Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want to hide the measurement values and labels, clear the Show Values and Labels check box in the Measurement tab in Preferences under a custom measurement package.
- If you want to temporarily override the default, check/uncheck the Show Values and Labels check box at the bottom of the measurement panel.



To access the generic measurement tools for PW Doppler Mode

- ◆ Open an image and then click Measurements . Vevo LAB displays the measurement tools at the top of the Measurements panel. Hover over a tool

to see the description label.

## Generic PW Doppler Mode measurements

All generic measurements are described in "[Generic Measurements](#)" on page 465. The following generic measurements are available for PW Doppler Mode images:

- "[Acceleration measurement](#)" on page 470
- "[Heart Rate measurement](#)" on page 496
- "[Point measurement](#)" on page 511
- "[Time measurement for PW Doppler Mode images](#)" on page 513
- "[Time measurement for physiological display](#)" on page 512
- "[Velocity measurement](#)" on page 515
- "[VTI measurement without real-time frequency trace enabled](#)" on page 519
- "[VTI measurement with automatic frequency trace](#)" on page 518

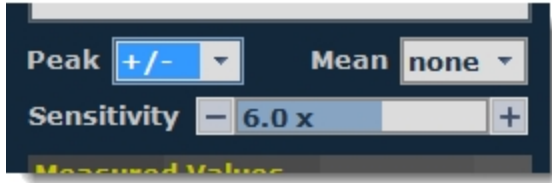
## Applying automatic traces to the frequency waveform

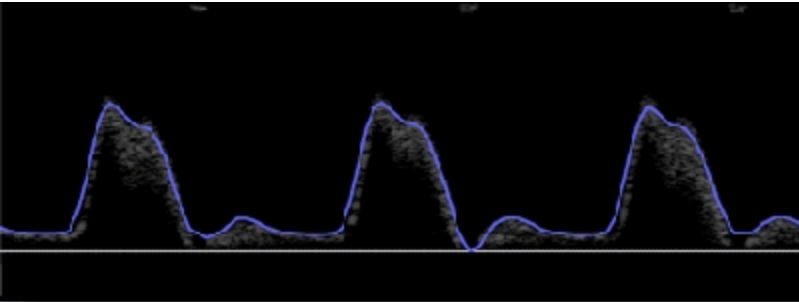
You can set Vevo LAB to apply a range of peak and mean frequency traces to your PW Doppler spectral data.

To apply an automatic trace of the frequency waveform

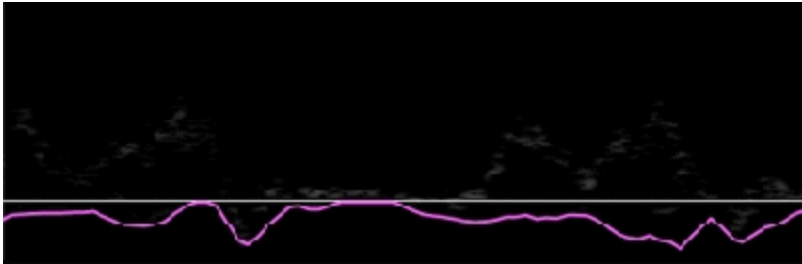
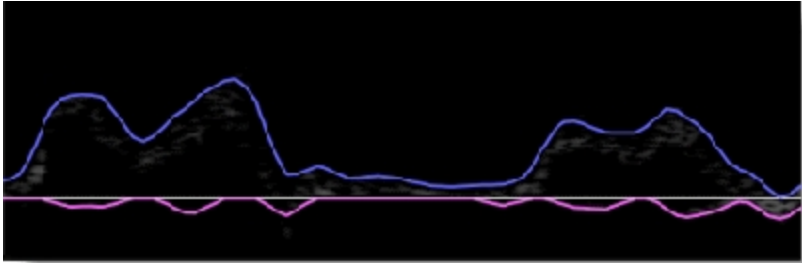
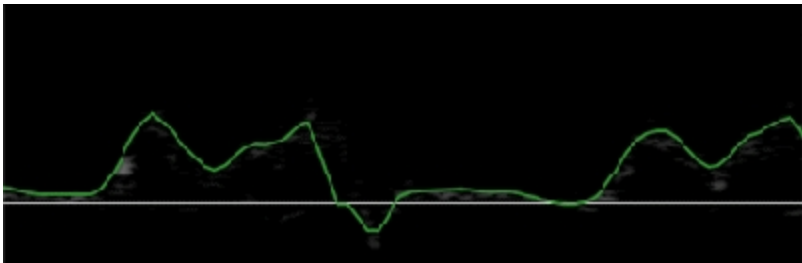
- 1 Open a PW Doppler Mode image and click Measurements .

2 In the Measurements panel, select the appropriate auto trace option in the Peak or Mean frequency drop-down boxes as described in the following tables.



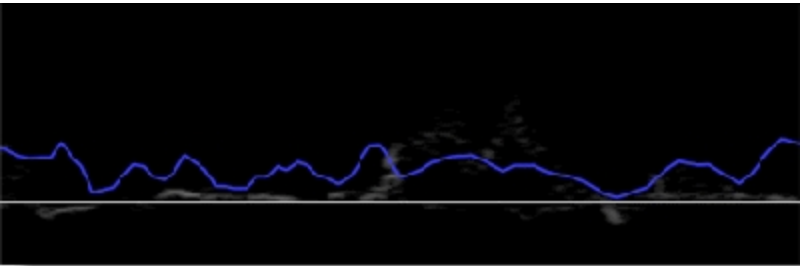
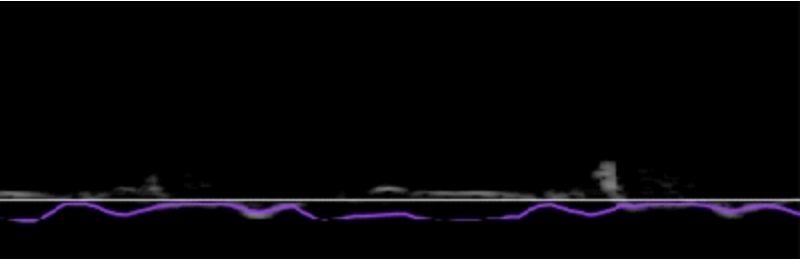
Peak	
Option	Description
none	Vevo LAB does not apply a trace.
+	Applies a blue trace to all positive peak frequency signal traces (flow moving toward the transducer face). <div style="text-align: center; margin-top: 10px;">  </div>
-	Applies a pink trace to all negative peak frequency signal traces.

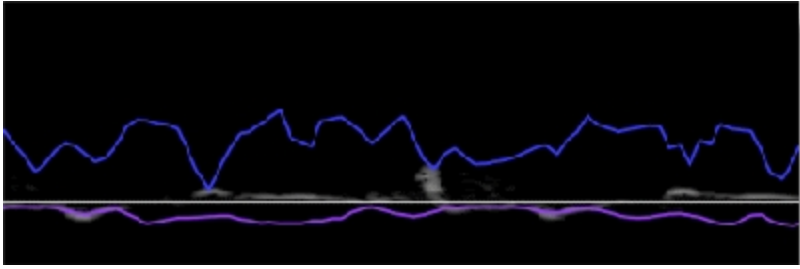
Peak

Option	Description
	
+ / -	<p>Applies both the positive and negative peak frequency traces.</p> 
auto	<p>Applies a green trace to the largest velocity values—positive and negative.</p> 



### Mean

Option	Description
none	Vevo LAB does not apply a trace.
+	<p>Applies a blue trace to all positive mean frequency signal traces along the entire cine loop.</p> 
-	<p>Applies a purple trace to all negative mean frequency signal traces along the entire cine loop.</p> 
+ / -	Applies both the positive and negative mean frequency traces.


Mean	
Option	Description
	

3 To adjust the VTI threshold for a trace, drag the sensitivity slider left or right.

## Adding protocol measurements

Protocol measurements are labeled uniquely for a specific measurement protocol.

### To place the protocol measurement

- 1 Open an image and click Measurements .
- 2 In the measurement packages drop-down list, click the appropriate package.
- 3 In the list of protocols, select the appropriate protocol.
- 4 In the list of measurements, select the measurement you want to add.
- 5 On the image, add your measurement. If you selected the Show Values and Labels option in the measurement panel in the mode window, the measurement value and an editable label for the measurement appear.


**Note:** This option is on by default for all default measurements

## S Wave measurement

The S Wave measurement is available in the Cardiac measurement package for PW Tissue Doppler images, under MV Flow. The S Wave is a standard PW velocity line, dropped to the baseline from a point on the spectrum window.

S Wave is measured in mm/s.

### To place an S Wave measurement

- 1 Click Measurements .
- 2 Click the **S WAVE** option under MV Flow in the Cardiac measurement package.
- 3 In the spectral display, move your cursor to the location where you want to place your caliper and left click.
- 4 (Optional) If you need to move the entire measurement, click on the measurement line, then drag it into position.

## Color Doppler Mode Analysis

Color Doppler Mode uses PW Doppler Mode ultrasound to produce an image of a blood vessel. In addition, the Doppler sounds are converted into colors that are overlaid on the image of the blood vessel to represent the speed and direction of blood flow through the vessel.

This mode is useful for blood flow applications such as:

- Distinguishing non-vascular tissue structures from vascular tissue structures.
- Identifying vascular structures that can be difficult to identify in other modes.

## Color Doppler Mode window workspace



## B-Mode image area

- Displays image data.
- Displays physiological data for the animal (if recorded during image acquisition).
- Provides cine loop range controls for acquired cine loops.
- Provides Browse Images controls for scrolling through an inset gallery of images without having to return to the Study Browser.

If you export an image and select Image as your export type, Vevo LAB includes the image area content along with header information.

## Image scale

Indicates the distance from the transducer face to the tissue being imaged at the moment of acquisition. The image scale units are displayed in mm.

## Focus depth indicator

The triangular arrow indicates the focal depth of the transducer.

## Image data panel

The image data that the transducer acquires. This is where you do the majority of work with images such as reviewing, adding measurements and annotations, post-processing and more.

**5** Region of interest color box overlay

Vevo LAB applies the Color Doppler Mode based colors only to the image data within this box.

**6** Vascular flow moving away from the transducer

Displayed in blue colors.

**7** Vascular flow moving toward the transducer

Displayed in red colors.

**8** Color and velocity scale

The right column of the scale is the color scale. It follows the acronym BART color principle for Doppler (Blue = Away, Red = Toward). Positive vascular flows are indicated by colors in the red range, negative flows are in the blue range, and velocities for each direction increase from dark to light. The velocity range of the scale changes when you change the signal velocity or frequency.

The left column of the scale is the standard gray scale that appears for all B-Mode based images.

**9** Priority indicator

Drag the red arrow control to adjust the priority relationship between the overlay data and the background B-Mode data so you can eliminate false readings.

**10** Physiological data values

Displays the recorded numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature.

**11** Physiological data trace panel

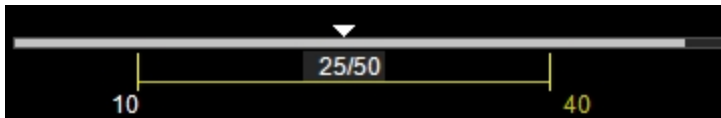
Displays the animal's recorded dynamic heart rate, temperature, respiration rate and blood pressure data during acquisition.

**12** Cine loop control

Displays the length of the cine loop. The triangular white marker identifies the individual frame number within the cine loop.



To create a range within the loop, drag the left and right vertical markers.



**13** Playback control





You can select the playback speed (via slider or - / + controls) and what image frame is being displayed in the mode window.



## 14

### Image mode management panel


Displays a unique set of controls and information depending on the image management panel tab you click:

- Click the Mode Settings tab icon  to open the Mode Settings panel and display a read-only list of Mode Settings for the image. This is the default panel when you open a mode window.
- Click the Image Processing tab icon  to open the Image Processing panel and to display the following:
  - Any available mode-specific image controls you can apply to the image.
  - Read-only image control settings that were applied during acquisition.
- Click the Measurements tab icon  to open the Measurements panel and display the available measurement tools.
- Click the Physiological tab icon  to open the Physiological panel and display the following, (if physiological data was recorded during acquisition):
  - The Physiological Display options that you can apply to the image.
  - Physiological Display settings and Respiration Gating settings that were recorded during acquisition.

**Note:** This panel is always available and editable.


You can clear the View Physiology check box to hide the data from the image. Hiding the data will increase the size of the image.



- Click the Preferences tab icon  to open the Preferences window. This window provides a series of tabs you can use to customize the way you work with a range of Vevo LAB features, see "[Preferences](#)" on page 93.

## Color Doppler Mode settings

To view the Color Doppler Mode settings

- ◆ Open a Color Doppler Mode image and click the Mode Settings tab icon . The Mode Settings panel displays the following list of parameters:

Transmit	
Parameter	Description
Frequency	The ultrasound frequency during acquisition, measured in MHz.
Power	The transmission power level of the ultrasound signal during acquisition, displayed as a percentage of the maximum power.
PRF	The pulse repetition frequency (PRF) of the transmitted PW Doppler signal, measured in kilohertz. This parameter defines the maximum observable PW Doppler frequency shift and flow velocity.
Gate	Number of transmit cycles in the ultrasound pulse.  <b>Note:</b> Higher gate values deliver more detail sensitivity, but lower image resolution.

### Acquisition

Parameter	Description
Frame Rate	The number of image frames per second recorded during acquisition.
Doppler Gain	The Doppler frequency, measured in dB.
2D Gain	The strength of the ultrasound signal when it returns to the face of the transducer. Range values vary by transducer.
Width	The width of the acquired image area, measured in mm.
Beam Angle	The number of degrees of steer to the ultrasound beam.
Sensitivity	The signal resolution level.
Line Density	The line density level during acquisition—Quarter, Third, Half or Full.
Persistence	The state of the Persistence feature during acquisition—Off, Low, Med, High or Max.
ECG/Resp Gate	The state of the ECG trigger and Respiration Gating during acquisition—On or Off.

### Display

Parameter	Description
Display Map	The selected predefined display map, applied during acquisition, from the predefined set of maps.
Wall Filter	The level of low velocity signals, measured in Hz, filtered

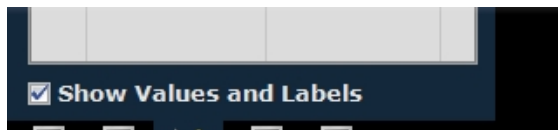
Parameter	Description
	out of the spectral display.
Priority	The threshold level on the B-Mode gray scale, displayed as a percentage, above which the system does not apply color data.
Brightness	The image brightness level.
Contrast	The image contrast level.

## Adding generic Color Doppler Mode measurements


Color Doppler Mode provides a range of generic measurement tools you can use to add measurements that are not part of a measurement protocol.

### Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want to hide the measurement values and labels, clear the Show Values and Labels check box in the Measurement tab in Preferences under a custom measurement package.
- If you want to temporarily override the default, check/uncheck the Show Values and Labels check box at the bottom of the measurement panel.



## To access the generic measurement tools for Color Doppler Mode

◆ Open an image and then click Measurements . Vevo LAB displays the measurement tools at the top of the Measurements panel. Hover over a tool to see the description label.

## Generic Color Doppler Mode measurements


All generic measurements are described in "[Generic Measurements](#)" on page 465. The following generic measurements are available for Color Doppler Mode images:

- "[2D Area measurement](#)" on page 467
- "[Angle measurement](#)" on page 471
- "[Ellipse measurement](#)" on page 495
- "[Linear measurement](#)" on page 498
- "[Time measurement for Color Doppler Mode images](#)" on page 514
- "[Time measurement for physiological display](#)" on page 512
- "[Traced Distance measurement](#)" on page 515
- "[Vevo Color tool](#)" on page 516

## Adding protocol measurements

Protocol measurements are labeled uniquely for a specific measurement protocol.

## To place the protocol measurement

- 1 Open an image and click Measurements .
- 2 In the measurement packages drop-down list, click the appropriate package.
- 3 In the list of protocols, select the appropriate protocol.
- 4 In the list of measurements, select the measurement you want to add.
- 5 On the image, add your measurement. If you selected the Show Values and Labels option in the measurement panel in the mode window, the measurement value and an editable label for the measurement appear.

**Note:** This option is on by default for all default measurements

# Power Doppler Mode Analysis

Power Doppler Mode provides tools to visualize and measure flow dynamics. This imaging mode displays the energy from the returning Doppler signal and assigns a color range to the energy generated by moving blood flow. This is useful for applications such as detecting vascularity in and around orthotopic and subcutaneous tumors and producing a measure of relative quantification.

## Power Doppler Mode window workspace

The Power Doppler Mode window is the workspace you use when you work with Power Doppler Mode image data. The following illustration identifies the key features.



## B-Mode image area

- Displays image data.
- Displays physiological data for the animal (if recorded during image acquisition).
- Provides cine loop range controls for acquired cine loops.
- Provides Browse Images controls for scrolling through an inset gallery of images without having to return to the Study Browser.

If you export an image and select Image as your export type, Vevo LAB includes the image area content along with header information.

## Image scale

Indicates the distance from the transducer face to the tissue being imaged at the moment of acquisition. The image scale units are displayed in mm.

## Focus depth indicator

The triangular arrow indicates the focal depth of the transducer. When you reposition the ROI power box, Vevo LAB automatically resets the focal depth to the vertical center of the box.

## Image data panel

The image data that the transducer acquires. This is where you do the majority of work with images such as reviewing, adding measurements and annotations, post-processing and more.

## 5 Power box overlay

Vevo LAB applies the Power Doppler Mode based colors only to the image data within this region-of-interest box.

## 6 Gray scale and power scale

The right column of the scale is the power scale. The darker colors indicate lower frequency signals and the lighter colors indicate higher frequency signals.

The left column of the scale is the standard gray scale that appears for the B-Mode background image.

## 7 Physiological data values

Displays the recorded numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature.

## 8 Physiological data trace panel

Displays the animal's recorded dynamic heart rate, temperature, respiration rate and blood pressure data during acquisition.

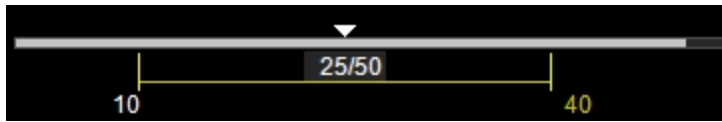
## 9 Cine loop control

Displays the length of the cine loop. The triangular white marker identifies the individual frame number within the cine loop.





To create a range within the loop, drag the left and right vertical markers.





## 10 Playback control



You can select the playback speed (via slider or - / + controls) and what image frame is being displayed in the mode window.



## 11 Image mode management panel


Displays a unique set of controls and information depending on the image management panel tab you click:

- Click the Mode Settings tab icon  to open the Mode Settings panel and display a read-only list of Mode Settings for the image. This is the default panel when you open a mode window.
- Click the Image Processing tab icon  to open the Image Processing panel and to display the following:
  - Any available mode-specific image controls you can apply to the image.
  - Read-only image control settings that were applied during acquisition.

- Click the Measurements tab icon  to open the Measurements panel and display the available measurement tools.
- Click the Physiological tab icon  to open the Physiological panel and display the following, (if physiological data was recorded during acquisition):
  - The Physiological Display options that you can apply to the image.
  - Physiological Display settings and Respiration Gating settings that were recorded during acquisition.


**Note:** This panel is always available and editable.

You can clear the View Physiology check box to hide the data from the image. Hiding the data will increase the size of the image.

- Click the Preferences tab icon  to open the Preferences window. This window provides a series of tabs you can use to customize the way you work with a range of Vevo LAB features, see "[Preferences](#)" on page 93.

## Power Doppler Mode settings

### To view the Power Doppler Mode settings

- ◆ Open a Power Doppler Mode image and click the Mode Settings tab icon . The Mode Settings panel displays the following list of parameters:

### Transmit

Parameter	Description
Frequency	The ultrasound frequency during acquisition, measured in MHz.
Power	The transmission power level of the ultrasound signal during acquisition, displayed as a percentage of the maximum power.
PRF	The pulse repetition frequency (PRF) of the transmitted PW Doppler signal, measured in kilohertz. This parameter defines the maximum observable PW Doppler frequency shift and flow velocity.
Gate	Number of transmit cycles in the ultrasound pulse. Higher gate values deliver more detail sensitivity, but lower image resolution.

### Acquisition

Parameter	Description
Doppler Gain	The Doppler frequency, measured in dB.
2D Gain	The strength of the ultrasound signal when it returns to the face of the transducer. Range values vary by transducer.
Frame Rate	The number of image frames per second recorded during acquisition.
Width	The width of the acquired image area, measured in mm.
Beam Angle	The number of degrees of steer to the ultrasound beam.

### Acquisition

Parameter	Description
Sensitivity	The level of detail at deeper distances from the transducer head during acquisition.
Line Density	The line density level during acquisition—Quarter, Third, Half or Full.
Persistence	The state of the Persistence feature during acquisition—Off, Low, Med, High or Max.
ECG/Resp Gate	The state of the ECG trigger and Respiration Gating during acquisition—On or Off.

### Display

Parameter	Description
Dynamic Range	The contrast of the image during acquisition, measured in dB.
Display Map	The selected predefined display map, applied during acquisition, from the predefined set of maps.
Wall Filter	The level of low velocity signals, measured in Hz, filtered out of the spectral display.
Priority	The threshold level on the B-Mode gray scale, displayed as a percentage, above which the system does not apply color data.
Brightness	The image brightness level.

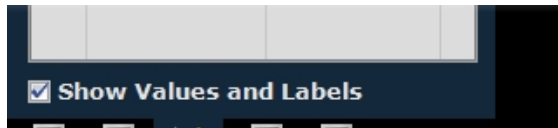
Parameter	Description
Contrast	The image contrast level.

## Adding generic Power Doppler Mode measurements


Power Doppler Mode provides a range of generic measurement tools you can use to add measurements that are not part of a measurement protocol.

### Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want to hide the measurement values and labels, clear the Show Values and Labels check box in the Measurement tab in Preferences under a custom measurement package.
- If you want to temporarily override the default, check/uncheck the Show Values and Labels check box at the bottom of the measurement panel.



### To access the generic measurement tools for Power Doppler Mode

- ◆ Open an image and then click Measurements . Vevo LAB displays the measurement tools at the top of the Measurements panel. Hover over a tool to see the description label.

## Generic Power Doppler Mode measurements


All generic measurements are described in "[Generic Measurements](#)" on page 465. The following generic measurements are available for Color Doppler Mode images:

- "[2D Area measurement](#)" on page 467
- "[Angle measurement](#)" on page 471
- "[Ellipse measurement](#)" on page 495
- "[Linear measurement](#)" on page 498
- "[Time measurement for physiological display](#)" on page 512
- "[Traced Distance measurement](#)" on page 515
- "[Vevo Color tool](#)" on page 516

## Adding protocol measurements

Protocol measurements are labeled uniquely for a specific measurement protocol.

### To place the protocol measurement

- 1 Open an image and click Measurements .
- 2 In the measurement packages drop-down list, click the appropriate package.
- 3 In the list of protocols, select the appropriate protocol.
- 4 In the list of measurements, select the measurement you want to add.

5 On the image, add your measurement. If you selected the Show Values and Labels option in the measurement panel in the mode window, the measurement value and an editable label for the measurement appear.

**Note:** This option is on by default for all default measurements

## Linear Contrast Mode Analysis

---

Linear Contrast Mode imaging provides tools to detect and quantify vascular structures and dynamics at the molecular level in two or three dimensions.

This mode is useful in cancer, vascular and cardiology research for real-time in vivo applications such as:

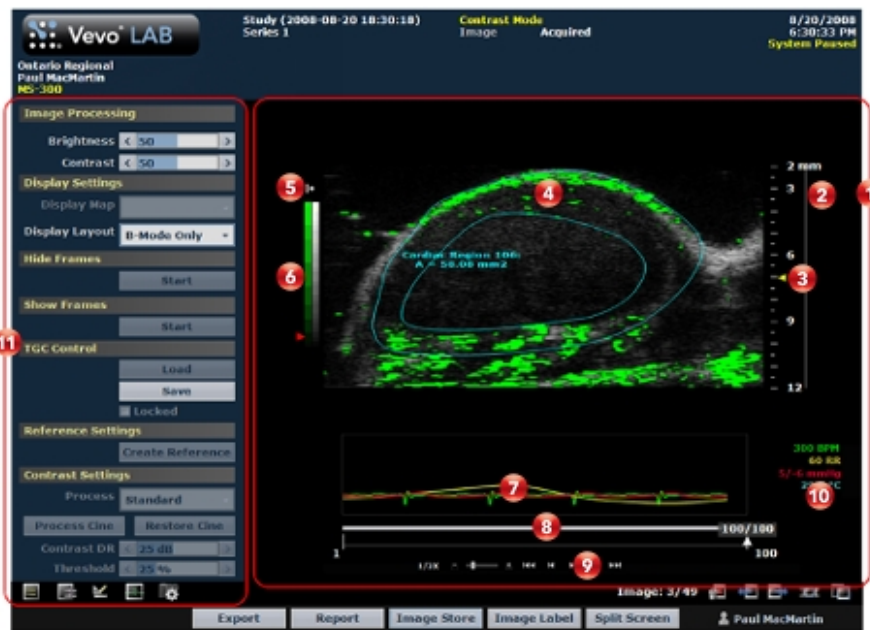
- Targeted molecular imaging for visualizing and quantifying the expression of intravascular molecular markers, such as angiogenesis and inflammation.
- Tumor perfusion and relative quantification of vascular volume and structure.
- Assessment of myocardial perfusion and area of infarction.

**Note:** Linear Contrast Mode is not available on the Vevo 3100 or Vevo LAZR-X Imaging System.

## Linear Contrast Mode window workspace

The Linear Contrast Mode window is the workspace you use when you work with Linear Contrast Mode image data. The following illustration identifies the key features.





## 1 Linear Contrast Mode image area

- Displays image data.
- Displays physiological data for the animal (if recorded during image acquisition).
- Provides cine loop range controls for acquired cine loops.
- Provides Browse Images controls for scrolling through an inset gallery of images without having to return to the Study Browser.

If you export an image and select Image as your export type, Vevo LAB includes the image area content along with header information.

## Image scale

Indicates the distance from the transducer face to the tissue being imaged at the moment of acquisition. The image scale units are displayed in mm.

## Focus depth indicator


The triangular arrow indicates the focal depth of the transducer.

## Image data panel

The image data that the transducer acquires. This is where you do the majority of work with images such as reviewing, adding measurements and annotations, post-processing and more.

## Orientation icon

The orientation icon indicates the orientation of the transducer during acquisition in relation to the image.

For Vevo 3100 and Vevo LAZR-X image data, you can change the orientation in Vevo LAB via the Image Processing panel , under the Display Settings section in the Orientation drop down menu. Choose between Upper Left, Upper Right, Lower Left, and Lower Right.

## 6 Contrast scale

The left column of the scale is the green scale which indicates the dynamic range of the contrast intensity.

The right column of the scale is the standard gray scale that appears for all B-Mode based images.

## 7 Physiological data trace panel

Displays the animal's recorded dynamic heart rate, temperature, respiration rate and blood pressure data during acquisition.

## 8 Cine loop control

Displays the length of the cine loop. The triangular white marker identifies the individual frame number within the cine loop.



To create a range within the loop, drag the left and right vertical markers.



## 9 Playback control

You can select the playback speed (via slider or - / + controls) and what image frame is being displayed in the mode window.







## 10 Physiological data trace panel

Displays the animal's recorded dynamic heart rate, temperature, respiration rate and blood pressure data during acquisition.

## 11 Image mode management panel


Displays a unique set of controls and information depending on the image management panel tab you click:

- Click the Mode Settings tab icon  to open the Mode Settings panel and display a read-only list of Mode Settings for the image. This is the default panel when you open a mode window.
- Click the Image Processing tab icon  to open the Image Processing panel and to display the following:
  - Any available mode-specific image controls you can apply to the image.
  - Read-only image control settings that were applied during acquisition.
- Click the Measurements tab icon  to open the Measurements panel and display the available measurement tools.

- Click the Physiological tab icon  to open the Physiological panel and display the following, (if physiological data was recorded during acquisition):
  - The Physiological Display options that you can apply to the image.
  - Physiological Display settings and Respiration Gating settings that were recorded during acquisition.


**Note:** This panel is always available and editable.

You can clear the View Physiology check box to hide the data from the image. Hiding the data will increase the size of the image.

- Click the Preferences tab icon  to open the Preferences window. This window provides a series of tabs you can use to customize the way you work with a range of Vevo LAB features, see "[Preferences](#)" on page 93.

## Linear Contrast Mode settings

To view the Linear Contrast Mode settings

- ◆ Open a Linear Contrast Mode image and click the Mode Settings tab icon . The Mode Settings panel displays the following list of parameters:

### Transmit

Parameter	Description
Frequency	The ultrasound frequency during acquisition, measured in MHz.

Parameter	Description
Power	The transmission power level of the ultrasound signal during acquisition, displayed as a percentage of the maximum power.

#### Acquisition

Parameter	Description
Contrast Gain	The gain control scheme specified during acquisition such that each gain stage in the receive signal path is adjusted according to the total gain required.
2D Gain	The strength of the ultrasound signal during acquisition, specified in dB increments.
Frame Rate	The number of image frames per second recorded during acquisition.
Depth	The distance, measured in mm, from the face of the transducer during acquisition.
Width	The width of the acquired image area during acquisition, measured in mm.
Sensitivity	The level of detail at deeper distances from the transducer head during acquisition.
Line Density	The line density level during acquisition—Quarter, Third, Half or Full.
Persistence	The state of the Persistence feature during acquisition—None or MIP.

### Acquisition

Parameter	Description
ECG/Resp Gate	The state of the ECG trigger and Respiration Gating during acquisition—On or Off.

### Display

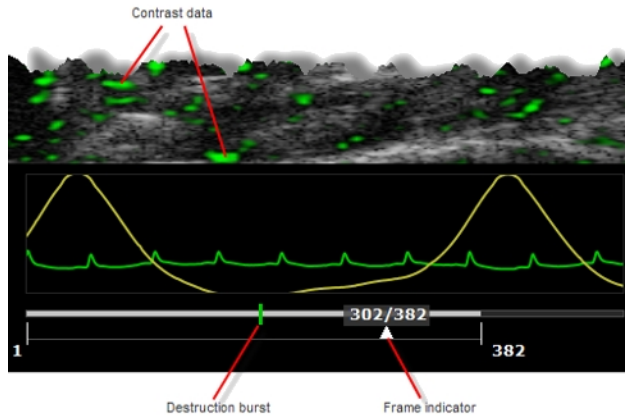
Parameter	Description
Dynamic Range	The contrast of the image during acquisition, measured in dB.
Display Map	The selected predefined display map, applied during acquisition, from the predefined set of maps.
Brightness	The image brightness level during acquisition.
Contrast	The image contrast level during acquisition.
Overlay	The contrast process that was applied— Standard, Smooth, MIP or Cardiac.
Reference	The number of frames in the reference set.


## Displaying contrast agents as an overlay

To display the contrast data as an overlay

- 1 In a cine loop acquired by using the Image Sequence process, drag the right side range control bracket to the end of the cine loop.

2 Drag the frame indicator into the range of frames after the vertical green bar which identifies the destruction burst event.



3 Click the Image Processing tab  and in the Display Settings section select the appropriate Display Layout option:

- Both will display B-Mode image and Contrast overlay.
- Contrast Only will display Contrast overlay only.
- B-Mode Only will only display the B-Mode image.

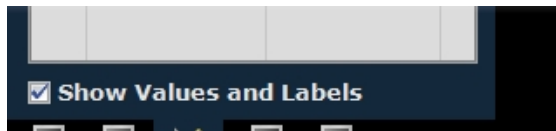
## Adding generic Contrast Mode measurements

Linear Contrast Mode and Nonlinear Contrast Mode provides a range of generic measurement tools you can use to add measurements that are not part of a measurement protocol.




## Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want to hide the measurement values and labels, clear the Show Values and Labels check box in the Measurement tab in Preferences under a custom measurement package.
- If you want to temporarily override the default, check/uncheck the Show Values and Labels check box at the bottom of the measurement panel.



### To access the generic measurement tools for Contrast Mode

- ◆ Open an image and then click Measurements . Vevo LAB displays the measurement tools at the top of the Measurements panel. Hover over a tool to see the description label.

## Generic Contrast Mode measurements

All generic measurements are described in "[Generic Measurements](#)" on page 465. The following generic measurements are available:


- "[2D Area measurement](#)" on page 467
- "[Angle measurement](#)" on page 471
- "[Cardiac Region measurement](#)" on page 473

- "Contrast Region measurement" on page 478
- "Ellipse measurement" on page 495
- "Linear measurement" on page 498
- "Time measurement for physiological display" on page 512
- "Traced Distance measurement" on page 515
- "Vevo Color tool" on page 516

## Adding protocol measurements

Protocol measurements are labeled uniquely for a specific measurement protocol.

### To place the protocol measurement

- 1 Open an image and click Measurements .
- 2 In the measurement packages drop-down list, click the appropriate package.
- 3 In the list of protocols, select the appropriate protocol.
- 4 In the list of measurements, select the measurement you want to add.
- 5 On the image, add your measurement. If you selected the Show Values and Labels option in the measurement panel in the mode window, the measurement value and an editable label for the measurement appear.

**Note:** This option is on by default for all default measurements

# Nonlinear Contrast Mode Analysis

Nonlinear Contrast Mode is a high-frequency imaging mode that produces improved sensitivity in microbubble detection and quantification. This mode suppresses the tissue signal while increasing the detection of the contrast agents.

During acquisition the system modulates the amplitude of the ultrasound pulses, enabling a nonlinear response to microbubbles.

## Nonlinear Contrast Mode window workspace

The Nonlinear Contrast Mode window is the workspace you use when you work with Nonlinear Contrast Mode image data. The following illustration identifies the key features.



## 1 Nonlinear Contrast Mode image area


- Displays image data.
- Displays physiological data for the animal (if recorded during image acquisition).
- Provides cine loop range controls for acquired cine loops.
- Provides Browse Images controls for scrolling through an inset gallery of images without having to return to the Study Browser.

If you export an image and select Image as your export type, Vevo LAB includes the image area content along with header information.


## 2 Image scale

Indicates the distance from the transducer face to the tissue being imaged at the moment of acquisition. The image scale units are displayed in mm.

## 3 Contrast overlay boundary


This yellow box applied over the background B-Mode image defines the boundary where contrast data was acquired. To change the layout options for displaying the B-Mode data and contrast data, click the Image Processing tab icon  and then select a color in the Display Layout drop-down list.

## 4 Contrast data

Displays the acquired contrast data. To change the color of the contrast data, click the Image Processing tab icon  and then select a color in the Display Map drop-down list.

## Orientation icon

The orientation icon indicates the orientation of the transducer during acquisition in relation to the image.

For Vevo 3100 and Vevo LAZR-X image data, you can change the orientation in Vevo LAB via the Image Processing panel , under the Display Settings section in the Orientation drop down menu. Choose between Upper Left, Upper Right, Lower Left, and Lower Right.

## Contrast scale

The left column of the two-toned scale is the green scale which indicates the dynamic range of the contrast intensity.

The right column of the scale is the standard gray scale that appears for all B-Mode based images.

## B-Mode image data

The B-Mode image data that the transducer acquires as background orientation.

## Focus depth indicator

The triangular arrow indicates the focal depth of the transducer.

## 9 Physiological data trace panel

Displays the animal's recorded dynamic heart rate, temperature, respiration rate and blood pressure data during acquisition.

## 10 Cine loop control

Displays the length of the cine loop. The triangular white marker identifies the individual frame number within the cine loop.



To create a range within the loop, drag the left and right vertical markers.



## 11 Playback control

You can select the playback speed (via slider or - / + controls) and what image frame is being displayed in the mode window.







## 12 Physiological data values

Displays the recorded numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature.




### Image mode management panel

Displays a unique set of controls and information depending on the image management panel tab you click:

- Click the Mode Settings tab icon  to open the Mode Settings panel and display a read-only list of Mode Settings for the image. This is the default panel when you open a mode window.
- Click the Image Processing tab icon  to open the Image Processing panel and to display the following:
  - Any available mode-specific image controls you can apply to the image.
  - Read-only image control settings that were applied during acquisition.
- Click the Measurements tab icon  to open the Measurements panel and display the available measurement tools.
- Click the Physiological tab icon  to open the Physiological panel and display the following, (if physiological data was recorded during acquisition):
  - The Physiological Display options that you can apply to the image.
  - Physiological Display settings and Respiration Gating settings that were recorded during acquisition.


**Note:** This panel is always available and editable.

You can clear the View Physiology check box to hide the data from the image. Hiding the data will increase the size of the image.

- Click the Preferences tab icon  to open the Preferences window. This window provides a series of tabs you can use to customize the way you work with a range of Vevo LAB features, see ["Preferences"](#) on page 93.

## Nonlinear Contrast Mode settings

To view the Nonlinear Contrast Mode settings

- ◆ Open a Nonlinear Contrast Mode image and click the Mode Settings tab icon . The Mode Settings panel displays the following list of parameters:

### Transmit

Parameter	Description
Frequency	The ultrasound frequency during acquisition, measured in MHz.
Power	The transmission power level of the ultrasound signal during acquisition, displayed as a percentage of the maximum power.
Gate	Number of transmit cycles in the ultrasound pulse. <b>Note:</b> Higher gate values deliver more detail sensitivity, but lower image resolution.



Parameter	Description
Beamwidth	The predefined array transmit beamwidth level selected during acquisition—Narrow, Medium, Wide or Unknown. Notably useful, when using contrast agents with burst scans, to widen the field of view during acquisition.

### Acquisition

Parameter	Description
Contrast Gain	The gain control scheme specified during acquisition such that each gain stage in the receive signal path is adjusted according to the total gain required.
2D Gain	The strength of the ultrasound signal during acquisition, specified in dB increments.
Frame Rate	The number of image frames per second recorded during acquisition.
Depth	The distance, measured in mm, from the face of the transducer during acquisition.
Width	The width of the acquired image area during acquisition, measured in mm.
Sensitivity	The level of detail at deeper distances from the transducer head during acquisition.
Line Density	The line density level during acquisition—Quarter, Third, Half or Full.
Persistence	The state of the Persistence feature during acquisition—

### Acquisition

Parameter	Description
	Off, Low, Med, High, Max or MIP.
ECG/Resp Gate	The state of the ECG trigger and Respiration Gating during acquisition—On or Off.

### Display

Parameter	Description
Dynamic Range	The contrast of the image during acquisition, measured in dB.
Display Map	The selected predefined display map, applied during acquisition, from the predefined set of maps.
Brightness	The image brightness level during acquisition.
Contrast	The image contrast level during acquisition.

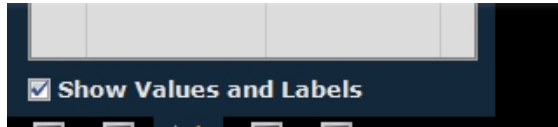
## Adding generic Contrast Mode measurements

Linear Contrast Mode and Nonlinear Contrast Mode provides a range of generic measurement tools you can use to add measurements that are not part of a measurement protocol.


## Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.

- If you want to hide the measurement values and labels, clear the Show Values and Labels check box in the Measurement tab in Preferences under a custom measurement package.
- If you want to temporarily override the default, check/uncheck the Show Values and Labels check box at the bottom of the measurement panel.



### To access the generic measurement tools for Contrast Mode

- ◆ Open an image and then click Measurements . Vevo LAB displays the measurement tools at the top of the Measurements panel. Hover over a tool to see the description label.

## Generic Contrast Mode measurements

All generic measurements are described in "[Generic Measurements](#)" on page 465. The following generic measurements are available:


- "[2D Area measurement](#)" on page 467
- "[Angle measurement](#)" on page 471
- "[Ellipse measurement](#)" on page 495
- "[Cardiac Region measurement](#)" on page 473
- "[Contrast Region measurement](#)" on page 478
- "[Linear measurement](#)" on page 498

- ["Time measurement for physiological display"](#) on page 512
- ["Traced Distance measurement"](#) on page 515
- ["Vevo Color tool"](#) on page 516

## Adding protocol measurements

Protocol measurements are labeled uniquely for a specific measurement protocol.

### To place the protocol measurement

- 1 Open an image and click Measurements .
- 2 In the measurement packages drop-down list, click the appropriate package.
- 3 In the list of protocols, select the appropriate protocol.
- 4 In the list of measurements, select the measurement you want to add.
- 5 On the image, add your measurement. If you selected the Show Values and Labels option in the measurement panel in the mode window, the measurement value and an editable label for the measurement appear.

**Note:** This option is on by default for all default measurements

## 3D Mode Analysis

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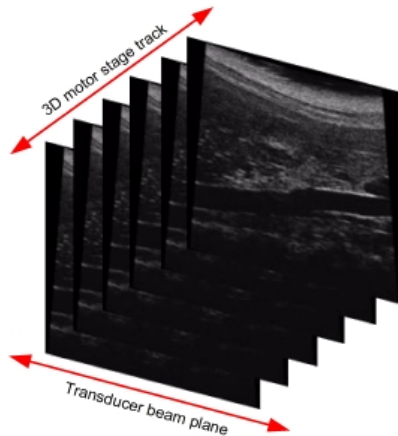
3D Mode provides a three-dimensional view of an area of interest from frame-based imaging modes, excluding PA-Mode (Spectro) and 4D-Mode.

### How 3D Mode works

3D Mode images are created by acquiring a series of 2-dimensional 'slices' and assembling them into a 3D data set. The 3D data set can then be visualized and manipulated. Targets (for example, tumor growth) can be segmented and volumetric measurements made.

### 3D Mode image acquisition

Based on user-defined parameters, the 3D motor travels a set distance across the target object in a series of very small steps. The 3D motor, with the attached transducer, travels in a direction perpendicular to the imaging orientation.



Vevo LAB compiles each two-dimensional image slice with the other acquired slices and renders them into a three-dimensional whole.

## Dual ECG triggered 3D Mode volumes

The Vevo 3100 and Vevo LAZR-X Imaging System supports simultaneous and automated collection of diastolic and systolic ECG triggered 3D Mode volumes.

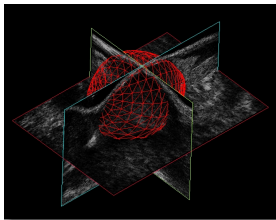
During acquisition, you will typically set one trigger point to represent the systole, while the other represents the diastole of the cardiac cycle. The system will then acquire a single frame after each of the set trigger points during the cardiac cycle or acquire 2 frames for every 3D motor position.

Dual ECG triggered 3D Mode volumes are available in B-Mode 3D (3D-Mode), Power 3D Mode, Color 3D Mode and Nonlinear Contrast 3D imaging. When an image is loaded into 3D, you will be able to select to toggle between each ECG trigger set of 3D mode slices. T1 (diastolic) and T2 (systolic) buttons are located on the ["3D Mode visualization tools"](#) on page 380 bar.

## 3D Mode analysis

You can use the 3D analysis tools to:

- View and render objects of interest, such as target tumors.
- Segment objects on any plane or across planes.
- Measure lengths, areas and volume.



## 3D Mode window workspace

The 3D Mode window is the workspace you use when you work with 3D Mode image data. The following illustration identifies the key features.



**1** 3D Mode image data area

Includes the view panes area and the visualization options toolbar.

## 2 View panes area

Vevo LAB defaults to four view panes (Quad Pane) , but you can also select Dual Pane or Single Pane. When you export a stored image and configure your export to send only the image area, this is the area of the window that Vevo LAB exports.

## 3 Active pane yellow border

When you select a view pane, Vevo LAB applies a yellow border along the borders of that pane.

## 4 Active pane menu drop-down icon

Click to display the available commands that apply to the image in the active pane. Not all panes include the same commands. The following table describes all of the available commands:

Active Pane Commands

Command	Description
Wire-frame	Turns the image outline on/off.
Rotation	Available in cross view. Enables rotation of the image data. Once activated, left-click and drag to rotate in any direction within the pane.
Data	Available in Surface View. Toggle the display of image data on/off.
Overlay	Available in Surface View. Toggle the overlay on/off.



### Active Pane Commands

Command	Description
Surface Overlay	Available in Surface View. Toggle the surface overlay on/off.
View	Displays all of the available view options. Click a view to change the active pane view.
Orientation	Available in Cube View. Turns the orientation marker points on/off.
Plane Orientation	Available in Multi-slice View. Select either Transverse, Sagittal or Coronal.
Step Size Factor	Available in Multi-slice View. Set the distance between the slices displayed—1X, 2X, 3X or 4X.  <b>Note:</b> Default Step Size Factor can be set in the 3D/4D Mode Multi-slice View Defaults section under Mode Settings in Preferences.
Slice Size	Available in Multi-slice View. Set the size of the slices displayed—Auto, Small, Medium or Large.  <b>Note:</b> Default Slice Size can be set in the 3D/4D Mode Multi-slice View Defaults section under Mode Settings in Preferences.
Render Mode	Available in Cube View. Displays a list of rendering modes you can apply—Texture Mapping, Render, MIP (Max) or MIP (Min).
Restore	Resets the original view of the image including size,

### Active Pane Commands

Command	Description
	orientation, brightness and zoom values

#### 5 Active pane previous/next slice tool

Click < to view previous slices in your 3D image. Click > to view the next slices. You can use the following keyboard combinations to move forward or back one slice at a time, five at a time, or ten at a time, as detailed in the following table:

Command	Step size
>	1 slice
Shift + >	5 slices
Ctrl + >	10 slices

#### 6 Unique image view

Each pane displays a unique view of the 3D image. When you click a different view icon in the image analysis toolbar to change the view, Vevo LAB visualizes the same slice from a different perspective.

#### 7 Visualization options toolbar

Click the appropriate analysis tool to change either the number of panes or the analysis view. For complete information on each tool see "[3D Mode visualization tools](#)" on page 380.

## 8 3D Settings tool panels

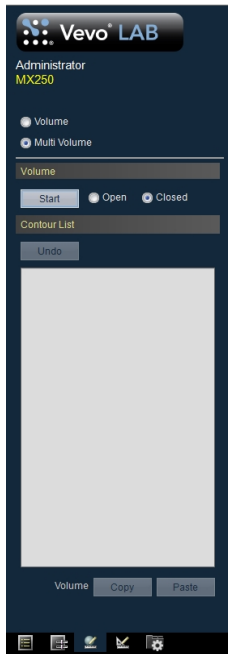
At the top of the 3D Settings panel, click either Render, Record or Sculpting and the corresponding tool panel appears.

If Render is selected, click the appropriate Mode to display the panel you want to work with—Texture mapping, Render, MIP (Max) or MIP (Min). You can also select the appropriate Render Version—0, 1.0 or 2.0.

See "[Manipulating 3D Mode image data](#)" on page 386 for more details.

## 9 Volume Measurement panel

At the top of the Volume Measurement panel, click either **Parallel & Rotational Methods** or **Multi-slice Method**, select the volume type you want to record (Open or Closed), then click Start. See "[Creating a 3D Volume measurement](#)" on page 395 for more details.



## 3D Mode visualization tools


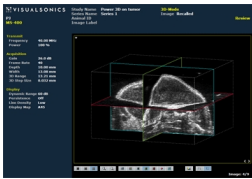

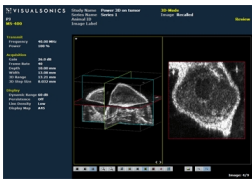



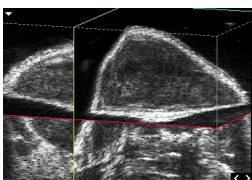

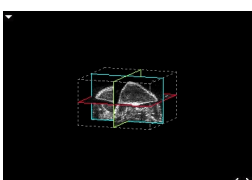
When you are in the Cube View, the 3D Mode image analysis toolbar provides a series of analysis tools you can use to change either the number of view panes in the area or the type of analysis view you want to work with.

## Visualization tools available for all 3D images


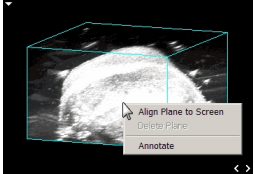


*Visualization tools for 3D Mode with Quad Pane, Cube View and T1 (Trigger 1) options selected.*


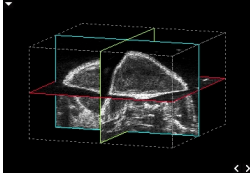

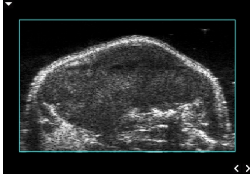

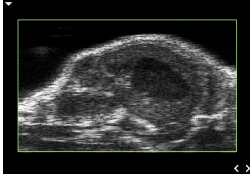

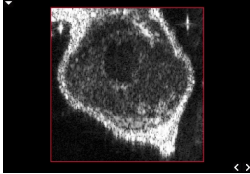
### 3D Mode Visualization Tools Descriptions

Tool	Description	Example
 <p>Single Pane</p>	<p>Click to display one 3D Mode image view across the entire image area.</p>	
 <p>Dual Pane</p>	<p>Click to display two 3D Mode image views across the image area.</p>	
 <p>Quad Pane</p>	<p>Click to display four image views across the image area.</p>	
 <p>Zoom In</p>	<p>Click to magnify the view up to 20 levels of zoom.</p>	
 <p>Zoom Out</p>	<p>Click to minimize the view up to 20 levels of zoom.</p>	


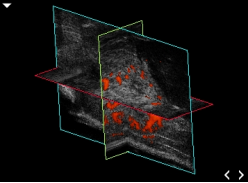

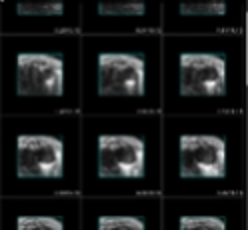


### 3D Mode Visualization Tools Descriptions

Tool	Description	Example								
<div style="text-align: center;">  </div> <p>Cube View</p>	<p>Click to display a three-dimensional view of the acquired data, constructed from the full set of B-Mode image slices. The cube displays a blue wire-frame by default.</p> <p>As you move the cursor over a plane on the cube, the plane becomes 'active' and the wire-frame for that plane is displayed in green.</p> <p>Right-click a plane to display the following commands:</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th style="width: 30%;">Command</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Align Plane to Screen</td> <td>Rotates the cube to display a head-on view of the active plane.</td> </tr> <tr> <td>Remove Plane</td> <td>Removes a manually created plane.</td> </tr> <tr> <td>Annotate</td> <td>Provides a text box in which to type an annotation.</td> </tr> </tbody> </table>	Command	Description	Align Plane to Screen	Rotates the cube to display a head-on view of the active plane.	Remove Plane	Removes a manually created plane.	Annotate	Provides a text box in which to type an annotation.	
Command	Description									
Align Plane to Screen	Rotates the cube to display a head-on view of the active plane.									
Remove Plane	Removes a manually created plane.									
Annotate	Provides a text box in which to type an annotation.									

### 3D Mode Visualization Tools Descriptions

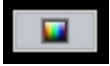
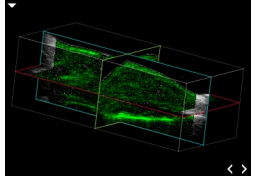

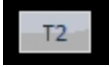
Tool	Description	Example
 <p>Cross View</p>	<p>Click to display three single, slidable image slice views presented on the x, y, and z planes. Each plane presents its own color outline:</p> <ul style="list-style-type: none"> <li>• Blue = x-y plane on the z axis</li> <li>• Green = y-z plane on the x axis</li> <li>• Red = x-z plane on the y axis</li> </ul>	
 <p>Transverse View</p>	<p>Click to display a straight-on perspective of the x-y plane image slice, displayed on the Cross View as the plane outlined in blue.</p>	
 <p>Sagittal View</p>	<p>Click to display a straight-on perspective of the y-z plane image slice, displayed on the Cross View as the plane outlined in green.</p>	
 <p>Coronal View</p>	<p>Click to display a straight-on perspective of the x-z plane image slice, displayed on the Cross View as the plane outlined in red.</p>	

### 3D Mode Visualization Tools Descriptions

Tool	Description	Example
 Surface View	Click to display a compilation view that uses the Cross View to map user-generated volumes to the acquired data.	
 Multi-slice View	Displays each image slice within the active pane.  <div style="background-color: #1a3d4d; color: white; padding: 5px; border-radius: 5px;"> <b>Note:</b> Multi-slice view is only available when viewing data in single or dual pane view.                     </div>	
 Toggle Display Layout	Click to cycle through the set of Display Layouts available for B-Mode based images with overlays: <ul style="list-style-type: none"> <li>• 'Current mode' Only (ex. PA-Mode Only, Color Only, Contrast Only)</li> <li>• B-Mode Only</li> <li>• Both</li> </ul>	 <p style="text-align: center;"><i>PA-Mode Only</i></p> <p style="text-align: center;"><i>B-Mode Only</i></p> <p style="text-align: center;"><i>Both</i></p>



### 3D Mode Visualization Tools Descriptions

Tool	Description	Example
 <p>Toggle Display Map</p>	<p>Click to cycle through the set of Display Maps available for images in all B-Mode based imaging modes:</p> <ul style="list-style-type: none"> <li>• 3D-Mode (B-Mode 3D)–C1-C6</li> <li>• Nonlinear Contrast 3D Mode–MB1-MB3</li> <li>• Linear Contrast 3D Mode–MB1, MB2</li> <li>• Power Doppler 3D Mode–C1, C2</li> <li>• Color Doppler 3D Mode–C1-C5</li> <li>• PA-Mode 3D and PA-Mode 3D (Oxy-Hemo)–PA1-PA9</li> </ul>	
	<p>Click to display only the T1 (Trigger 1) frames. Once selected, all of the image views are updated only to display frames acquired with T1.</p> <div style="background-color: #1a3d4d; color: white; padding: 5px; border: 1px solid #1a3d4d;"> <p><b>Note:</b> Available when Dual ECG Trigger is enabled during an acquisition in B-Mode 3D (3D-Mode), Power 3D Mode, Color 3D Mode and Nonlinear Contrast 3D Mode.</p> </div>	<p>Applies to all views</p>
	<p>Click to display only the T2 (Trigger 2) frames. Once selected, all of the image</p>	<p>Applies to all views</p>

### 3D Mode Visualization Tools Descriptions

Tool	Description	Example
	<p>views are updated only to display frames acquired with T2.</p> <p><b>Note:</b> Available when Dual ECG Trigger is enabled during an acquisition in B-Mode 3D (3D-Mode), Power 3D Mode, Color 3D Mode and Nonlinear Contrast 3D Mode.</p>	

## Manipulating 3D Mode image data

This section describes how to use the 3D Mode tools to better define and visualize specific areas in the image.

### Rotating an image

You can rotate an image when you are in Cube View, Cross View and Surface View.

#### To rotate an image

- 1 Position the cursor outside the volume, and then left-click.
- 2 Drag in any direction.
- 3 Left-click to stop the rotation.

## Panning an image

### To pan an image


- 1 Position the cursor in the image pane.
- 2 While pressing the **Shift** key on your keyboard, left-click and drag in any direction.
- 3 Left-click to stop the panning.

## Rendering an image

Use the Render tool for adjusting the Opacity and Luminance settings of your image. You can only use this tool when you are viewing a 3D image in the Cube View.

Available for B-Mode 3D (3D-Mode), Nonlinear Contrast 3D Mode, Linear Contrast 3D Mode, Color 3D Mode, Power 3D Mode and PA-Mode 3D (Single).

### To render an image

- 1 Click  to display the 3D Settings panel.
- 2 Click **Render** at the top of the menu.
- 3 Click one of the following options:
  - a. Texture Mapping

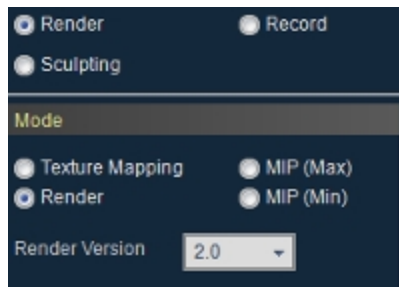
Texture Mapping displays the surface texture of the 3D Mode image in Cube View for each pane of the image.

**Note:** For 3D Mode images that apply color map overlays, the Threshold tool will appear. See "[Threshold color-mapped 3D images](#)" on page 409

b. Render

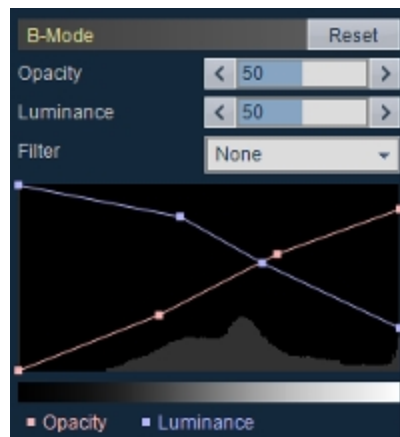
Render mode displays the full 3D Mode image in the Cube View. The Cube View traces each line of the data perpendicular to the display for the full image.

- i. Select your Render Version. The software will default to the version that was used when the image was originally saved. You can toggle your version to display the latest Render Version 2.0—this version has more options than what is available for the 0 and 1.0 versions.

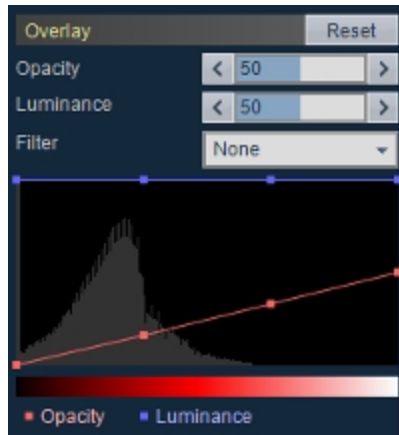


Render Version 2.0 options include:

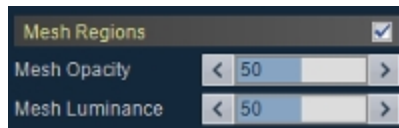
- Better render quality for rendered cube view.
  - Faster, more efficient display.
  - Mesh visualization inside rendered cube view.
  - Noise reduction pre-processor.
  - Better Color/Grey scale overlay visualization.
- ii. Use the Opacity curve to adjust the levels of transparency in the B-Mode image and use the Luminance curve to artificially adjust the contrast of the image. Click **Reset** to return Opacity, Luminance and Filter to their original settings.



- iii. For Nonlinear Contrast 3D Mode, Color 3D Mode, Power 3D Mode and PA-Mode 3D (Oxy-Hemo), use the Overlay Opacity and Overlay Luminance curves to adjust the opacity and luminance of the color map overlays.



- iv. Apply a noise reduction filter to either the B-Mode image or Overlay, select between None, Low or High.
- v. For PA-Mode 3D (Multi-wavelength/NanoStepper) images with a Multi-slice volume and B-Mode Only display layout, an additional Mesh Regions section is available. Click the Mesh Regions checkbox to enable this option, then adjust the Opacity and Luminance for the Mesh Region(s).



- vi. (Optional) Click **Reset** to return Opacity, Luminance and Filter to the original image settings for B-Mode and Overlay—Reset does not affect the Mesh Regions settings.

c. MIP (Max)

MIP (Maximum Intensity Persistence) enhances the contrast of an image by maximizing the brightest pixels in the image. Use this mode to better distinguish organs from their surrounding area when the organ objects are brighter than their surrounding structures.


d. MIP (Min)

MIP (Min) (Minimum Intensity Persistence) enhances the contrast of an image by minimizing the brightest pixels in the image. Use this mode to better distinguish organs from their surrounding area when the organ objects are darker than their surrounding structures.

## Sculpting an image

Use the Sculpting tool in 3D Mode to cut away superfluous image data so you can view volumes of interest more easily. You can only use this tool when you are viewing a 3D image in the Cube View.

### To sculpt an image

- 1 Click  to display the 3D Settings panel.
- 2 Click **Sculpting**.
- 3 Select from the three available modes as described in the following table:

Sculpting Tools

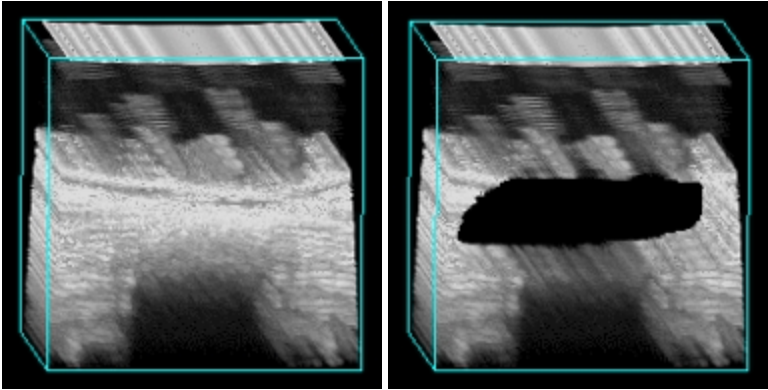
Mode	Description
Shave	Shave gives you fine control over the amount of data you want to cut away. This mode functions like an eraser. Set the depth that

## Sculpting Tools

Mode	Description
	<p>the tool will shave the target and then use the tool on the image in Cube view.</p> <p><b>To shave a 3D image data set</b></p> <ol style="list-style-type: none"> <li>1 Under Mode, click <b>Shave</b>.</li> <li>2 Under Depth, set the slider to the depth of shave required. Depth slider values are proportional. The Max setting represents the full distance through the image. When you set the slider to Max, Vevo LAB shaves a hole completely through the image.</li> <li>3 Step through the image slices to find the plane from which shaving should start.</li> <li>4 Move the cursor in the target area.</li> <li>5 Drag the cursor.</li> <li>6 Release the mouse button to complete the shaving procedure.</li> </ol>
Scalpel (Inside)	<p>Scalpel (Inside) mode functions like a cookie cutter. Select a depth, then outline an area within which to remove data.</p> <p><b>To scalpel inside a 3D image</b></p> <ol style="list-style-type: none"> <li>1 Under Mode, click <b>Scalpel (Inside)</b>.</li> <li>2 Under Depth, set the slider to the required depth.</li> <li>3 Position the cursor over the image.</li> </ol>



## Sculpting Tools

Mode	Description
	<p>4 Drag the cursor to create the outline of the area.</p> <p>5 Release the mouse button. The outlined area is removed from the image. See the two images below—on the left is the original image, on the right is the image after Scalpel (Inside).</p> 
<p>Scalpel (Outside)</p>	<p>Scalpel (Outside) mode functions like a cookie cutter, much the same way as Scalpel (Inside). Select a depth, then outline an area.</p> <p>To scalpel outside a 3D image</p> <ol style="list-style-type: none"> <li>1 Under Mode, click <b>Scalpel (Outside)</b>.</li> <li>2 Under Depth, set the slider to the required depth.</li> <li>3 Move the cursor over the image.</li> <li>4 Drag to create the outline of the area.</li> </ol>

## Sculpting Tools

Mode	Description
	<p>5 Release the mouse button. Data outside the outlined area is removed from the image. See the two images below—on the left is the original image, on the right is the image after Scalpel (Outside).</p> <div></div>

### Toggling ECG Trigger on an image

If your 3D image was acquired with dual ECG Trigger enabled, you will be able to view the set of images acquired for each trigger point while viewing your data in the 3D view.

**Note:** Available when dual ECG Trigger is enabled during an acquisition in 3D-Mode (B-Mode 3D), Power 3D Mode, Color 3D Mode and Nonlinear Contrast 3D Mode.

#### To toggle ECG Trigger

- 1 Load a 3D Mode image acquired with dual ECG Trigger into 3D view.

2 Note the current trigger image set that is currently displayed by looking at the visualization tools at the bottom of the screen.

In the example below, T1 is active, therefore all of the image data you see was acquired at the T1 setting.



3 To change to the T2 image set, click **T2**. The image data that you now see is only displaying data that was acquired at the T2 setting.

4 (Optional) Add measurements to either image data set.

5 (Optional) Add volumes to either image data set.

## Creating a 3D Volume measurement

In Cube View, the 3D Volume tool accurately measures object volumes within an image. Volumes are created by segmenting a series of contours and calculating the volume within the contoured region.

You can create a 3D Volume in B-Mode 3D (3D-Mode), 4D-Mode, Color 3D Mode, Power 3D Mode, PA-Mode 3D (Single), PA-Mode 3D (Oxy-Hemo), PA-Mode 3D (Multi-wavelength/NanoStepper), Linear Contrast 3D Mode and Nonlinear Contrast 3D Mode.

Typically, the Rotational Method should be used when the volume resembles a spherical shape, otherwise, use the Parallel Method.

For the Parallel Method, Vevo LAB can perform manual, semi-automated or automated segmentation of the volume. The Rotational Method does not support manual segmentation.

- When you segment the volume manually (in Parallel Method only) you manually draw each contour of the volume.


- When you segment the volume semi-automatically, Vevo LAB draws multiple contours.

For the Multi-slice Method, Vevo LAB allows more control when placing your contours. Choose either an open or closed volume—open volumes are best for a regular, spherical shape like a tumor, where closed volumes are best when your are dealing irregular shapes.

**Important:** FUJIFILM VisualSonics suggests using only one method per analysis within a study.

## Parallel Method

To create a volume using the Parallel Method

- 1 Click  to display the Volume Measurement panel.
- 2 Click **Parallel & Rotational Methods**.
- 3 In the Volume section, for the Parallel option click **Start**. The image will automatically be displayed in the Cube View.



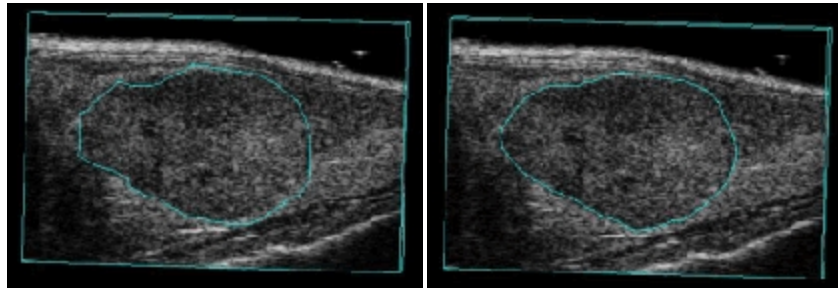
- 4 To create the first contour, complete the following:
  - i. Trace the contour you want to define and then right-click the last point, or left-click near the first point to complete the contour.

**Note:** If you make an error while creating your volume, press the **Backspace** key on your keyboard as often as required to undo your contour until you are ready to move forward again.

The first contour of the first volume measurement contour is displayed as Contour 001: 0.00 mm in the Contour List.

- ii. Click **Refine** to initiate the edge detection algorithm. This function detects the edge of the vessel or volume wall and attempts to closely fit the line to the outside wall of the vessel or volume. The Refine function can be repeated to achieve the closest possible fit.

**Note:** The Refine function achieves the best results when the contour is drawn just outside the boundary of the anatomical structure.



*Initial contour*

*Refined contour*

5 You can draw subsequent contours manually or semi-automatically. Select the preferred parameters in the Segmentation area of the Volume tool.

**Segmentation**

Step Size  mm

Steps

Direction

**Proceed**

- i. Set the Step Size. The default step size is the scan step size.
- ii. Set the number of Steps to a value of 2 or more. When you use semi-automatic segmentation, Vevo LAB generates the contours automatically. Each contour is refined before the next contour is drawn.
- iii. Set the Direction of Segmentation: Inward, Outward, or Both.
- iv. Click **Proceed** to generate the additional contours you configured. The Contour List displays the additional contours.

**Note:** The distance specified next to the label of the contour identifies the distance from the first plane of the cube.


6 Repeat the previous step as necessary until the desired number of contours have been defined, and then click **Finish** to calculate the following parameters:

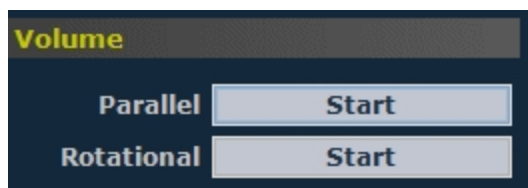
- 3D Volume in cubic millimeters ( $\text{mm}^3$ )
- Percent Agent–Linear/Nonlinear Contrast 3D Mode, Percent Vascularity–Color/Power Doppler 3D Mode, Percent Signal–PA-Mode 3D (Single), PA-Mode 3D (Oxy-Hemo), PA-Mode 3D (Multi-wavelength/NanoStepper)

You have successfully created the first calculated volume set for the image. If you need a second volume you can create an additional set of contours.

## Rotational Method

To create a volume measurement using the Rotational Method

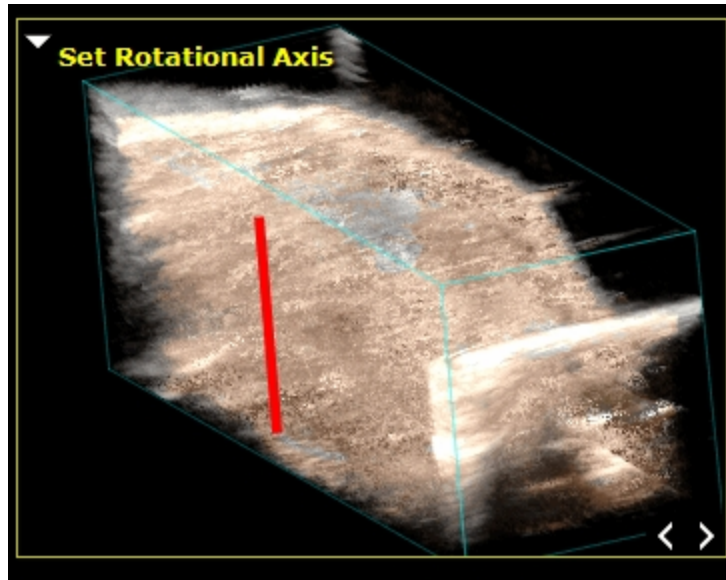
- 1 Click  to display the Volume Measurement panel.
- 2 Click **Parallel & Rotational Methods**.
- 3 In the Volume section, for the Rotational option, click **Start**. The image will automatically be displayed in the Cube View.



- 4 In the Cube View:
  - i. In the lower-right corner of the panel, click the < > tools to step to a slice that is not one of the outer slices of the cube.
  - ii. Click **Start**.

Vevo LAB prompts you to set a Rotational Axis. To set the axis click once at one end of the axis of rotation and then click at the other end.

The axis of rotation should run through entire volume region as shown in the following illustration:



- iii. The yellow cube command prompts you to Draw First Contour.
- iv. Click to create a point on the circumference of a contour and then trace the contour. Vevo LAB adds points as you trace.

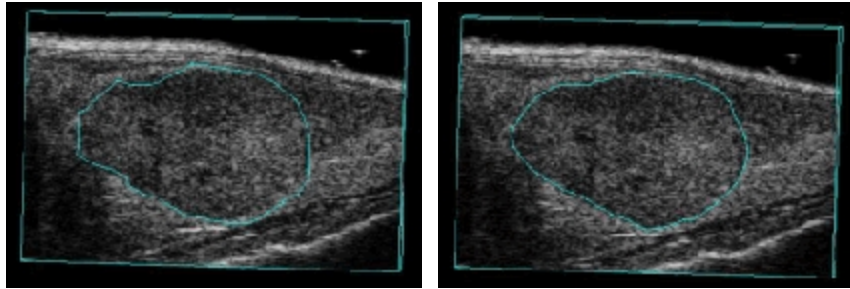
**Note:** If you make an error while creating your volume, press the **Backspace** key on your keyboard as often as required to undo your contour until you are ready to move forward again.

- v. To complete the contour, right-click the last point, or left-click near the first point. The contour is displayed in the contour list as Contour 001: 0.00° if this is the first contour of the first volume measurement on the image. The contour color changes from blue to the specified color.
- vi. (Optional) Click **Refine** to initiate the edge detection algorithm. This function detects the edge of the vessel or volume wall and attempts to closely fit the line to the outside wall of the vessel or volume. Continue



to refine the image to achieve the closest possible fit.

The Refine function achieves the best results when the contour is drawn just outside the boundary of the anatomical structure.



*Initial contour*

*Refined contour*

After you refine at least one contour, from the Contour List select the volume and then click the appropriate recalculation command:

- a. PA (Percent Agent) Recalc for Nonlinear and Linear Contrast Mode images.
- b. PV (Percent Velocity) Recalc for Color Doppler Mode images and Power Doppler Mode images.
- c. PS (Percent Signal) Recalc for PA-Mode images.

**Note:** If you make an error while creating your volume, press the **Backspace** key on your keyboard as often as required to undo your contour until you are ready to move forward again.

5 Set the Segmentation parameters:

- i. Set the Angle of rotation. The angle represents the degrees separating each contour.
- ii. Select the Steps value. This specifies the number of contours Vevo LAB creates. By default, this parameter is set to Auto.
- iii. Select the Direction of rotation. Select either Clockwise or Counterclockwise—relative to the axis of rotation.

#### 6 Click **Proceed**.

Vevo LAB draws the contours, based on the segmentation parameters you configured and displays the additional contours in the Contour List.


**Note:** The distance specified next to the label of the contour identifies the distance from the first plane of the cube.

#### 7 Click **Finish** to calculate the percent agent.

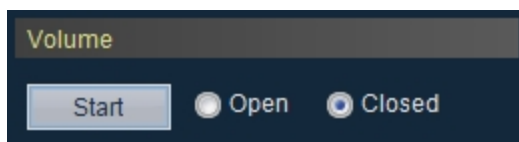
## Multi-slice Method

Once you select **Start**, Vevo LAB switches to the Transverse and Multi-slice Views. The Multi-slice View is displayed for an easier way to navigate through your slices while you are drawing irregular contours.

### To create a volume measurement using the Multi-slice Method

- 1 Click  to display the Volume Measurement panel.
- 2 Click **Multi-slice Method**.
- 3 In the Volume section:

- i. Click either an **Open** or **Closed** volume. Choose an open volume for regular, spherical shapes, and a closed volume for irregular shapes.



Volumes will be displayed in the Contour List as either Open  or Closed .

- ii. Click **Start**. The image will automatically be displayed in the Transverse and Multi-slice View.

#### 4 In the Transverse View:

- i. Draw a contour.
- ii. In the lower-right corner of the panel, click the < > tools to step to a different slice to draw additional contours.

**Note:** If you draw a contour on the first image slice and then a second contour on the last slice, Vevo LAB will automatically draw contours on every slice between the two contours.

5 When you are done, click **Finish**. The volume is displayed for the 3D volume you just created, and is displayed in mm<sup>3</sup>.

6 Once your volume is complete, click the appropriate recalculation command:

- a. PA (Percent Agent) Recalc for Nonlinear and Linear Contrast Mode images.

- b. PV (Percent Vascularity) Recalc for Color Doppler Mode images and Power Doppler Mode images.
- c. PS (Percent Signal) Recalc for PA-Mode images.

## Editing a volume contour

After you create a volume you can edit one or more of the contours.

### To modify a contour for the Parallel & Rotational Methods

- 1 Select the contour in the Contour List.
- 2 On the Transverse View, click a caliper point, drag it to a new position, then click to set the new location.
- 3 Repeat the procedure for any other contour caliper points you want to edit.
- 4 (Optional) Change the color of your contour by selecting a color from the drop down color menu located below the Contour List.

### To move a contour for Parallel & Rotational Methods

- 1 On the Transverse View, hover over the contour you want to edit.
- 2 Left-click between the caliper points on the contour line and drag to the new location.
- 3 Release the left mouse button to save your changes.

### To delete a contour for Parallel & Rotational Methods

- 1 Click a contour in the Contour List.

## 2 Click **Delete**.

If you are deleting a contour from a volume that only has two contours, a Delete Measurement confirmation dialog will be displayed . If a volume has only two contours, the entire volume will be removed. Click **OK** or **Cancel**.

## 3 The contour will be deleted.

### To modify a contour for the Multi-slice Method

#### 1 Select the contour in the Contour List.


2 Select a slice from the Multi-slice View panel. The Transverse View will be updated with your selection.

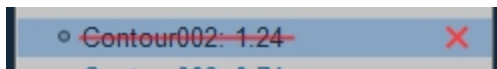
3 On the Transverse View, click a caliper point, drag it to a new position, then click to set the new location.

Once a contour has been edited, the Contour List changes to display the text of the edited contour to **black** instead of **blue** (auto-generated contours), see Contour002 in the image below.



#### 4 Repeat the procedure for any other contour caliper points you want to edit.

5 (Optional) Delete the modified contour from the Contour List by left-clicking on the contour, then click on the red .

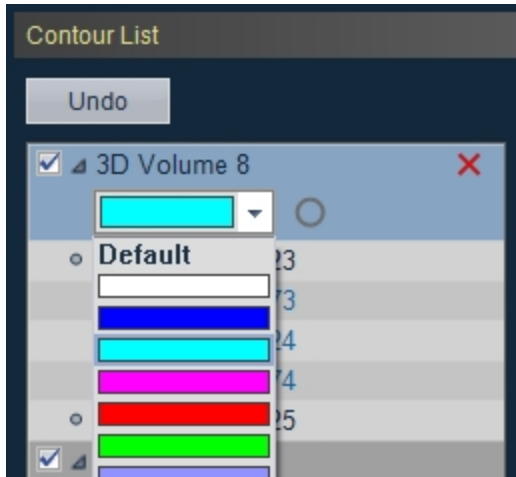


The contour will be regenerated and will no longer be displayed as a modified contour in the Contour List, see Contour002.



**Note:** If you have at least 3 modified contours in a volume, you will be able to delete a contour at the start or end of the volume. If you delete the start or end contour of a volume, the software will delete that contour plus any auto-generated contours up to the next modified contour.



6 (Optional) Change the color of your contour by selecting a color from the drop down color menu in the Contour List.



### To move a contour for the Multi-slice Method

- 1 On the Transverse View, hover over the contour you want to edit.
- 2 Left-click on the center of the contour and drag to a new location.
- 3 Release the left mouse button to save your changes.

### To delete a contour for the Multi-slice Method

- 1 Select a contour from the Contour List.
- 2 A red  will be displayed beside the contour. Click the .

If you are deleting a contour from a volume that only has two contours, a Delete Measurement confirmation dialog will be displayed. If a volume has only two contours, the entire volume will be removed. Click **OK** or **Cancel**.

- 3 The contour will be deleted.

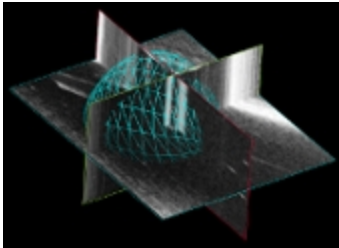
## Displaying a volume measurement as a 3D object

To display a volume measurement as a 3D object

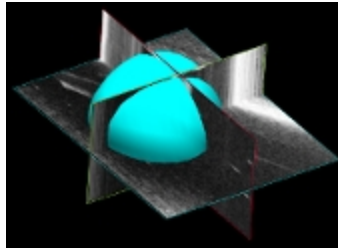
- 1 On the visualization tools toolbar, click the Surface View icon



Vevo LAB compiles a 3D representation of the volume in the Surface View, and then displays the measured volume as a wire mesh overlay on the three planes.



*Wire mesh overlay*



*Surface overlay*

- 2 Use the rotate, pan and zoom tools to modify the view of the object.




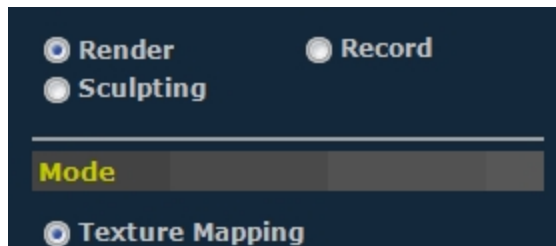
## Threshold color-mapped 3D images

Threshold provides a draggable control you can use to adjust the amount of color data that appears in images in the following 3D Mode based imaging modes:

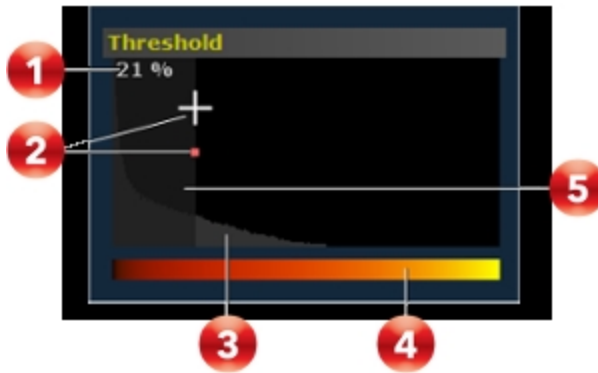
- PA-Mode 3D (Single)
- PA-Mode 3D (Oxy-Hemo)
- PA-Mode 3D (Multi-wavelength/NanoStepper)
- Color 3D Mode
- Power Doppler 3D Mode
- Linear Contrast 3D Mode
- Nonlinear Contrast 3D Mode

### To control the threshold of a color-mapped 3D image

- 1 Click  to display the 3D Settings panel.
- 2 Select **Render** at the top of the panel.
- 3 Under the Mode section, select **Texture Mapping**. The **Threshold** control panel appears.



4 Drag the control handle to adjust the threshold level as described in this illustration.



Threshold Controls

<b>1</b>	Displays the current percentage of color threshold you are applying.
<b>2</b>	Hover your cursor over the red handle until your cursor becomes a cross. To see more color, drag to the left, to see less color, drag to the right.
<b>3</b>	Histogram representing the color distribution.
<b>4</b>	Shows the full range of available color.
<b>5</b>	Semi-transparent gray screen. Shows you exactly where your threshold level meets the histogram so you can gauge how much color you are screening out.

The color data on the 3D image changes dynamically as you adjust the threshold level.

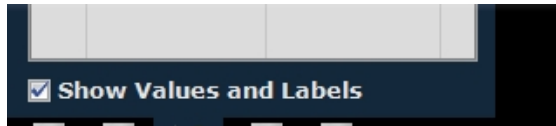
**Note:** Because Vevo LAB calculates volumes based on the amount of color data in an area, threshold affects the volume calculations. The higher you set the threshold, the lower the calculated area volume of color data will be.

## Adding generic 3D Mode measurements

3D Mode provides two generic measurement tools.

### Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want to hide the measurement values and labels, clear the Show Values and Labels check box in the Measurement tab in Preferences under a custom measurement package.
- If you want to temporarily override the default, check/uncheck the Show Values and Labels check box at the bottom of the measurement panel.



To access the generic measurement tools for 3D Mode

- ◆ Open an image and then click Measurements . Vevo LAB displays the measurement tools at the top of the Measurements panel. Hover over a tool

to see the description label.

## Generic 3D Mode measurements


All generic measurements are described in "[Generic Measurements](#)" on page 465. The following generic measurements are available for 3D Mode images:

- "[Linear measurement](#)" on page 498
- "[2D Area measurement](#)" on page 467

## Recording a 3D Mode analysis session

The Record tool creates a real-time AVI file of actions you perform on 3D image data in the active pane.

### To record a 3D Mode analysis study session

- 1 Load a 3D Mode image into review.
- 2 From the Image Processing panel, click **Load into 3D**.
- 3 Click  to display the 3D Settings panel.
- 4 Click to select **Record** at the top of the panel.
- 5 Choose to record volume surface data or not.
  - a. If you want to record volume surface data:
    - i. Select the Surface View Rotation check box, then select between the options that become available.

ii. Configure the Surface Overlay and rotation parameters.

b. If you do not want to record volume surface data:

i. Deselect the Surface View Rotation check box.

ii. If you want to have the option to record a playback through different volumes, click the **Step through volumes** check box to enable this option.

6 Click **Start Recording**. The 3D Recording window will be displayed.

7 Browse to the location you would like to save your file.

8 (Optional) Name the file by typing text in the Save As text box.

9 Select the File Type for the recording.

**File Types and Descriptions**

File Type	Description
Uncompressed AVI (*.avi)	Largest file size, provides the original image quality.
MPEG (*.mp4)	Smaller file size, provides good image quality.
Animated GIF (*.gif)	Medium file size, provides fair image quality.
Windows Media Video (*.wmv)	Smallest file size, provides good image quality.

10 Click to enable the **High resolution display during rotation** checkbox if you want to keep a high resolution during recording.

11 Click **OK**. The system starts the recording; when the recording is complete, the software will export the recording automatically.

## Exporting from the 3D Mode view window

If you are analyzing an image from the 3D Mode view window, you do not have to return to the Study Browser to export it. You can export it directly from the 3D Mode view window.

### To export from the 3D Mode view window

- 1 Load a 3D-Mode image into review.
- 2 From the Image Processing panel, click **Load into 3D**.
- 3 From the 3D Mode view window, click **Export**. The Export Image window is displayed.
- 4 Browse to and then select the folder that will contain the export.
- 5 (Optional) To add a subfolder click **New Folder**, name the folder and then click **OK**.
- 6 In the Export Type section, click **Image**.
- 7 (Optional) Name the file by typing text in the Save As text box.
- 8 Select the File Type based on your requirements.
- 9 Click **OK**. The software exports the image.

## 4D-Mode Analysis

---

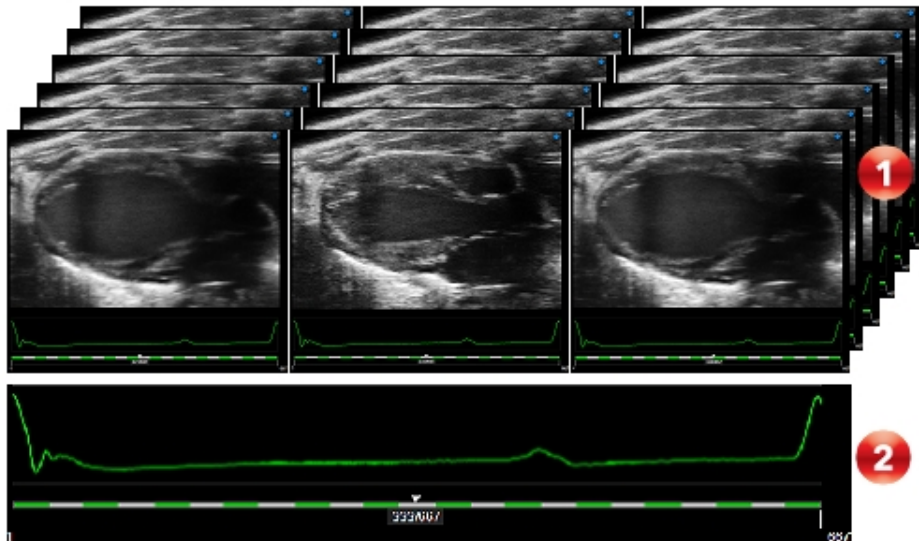
4D-Mode is a three dimensional EKV Mode (ECG-based Kilohertz Visualization) image of a one-heart-cycle clip synthesized from B-Mode image data acquired at a high frame rate.

4D-Mode is only available for acquisition on the Vevo 3100 Imaging System.

### How 4D-Mode works

The software acquires EKV (ECG-Gated Kilohertz Visualization) acquisitions at each 3D motor position. Each EKV acquisition is a complete heart cycle. Thus we end up with complete heart cycles at each motor position creating a 4D clip of the entire heart cycle.

4D EKV settings are optimized to produce high quality renderings in as short a time as possible.



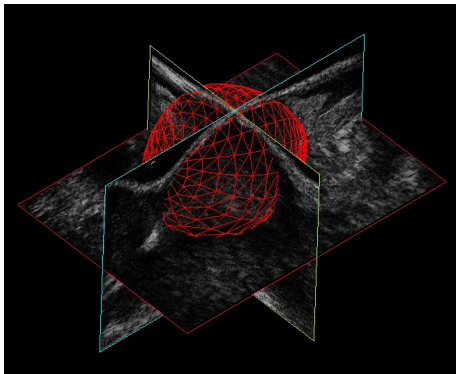
**1** Each layer represents a complete heart cycle. The image above displays the beginning (cardiac diastole when chambers of the heart are relaxed and filling passively), middle (atrial systole when the atria contract leading to ventricular filling) and end of the heart cycle (ventricular systole when blood is ejected into both the pulmonary artery and aorta). The length of each complete heart cycle is determined by your 4D settings when you acquired the image.

**2** A 4D-Mode image cine bar displays individual complete heart cycles in alternating white and green sections. The Physiological window is static and represents the average ECG trace from all of the heart cycles.

## 4D-Mode analysis

You can use the 4D analysis tools to:

- View and render objects of interest.
- Segment objects on any plane or across planes.
- Measure lengths, areas and volume.






## 4D-Mode image refinement tools

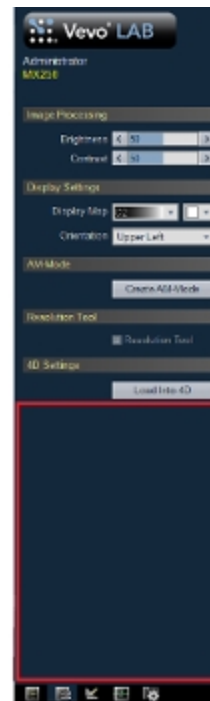
4D-Mode provides two image post-processing tools:

- EKV Processing
- EKV Resp Gate Adjust

To check if the tools are available for an image

- 1 Click  to display the Image Processing panel.
- 2 Check if the EKV refinement tools are available as follows:

*EKV refinement tools are displayed. This indicates that the Save EKV/4D data for post-processing option was enabled when the image was saved.*

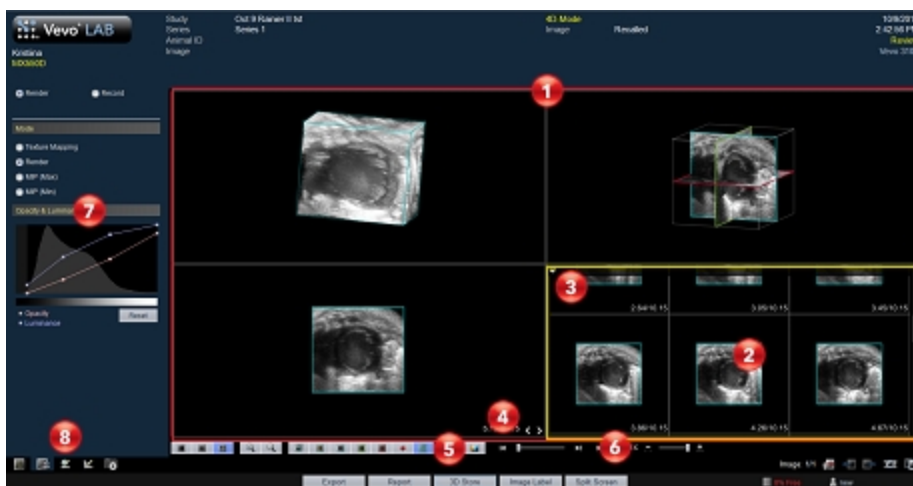


*No EKV refinement tools. This indicates that the Save EKV/4D data for post-processing option was not enabled when the image was saved.*

4D-Mode uses the same refinement tools as in EKV Mode, see "[EKV Mode image refinement tools](#)" on page 449 for more details.

## 4D-Mode window workspace

The 4D-Mode window is the workspace you use when you work with 4D-Mode image data. The following illustration identifies the key features.



**1** View panes area

Vevo LAB defaults to four view panes (Quad Pane View), but you can select Dual Pane View, Single Pane View and Multi-slice View. When you export a stored image and configure your export to send only the Image Area, this is the area of the window that Vevo LAB exports.

**2** Active pane

When you select a view pane, Vevo LAB applies a yellow border along that pane.

Each pane displays a unique view of the 4D image from a different perspective. Select a different pane or change the view of your active pane from the pane drop-down menu or the visualization options toolbar.



Active pane menu drop-down icon

Click to display the available commands that apply to the image in the active pane. Not all panes include the same commands. The following table describes all of the available commands:

**Active Pane Commands**

Command	Description
Wire-frame	Turns the image outline on/off.
Rotation	Available in cross view. Enables rotation of the image data. Once activated, left-click and drag to rotate in any direction within the pane.
Data	Available in Surface View. Toggle the display of image data on/off.
Overlay	Available in Surface View. Toggle the overlay on/off.
Surface Overlay	Available in Surface View. Toggle the surface overlay on/off.
View	Displays all of the available view options. Click a view to change the active pane view.
Orientation	Available in Cube View. Turns the orientation marker points on/off.
Plane	Available in Multi-slice View. Select either Transverse, Sagittal

### Active Pane Commands

Command	Description
Orientation	or Coronal.
Step Size Factor	Available in Multi-slice View. Set the distance between the slices displayed–1X, 2X, 3X or 4X.  <b>Note:</b> Default Step Size Factor can be set in the 3D/4D Mode Multi-slice View Defaults section under Mode Settings in Preferences.
Slice Size	Available in Multi-slice View. Set the size of the slices displayed–Auto, Small, Medium or Large.  <b>Note:</b> Default Slice Size can be set in the 3D/4D Mode Multi-slice View Defaults section under Mode Settings in Preferences.
Render Mode	Available in Cube View. Displays a list of rendering modes you can apply–Texture Mapping, Render, MIP (Max) or MIP (Min).
Restore	Resets the original view of the image including size, orientation, brightness and zoom values

#### 4 Active pane previous/next slice tool

Click < to view previous slices in your 4D image. Click > to view the next slices. You can use the following keyboard combinations to move forward or back one slice at a time, five at a time, or ten at a time, as detailed in the following table:

Command	Step size
>	1 slice
Shift + >	5 slices
Ctrl + >	10 slices

#### 5 Visualization options toolbar









Click the appropriate analysis tool to change either the number of panes or the analysis view. For complete information on each tool see ["4D-Mode visualization tools"](#) on page 424.

#### 6 Playback toolbar

Play speed, volume slider, next volume, previous volume, play and stop are all controls that are included on the playback toolbar.

By using these controls, you are actually moving through the ECG cycle, where series of 4D volumes were acquired at each point of the ECG cycle.



Control	Description
	Previous Volume.
	Volume Slider.
	Next Volume.
	Play.
	Playback rate.
	Decrease Speed.
	Speed slider.
	Increase Speed.

 3D Settings panel 

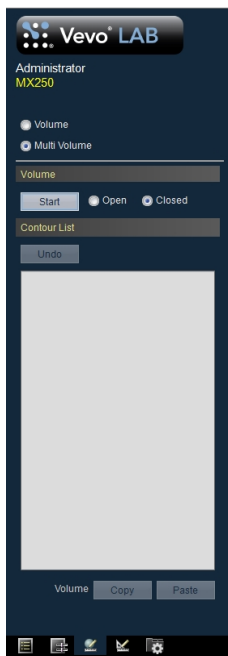
At the top of the 3D Settings panel, click either Render or Record and the corresponding tool panel appears.

If Render is selected, click the appropriate mode to display the panel you want to work with. Select either Texture mapping, Render, MIP (Max) or MIP (Min).

See "[Manipulating 4D-Mode image data](#)" on page 428 for more details.

## 8 Volume Measurement panel

At the top of the Volume Measurement panel, click either **Parallel & Rotational Methods** or **Multi-slice Method**, select either an Open or Closed volume, then click **Start**.




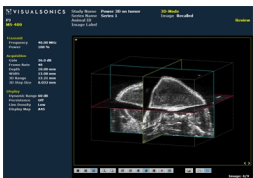



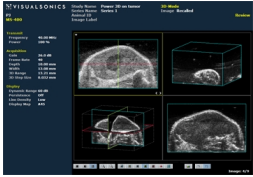
## 4D-Mode visualization tools

Visualization tools available for all 4D-Mode images


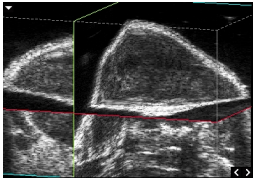

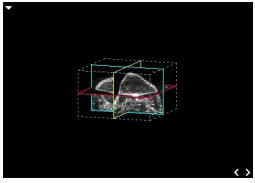

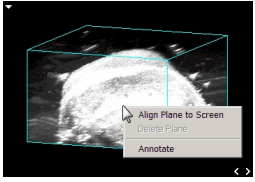



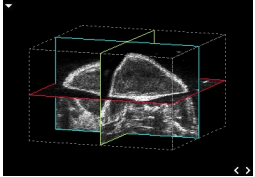

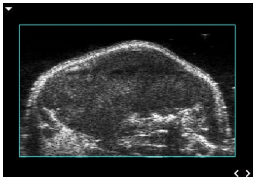

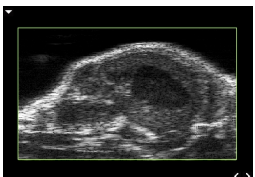
*Visualization tools for 4D-Mode with Quad Pane and Cube View options selected.*


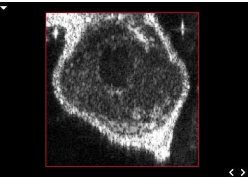

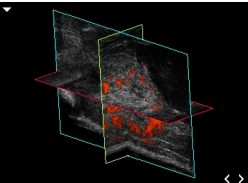

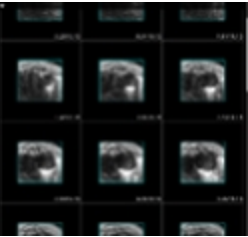

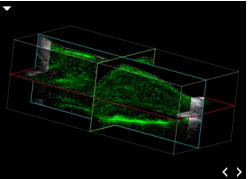
### 4D-Mode visualization tools descriptions

Tool	Description	Example
 Single Pane	Click to display one 4D-Mode image view across the entire image area.	
 Dual Pane	Click to display two 4D-Mode image views across the image area.	
 Quad Pane	Click to display four image views across the image area.	



Tool	Description	Example				
 Zoom In	Click to magnify the view up to 20 levels of zoom.					
 Zoom Out	Click to minimize the view up to 20 levels of zoom.					
 Cube View	<p>Click to display a three-dimensional view of the acquired data, constructed from the full set of B-Mode image slices. The cube displays a blue wire-frame by default.</p> <p>As you move the cursor over a plane on the cube, the plane becomes “active” and the wire-frame for that plane is displayed in green.</p> <p>Right-click a plane to display the following commands:</p> <table border="1"> <thead> <tr> <th>Command</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Align Plane to Screen</td> <td>Rotates the cube to display a head-on view of the active plane.</td> </tr> </tbody> </table>	Command	Description	Align Plane to Screen	Rotates the cube to display a head-on view of the active plane.	
Command	Description					
Align Plane to Screen	Rotates the cube to display a head-on view of the active plane.					

Tool	Description		Example
	Command	Description	
	Remove Plane	Removes a manually created plane.	
	Annotate	Provides a text box in which to type an annotation.	
 <p>Cross View</p>	<p>Click to display three single, slidable image slice views presented on the x, y, and z planes. Each plane presents its own color outline:</p> <ul style="list-style-type: none"> <li>• Blue = x-y plane on the z axis</li> <li>• Green = y-z plane on the x axis</li> <li>• Red = x-z plane on the y axis</li> </ul>		
 <p>Transverse View</p>	<p>Click to display a straight-on perspective of the x-y plane image slice, displayed on the Cross View as the plane outlined in blue.</p>		
 <p>Sagittal View</p>	<p>Click to display a straight-on perspective of the y-z plane image slice, displayed on the Cross View as the plane outlined in green.</p>		

Tool	Description	Example
 Coronal View	Click to display a straight-on perspective of the x-z plane image slice, displayed on the Cross View as the plane outlined in red.	
 Surface View	Click to display a compilation view that uses the Cross View to map user-generated volumes to the acquired data.	
 Multi-slice view	Displays each image slice within the active pane.	
 Toggle Display Map	Click to cycle through the set of display maps available for images in all B-Mode based imaging modes: <ul style="list-style-type: none"> <li>• B-Mode–C1-C6</li> <li>• Nonlinear Contrast Mode–MB1-MB3</li> <li>• Linear Mode–MB1, MB2</li> <li>• Power Doppler Mode–C1, C2</li> </ul>	

Tool	Description	Example
	<ul style="list-style-type: none"> <li>• Color Doppler Mode–C1-C5</li> <li>• PA-Mode sub-mode Oxy-Hemo and PA-Mode sub-mode Single–PA1-PA9</li> </ul>	

## Manipulating 4D-Mode image data

This section describes how to use the 4D-Mode tools to better define and visualize specific areas in the image.

### Rotating an image

You can rotate an image when you are in Cube View, Cross View and Surface View.

#### To rotate an image

- 1 Position the cursor outside the volume, and then left-click.
- 2 Drag in any direction.
- 3 Left-click to stop the rotation.

### Panning an image

#### To pan an image

- 1 Position the cursor in the image pane.


2 While pressing the **Shift** key on your keyboard, left-click and drag in any direction.

3 Left-click to stop the panning.

## Rendering an image

Use the Render tool for adjusting the Opacity and Luminance settings of your image. You can only use this tool when you are viewing a 4D-Mode image in the Cube View.

### To render an image

- 1 Click  to display the 3D Settings panel.
- 2 Click **Render** at the top of the menu.
- 3 Click **Render** in the Mode section.
- 4 Adjust the image using the following Render tools as described in the table below:

Render Tools

Tool	Description
Texture Mapping	Texture Mapping displays the surface texture of the 4D-Mode image in Cube View for each pane of the image.
Render	Render mode displays the full 4D-Mode image in the Cube View. The Cube View traces each line of the data perpendicular to the display for the full image.  Use the Opacity curve to adjust the levels of transparency in the B-Mode image and use the Luminance curve to artificially adjust the contrast of the image.

## Render Tools

Tool	Description
MIP (Max)	MIP (Maximum Intensity Persistence) enhances the contrast of an image by maximizing the brightest pixels in the image. Use this mode to better distinguish organs from their surrounding area when the organ objects are brighter than their surrounding structures.
MIP (Min)	MIP (Min) (Minimum Intensity Persistence) enhances the contrast of an image by minimizing the brightest pixels in the image. Use this mode to better distinguish organs from their surrounding area when the organ objects are darker than their surrounding structures.

## Creating a Volume measurement

In Cube View, the Volume measurement tool accurately measures object volumes within an image. Volumes are created by segmenting a series of contours and calculating the volume within the contoured region.

Typically the Rotational Method should be used when the volume resembles a spherical shape, otherwise, use the Parallel Method.

For the Parallel Method, Vevo LAB can perform manual, semi-automated or automated segmentation of the volume. The Rotational Method does not support manual segmentation.


- When you segment the volume manually (in Parallel Method only) you manually draw each contour of the volume.
- When you segment the volume semi-automatically, Vevo LAB draws multiple contours.

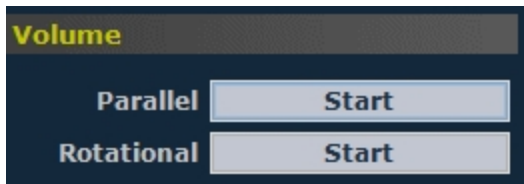
For the Multi-slice Method, Vevo LAB allows more control when placing your contours. Choose either an open or closed volume—open volumes are best for a regular, spherical shape like a tumor, where closed volumes are best when your are dealing irregular shapes.

**Important:** FUJIFILM VisualSonics suggests using only one method per analysis within a study.

## Parallel Method

To create a volume using the Parallel Method

- 1 Click  to display the Volume Measurement panel.
- 2 Click **Parallel & Rotational Methods**.
- 3 In the Volume section, for the Parallel option click **Start**. The image will automatically be displayed in the Cube View.



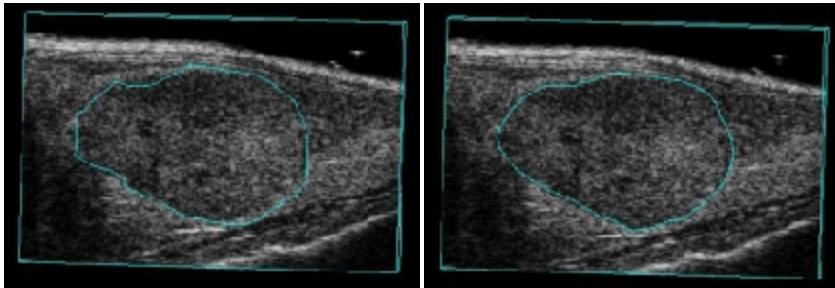
- 4 To create the first contour, complete the following:
  - i. Trace the contour you want to define and then right-click the last point, or left-click near the first point to complete the contour.

**Note:** If you make an error while creating your volume, press the **Backspace** key on your keyboard as often as required to undo your contour until you are ready to move forward again.

The first contour of the first volume measurement contour is displayed as Contour 001: 0.00 mm in the Contour List.

- ii. Click **Refine** to initiate the edge detection algorithm. This function detects the edge of the vessel or volume wall and attempts to closely fit the line to the outside wall of the vessel or volume. The Refine function can be repeated to achieve the closest possible fit.

**Note:** The Refine function achieves the best results when the contour is drawn just outside the boundary of the anatomical structure.



*Initial contour*

*Refined contour*

5 You can draw subsequent contours manually or semi-automatically. Select the preferred parameters in the Segmentation area of the Volume tool.



**Segmentation**

Step Size  mm

Steps

Direction

**Proceed**

- i. Set the Step Size. The default step size is the scan step size.
- ii. Set the number of Steps to a value of 2 or more. When you use semi-automatic segmentation, Vevo LAB generates the contours automatically. Each contour is refined before the next contour is drawn.
- iii. Set the Direction of Segmentation: Inward, Outward, or Both.
- iv. Click **Proceed** to generate the additional contours you configured. The Contour List displays the additional contours.

**Note:** The distance specified next to the label of the contour identifies the distance from the first plane of the cube.


6 Repeat the previous step as necessary until the desired number of contours have been defined, and then click **Finish** to calculate the following parameters:

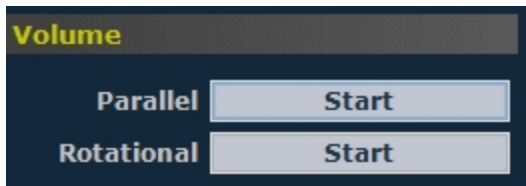
- 4D Volume in cubic millimeters ( $\text{mm}^3$ )

You have successfully created the first calculated volume set for the image. If you need a second volume you can create an additional set of contours.

## Rotational Method

To create a volume measurement using the Rotational Method

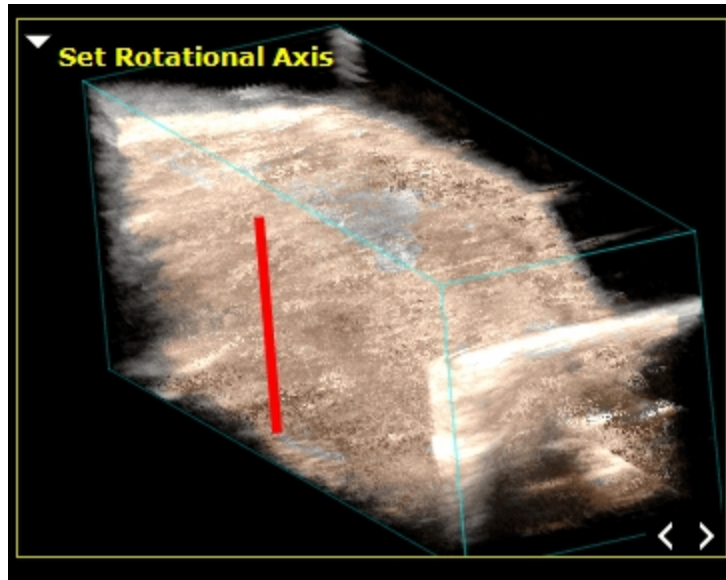
- 1 Click  to display the Volume Measurement panel.
- 2 Click **Parallel & Rotational Methods**.
- 3 In the Volume section, for the Rotational option, click **Start**. The image will automatically be displayed in the Cube View.



- 4 In the Cube View:
  - i. In the lower-right corner of the panel, click the < > tools to step to a slice that is not one of the outer slices of the cube.
  - ii. Click **Start**.

Vevo LAB prompts you to set a Rotational Axis. To set the axis click once at one end of the axis of rotation and then click at the other end.

The axis of rotation should run through entire volume region as shown in the following illustration:



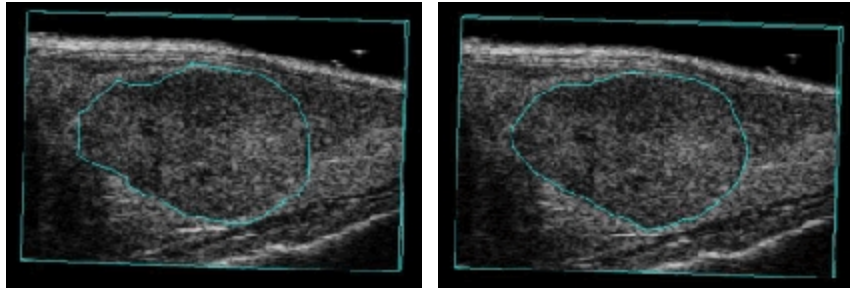
- iii. The yellow cube command prompts you to Draw First Contour.
- iv. Click to create a point on the circumference of a contour and then trace the contour. Vevo LAB adds points as you trace.

**Note:** If you make an error while creating your volume, press the **Backspace** key on your keyboard as often as required to undo your contour until you are ready to move forward again.

- v. To complete the contour, right-click the last point, or left-click near the first point. The contour is displayed in the contour list as Contour 001: 0.00° if this is the first contour of the first volume measurement on the image. The contour color changes from blue to the specified color.
- vi. (Optional) Click a contour then **Refine** to initiate the edge detection algorithm. This function detects the edge of the vessel or volume wall and attempts to closely fit the line to the outside wall of the vessel or

volume. Continue to refine the image to achieve the closest possible fit.

The Refine function achieves the best results when the contour is drawn just outside the boundary of the anatomical structure.



*Initial contour*

*Refined contour*

**Note:** If you make an error while creating your volume, press the **Backspace** key on your keyboard as often as required to undo your contour until you are ready to move forward again.

5 Set the Segmentation parameters:

- i. Set the Angle of rotation. The angle represents the degrees separating each contour.
- ii. Select the Steps value. This specifies the number of contours Vevo LAB creates. By default, this parameter is set to Auto.
- iii. Select the Direction of rotation. Select either Clockwise or Counterclockwise—relative to the axis of rotation.

6 Click **Proceed**.


Vevo LAB draws the contours, based on the segmentation parameters you configured and displays the additional contours in the Contour List.

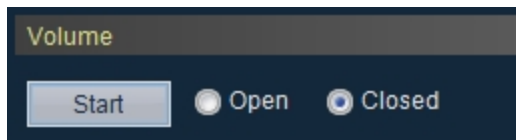
**Note:** The distance specified next to the label of the contour identifies the distance from the first plane of the cube.

## Multi-slice Method

Once you select **Start**, Vevo LAB switches to the Transverse and Multi-slice Views. The Multi-slice View is displayed for an easier way to navigate through your slices while you are drawing irregular contours.

### To create a volume measurement using the Multi-slice Method

- 1 Click  to display the Volume Measurement panel.
- 2 Click **Multi-slice Method**.
- 3 In the Volume section:
  - i. Click either an **Open** or **Closed** volume. Choose an open volume for regular, spherical shapes, and a closed volume for irregular shapes.



Volumes will be displayed in the Contour List as either Open  or Closed .

- ii. Click **Start**. The image will automatically be displayed in the Transverse and Multi-slice View.

#### 4 In the Transverse View:

- i. Draw your first contour on the volume at the first time point.
- ii. In the lower-right corner of the panel, click the < > tools to step to a different slice to draw the next contour on the volume at the first time point.

**Note:** If you draw a contour on the first image slice and then a second contour on the last slice, Vevo LAB will automatically draw contours on every slice between the two contours.

- iii. Click **Done** on the Volume Measurement panel to complete the measurement at the first time point.
- iv. Click the < > tools to step to a different slice.
- v. Click **Continue** on the Volume Measurement panel to draw a contour on the volume at the middle point.
- vi. Draw the first and second contours at the middle time point similar to steps i, ii and iii.
- vii. Draw the first and second contours at the quarter time point similar to steps i, ii and iii.
- viii. Click **Finish** to complete the 4D measurement.

The volume is displayed for the 4D volume you just created, and is displayed in mm<sup>3</sup>.


## Adding generic 4D-Mode measurements

Adding generic 4D-Mode measurements is the same as in 3D Mode, see ["Adding generic 3D Mode measurements"](#) on page 411.

## Recording a 4D-Mode analysis session

The Record tool creates a real-time AVI file of actions you perform on 4D-Mode image in the active pane.

### To record a 4D Mode analysis study session

- 1 Load a 4D-Mode image into review.
- 2 From the Image Processing panel, click **Load into 4D**.
- 3 Click  to display the 3D Settings panel.
- 4 Click to select **Record** at the top of the panel.
- 5 Choose to record volume surface data or not.
  - a. If you want to record volume surface data:
    - i. Select the Surface View Rotation check box, then select between the options that become available.
    - ii. Configure the Surface Overlay and rotation parameters.
  - b. If you do not want to record volume surface data:
    - i. Deselect the Surface View Rotation check box.
    - ii. If you want to have the option to record a playback through different volumes, click the **Step through volumes** check box to enable this option.
- 6 Click **Start Recording**. The 3D Recording window will be displayed.
- 7 Browse to the location you would like to save your file.

- 8 (Optional) Name the file by typing text in the Save As text box.
- 9 Select the File Type for the recording.

File Types and Descriptions

File Type	Description
Uncompressed AVI (*.avi)	Largest file size, provides the original image quality.
MPEG (*.mp4)	Smaller file size, provides good image quality.
Animated GIF (*.gif)	Medium file size, provides fair image quality.
Windows Media Video (*.wmv)	Smallest file size, provides good image quality.

- 10 Click to enable the **High resolution display during rotation** checkbox if you want to keep a high resolution during recording.
- 11 Click **OK**. The system starts the recording; when the recording is complete, the software will export the recording automatically.

## Exporting from the 4D-Mode view window

If you are analyzing an image from the 4D-Mode view window, you do not have to return to the Study Browser to export it. You can export it directly from the 4D-Mode view window.

**Note:** When exporting 4D-Mode image as 3D Volume slices, each individual 4D slice is saved in a separate TIFF file. All TIFF files are numbered sequentially in Z direction (slice in volume) and also in the T direction (Time). The number of TIFF files generated shall equal the number of frames acquired for the 4D-Mode image.



### To export from the 4D-Mode view window

- 1 Load a 4D-Mode image into review.
- 2 From the Image Processing panel, click **Load into 4D**.
- 3 From the 4D-Mode view window, click **Export**. The Export Image window is displayed.
- 4 Browse to and then select the folder that will contain the export.
- 5 (Optional) To add a subfolder click **New Folder**, name the folder and then click **OK**.
- 6 In the Export Type section, click **Image**.
- 7 (Optional) Name the file by typing text in the Save As text box.
- 8 Select the File Type based on your requirements.
- 9 Click **OK**. The software exports the image.

## EKV Mode Analysis

EKV Mode (ECG-based Kilohertz Visualization) is an image reconstruction technique that produces a one-heart-cycle cine loop synthesized from B-Mode image data acquired at a very high frame rate.

The process works by acquiring data over multiple heart cycles, extracting data at specific time points in these cycles, then producing a representative one-heart-cycle cine loop.

To analyze an EKV Mode image, you can use the same analysis tools you use to analyze a B-Mode image. Additional EKV Mode refinement tools in the Image Processing panel are also available.

## EKV Mode window workspace

The EKV Mode window is the workspace you use when you work with EKV Mode image data. The following illustration identifies the key features.



## 1 EKV Mode image area

- Displays image data.
- Displays physiological data for the animal (if recorded during image acquisition).
- Provides cine loop range controls for acquired cine loops.
- Provides Browse Images controls for scrolling through an inset gallery of images without having to return to the Study Browser.

If you export an image and select Image as your export type, Vevo LAB includes the image area content along with header information.

## 2 Image data panel

The image data that the transducer acquires. This is where you do the majority of work with images such as reviewing, adding measurements and annotations, post-processing image properties, and more.

## 3 Image scale


Indicates the distance from the transducer face to the tissue being imaged at the moment of acquisition. The image scale units are displayed in mm.

## 4 Focus depth indicator

The triangular arrow indicates the focal depth of the transducer.

## 5 Orientation icon

The orientation icon indicates the orientation of the transducer during acquisition in relation to the image.

For Vevo 3100 and Vevo LAZR-X image data, you can change the orientation in Vevo LAB via the Image Processing panel , under the Display Settings section in the Orientation drop down menu. Choose between Upper Left, Upper Right, Lower Left, and Lower Right.

## 6 Display map scale

Indicates the dynamic range of the display. The contrast of the image is measured in dB and is adjusted at time of acquisition.

## 7 Physiological data values

Displays the animal's recorded heart rate.

## 8 Physiological data trace panel

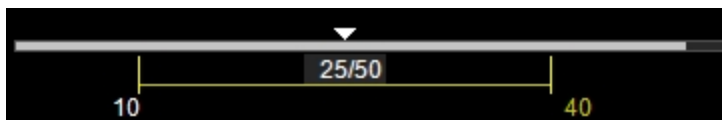
Displays a single cardiac cycle.

## 9 Cine loop control

Displays the length of the cine loop. The triangular white marker identifies the individual frame number within the cine loop.



To create a range within the loop, drag the left and right vertical markers.



## 10 Playback control





You can select the playback speed (via slider or - / + controls) and what image frame is being displayed in the mode window.



**Note:** When playback is paused, you will be able to scroll through the image using your mouse wheel.


## 11 Image mode management panel

Displays a unique set of controls and information depending on the image management panel tab you click:

- Click the Mode Settings tab icon  to open the Mode Settings panel and display a read-only list of Mode Settings for the image. This is the default panel when you open a mode window.
- Click the Image Processing tab icon  to open the Image Processing panel and to display the following:
  - Any available mode-specific image controls you can apply to the image.
  - Read-only image control settings that were applied during acquisition.
- Click the Measurements tab icon  to open the Measurements panel and display the available measurement tools.
- Click the Physiological tab icon  to open the Physiological panel and display the following, (if physiological data was recorded during acquisition):
  - The Physiological Display options that you can apply to the image.
  - Physiological Display settings and Respiration Gating settings that were recorded during acquisition.


**Note:** This panel is always available and editable.

You can clear the View Physiology check box to hide the data from the image. Hiding the data will increase the size of the image.

- Click the Preferences tab icon  to open the Preferences window. This window provides a series of tabs you can use to customize the way you work with a range of Vevo LAB features, see "[Preferences](#)" on page 93.

## EKV Mode settings

To view the EKV Mode settings

- ◆ Open the EKV Mode image and then, at the bottom of the image management panel, click the Mode Settings tab icon .

The Mode Settings panel displays the following list of parameters:

### Transmit

Parameter	Description
Frequency	The ultrasound frequency during acquisition, measured in MHz.
Power	The transmission power level of the ultrasound signal during acquisition, displayed as a percentage of the maximum power.

### Acquisition

Parameter	Description
Gain	The strength of the ultrasound signal during acquisition, specified in dB increments.
Depth	The distance, measured in mm, from the face of the transducer during acquisition.
Width	The width of the acquired image area during acquisition, measured in mm.
Line Density	The line density level during acquisition—Standard or High.

Parameter	Description
Persistence	The state of the Persistence feature during acquisition—Off, Low, Med, High or Max.
Sensitivity	The level of detail at deeper distances from the transducer head during acquisition.
EKV	The frame rate, in Hz, that was used during EKV acquisition.
Acquisition Type	The selected EKV acquisition setting before acquisition—Quick, Standard or Presentation.
Resp Gate	The state of the Respiration Gating during acquisition—On or Off.

#### Display

Parameter	Description
Dynamic Range	The contrast of the image during acquisition, measured in dB.
Display Map	The selected predefined display map, applied during acquisition, from the predefined set of maps.
Brightness	The image brightness level during acquisition.
Contrast	The image contrast level during acquisition.




## EKV Mode image refinement tools

EKV Mode provides two image post-processing tools that help you refine image quality and create new EKV Mode images:

- EKV Processing
- EKV Resp Gate Adjust

**Note:** You can only use these tools on a stored EKV Mode loop if the Save Data for EKV Processing check box in the Image Processing tools panel was selected on a Vevo Imaging System before the loop was saved.

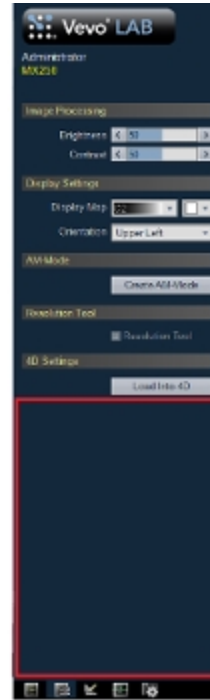
To check if the tools are available for an image

- 1 From the Study Browser, open the EKV Mode image.
- 2 Click the Image Processing tab  at the bottom of the image management panel. The Image Processing panel appears.
- 3 Check the tools that appear, as shown in the following illustration:

*EKV refinement tools are displayed. This indicates that the Save EKV/4D data for post-processing option was enabled when the image was saved.*



*No EKV refinement tools. This indicates that the Save EKV/4D data for post-processing option was not enabled when the image was saved.*




## Refining EKV image detail quality

**Note:** You can only use this EKV Mode image refinement tool if the image was saved with the Save EKV/4D data for post-processing option selected at the time of acquisition on the Vevo Imaging System.

To refine the quality of an EKV image

- 1 From the Study Browser, open an EKV Mode image.

2 Click the Image Processing tab  at the bottom of the image management panel. The Image Processing panel appears.

3 In the EKV Processing section, choose the appropriate Quality setting from the drop-down list as follows:

Setting	Description
Sharp	Emphasizes quality of detail in each cine loop frame.
Standard	Emphasizes smoothness of movement through the cine loop.
Smooth	Maximizes smoothness of movement through the cine loop.


## Refining EKV image respiration effects

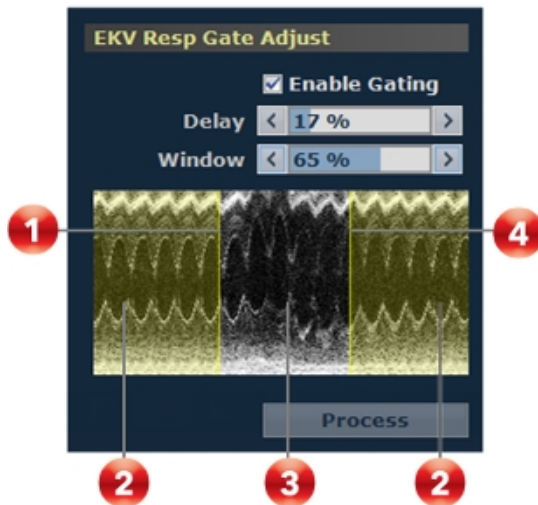
The natural act of respiration can affect the heart cycle image slightly as the diaphragm and chest cavity moves the position of the heart.





The EKV respiration gate is an image processing tool you can use to reduce this effect. Based on the data acquired during an EKV Mode scan, this gating tool gives you controls to select heart cycle data that is least affected by respiration.

Typically, you do not need to directly adjust the Delay and Window controls. For most acquisitions, it is sufficient to select the Process Quality settings in the EKV Acquisition Setup dialog box during your scan setup. The refinement described in this section is most useful for complicated situations.

## To refine the image by adjusting the EKV respiration gate

- 1 From the Study Browser, open an EKV Mode image.
- 2 Click the Image Processing tab  at the bottom of the image management panel. The Image Processing panel appears.
- 3 In the EKV Resp Gate Adjust section, click the Enable Gating check box.
- 4 The Delay and Window slider tools become available.
  - i. As shown below, adjust the gate window to create the respiration gate. Work back and forth between the window length controls and the delay controls to refine the adjustment so that you include (by dragging the yellow transparency over) the heart cycle data that is least affected by the movement of the chest cavity during respiration.



	<p>Window length handle. Alternative to the Window slider control. Drag the handle left or right to the point where you visually see the effect of the movement of the chest cavity during respiration.</p>
	<p>This heart cycle image data is included in the data when you click <b>Process</b>.</p>
	<p>This heart cycle image data is excluded from the data when you click <b>Process</b>.</p>
	<p>Delay handle. Alternative to the Delay slider control. Drag the handle left or right to the point where you visually see the effect of the movement of the chest cavity during respiration.</p>

- ii. Click **Process**. Vevo LAB synthesizes all the scan data into a new EKV Mode cine loop based on the respiration gate refinements you made.

## Adding generic measurements to EKV Mode images

EKV Mode images do not have dedicated acquisition or analysis tools because they are derived from B-Mode.

Therefore, when you want to analyze an EKV Mode image, use B-Mode analysis tools. See "[B-Mode Analysis](#)" on page 254 and additional "[EKV Mode image refinement tools](#)" on page 449 to analyze EKV Mode images.

### To add measurements to EKV Mode images

- ◆ See "[Adding generic B-Mode measurements](#)" on page 261.

## RF Mode Analysis

Digital RF Mode provides data in RF, Raw and IQ format for further analysis. Digital RF Mode allows users to digitize and view the RF data from the high-frequency ultrasound signal, which can be acquired in both frame-based and time-based imaging modes.

The data can be envelope detected and log compressed to be exported in a range of file formats. Envelope format is a useful way of storing raw data that correlates exactly to what is seen in the B-Mode image and is readily available for image processing applications.

## RF Mode window workspace

The RF Mode window is the workspace you use when you work with RF Mode image data. The following illustration identifies the key features.



## B-Mode image area

- Displays image data.
- Displays physiological data for the animal (if recorded during image acquisition).
- Provides cine loop range controls for acquired cine loops.
- Provides Browse Images controls for scrolling through an inset gallery of images without having to return to the Study Browser.

If you export an image and select Image as your export type, Vevo LAB includes the image area content along with header information.

## Image scale

Indicates the distance from the transducer face to the tissue being imaged at the moment of acquisition. The image scale units are displayed in mm.

## Focus depth indicator

The triangular arrow indicates the focal depth of the transducer.

## A-scan data position indicator


The A-scan line (the red arrow at the top of the image) indicates the position of the data displayed in the histogram located to the left of the image—not displayed for RF PW Doppler Mode, RF PW Tissue Doppler Mode, RF M-Mode or RF AM-Mode images.

## 5 Ultrasound signal intensity histogram

Displays the intensity of the acquired signal along a vertical line extending down at the position indicated by the red arrow at the top of the image.

## 6 Orientation icon

The orientation icon indicates the orientation of the transducer during acquisition in relation to the image.

For Vevo 3100 and Vevo LAZR-X image data, you can change the orientation in Vevo LAB via the Image Processing panel , under the Display Settings section in the Orientation drop down menu. Choose between Upper Left, Upper Right, Lower Left, and Lower Right.

**Note:** For M-Mode and AM- Mode, changing the orientation not only affects the B-Mode scout but also affects the M-Mode/AM-Mode image data. For PW Doppler Mode and PW Tissue Doppler Mode, changing the orientation only affects the B-Mode scout.

## 7 Display map scale

Indicates the dynamic range of the display. The contrast of the image is measured in dB and is adjusted at time of acquisition.

## 8 Physiological data values

Displays the recorded numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature.



## 9 Physiological data trace panel

Displays the animal's recorded dynamic heart rate, temperature, respiration rate and blood pressure data during acquisition.

## 10 Cine loop control

**Note:** RF-Mode data can be acquired in both frame-based and time-based imaging modes.

For frame-based modes only:

Displays the length of the cine loop. The triangular white marker identifies the individual frame number within the cine loop.



To create a range within the loop, drag the left and right vertical markers.



## 11 Playback control



**Note:** RF-Mode data can be acquired in both frame-based and time-based imaging modes.

### For frame-based modes:

You can select the playback speed (via slider or - / + controls) and what image frame is being displayed in the mode window.





### For time-based modes:



You can select playback speed (via slider or increase  /decrease  controls), volume levels, and what data is being displayed in the region of interest window.



## 12 Image mode management panel


Displays a unique set of controls and information depending on the image management panel tab you click:

- Click the Mode Settings tab icon  to open the Mode Settings panel and display a read-only list of Mode Settings for the image. This is the default panel when you open a mode window.
- Click the Image Processing tab icon  to open the Image Processing panel and to display the following:
  - Any available mode-specific image controls you can apply to the image.


- Read-only image control settings that were applied during acquisition.
- Click the Measurements tab icon  to open the Measurements panel and display the available measurement tools.
- Click the Physiological tab icon  to open the Physiological panel and display the following, (if physiological data was recorded during acquisition):
  - The Physiological Display options that you can apply to the image.
  - Physiological Display settings and Respiration Gating settings that were recorded during acquisition.

**Note:** This panel is always available and editable.

You can clear the View Physiology check box to hide the data from the image. Hiding the data will increase the size of the image.


- Click the Preferences tab icon  to open the Preferences window. This window provides a series of tabs you can use to customize the way you work with a range of Vevo LAB features, see "[Preferences](#)" on page 93.

### **13** RF Overlay On/Off checkbox

To turn the RF data in the image on or off, click the Image Processing tab , then select or deselect the RF Overlay checkbox.

## RF-Mode Settings

To view the RF-Mode settings

- ◆ Open the RF-Mode image and then, at the bottom of the image management panel, click the Mode Settings tab icon .

The Mode Settings panel displays the list of parameters for the mode that was used to acquire the image.

## Exporting RF-Mode data from the Study Browser

RF data files may be exported from open images or directly from the Study Browser by clicking **Export**.

To export RF-Mode data from the Study Browser

- 1 In the Study Browser, select the images you want to export.
  - a. To select one item, click it
  - b. To select a collection of individual items, press and hold **Ctrl** on your keyboard and then click to select each item
  - c. To select a consecutive group of items, click to select the first item, press and hold **Shift** on your keyboard and then click to select the last item in the range
- 2 Click **Export**. The Export Image window appears.
- 3 Browse to, and then select, the folder that will contain the export.

4 (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.

5 In the Export Type section, click the type of content you are exporting and then, if needed, in the File Type box, select the desired RF data file format. Depending on the source mode that was acquiring data when you began acquiring in RF-Mode, the following file formats are available:

- a. RAW data file - Data file used to display the log compressed data as gray scale.
- b. RF data file - Reconstructed RF data; most useful when the original frequency information is required.
- c. IQ data file - The IQ data format can be used for analysis as the most unprocessed data format. This format is required for Doppler processing and phase analysis. The IQ format also provides the highest bit resolution of the 3 data formats. The data is organized as IQ pairs with the Q value leading the I value.

The following table lists the available RF data file formats:

File extension	Imaging mode
*.iq.bmode	B-Mode, PA-Mode (Single, Multi-wavelength/NanoStepper, Oxy-Hemo sub-modes), Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
*.rf.bmode	B-Mode, Linear Contrast Mode, Nonlinear Contrast Mode

### RF Data File Formats

File extension	Imaging mode
*.raw.bmode	B-Mode, EKV, PA-Mode (Single, Multi-wavelength/NanoStepper, Oxy-Hemo, Spectro sub-modes), Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
*.iq.color	Color Doppler Mode, Power Doppler Mode
*.raw.color	Color Doppler Mode
*.raw.power	Power Doppler Mode
*.rf.contrast, *.raw.contrast	Nonlinear Contrast Mode
*.iq.pw	PW Doppler Mode, PW Tissue Doppler Mode
*.iq.mmode, *.rf.mmode, *.raw.mmode	M-Mode
*.iq.pamode	PA-Mode (Single, Multi-wavelength/NanoStepper sub-modes)
*.raw.pamode	PA-Mode (Single, Multi-wavelength/NanoStepper, Oxy-Hemo, Spectro sub-modes)
*.rf.3d.bmode	3D Mode (B-Mode, Linear Contrast Mode,

### RF Data File Formats

File extension	Imaging mode
	Nonlinear Contrast Mode)
*.iq.3d.bmode	3D Mode (B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, PA-Mode [Single, Multi-wavelength/NanoStepper sub-modes])
*.raw.3d.bmode	3D Mode (B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode, PA-Mode (Single, Multi-wavelength/NanoStepper, Oxy-Hemo sub-modes))
*.iq.3d.color	3D Mode (Color Doppler Mode, Power Doppler Mode)
*.raw.3d.color	3D Mode (Color Doppler Mode)
*.raw.3d.power	3D Mode (Power Doppler Mode)
*.rf.3d.contrast, *.raw.3d.contrast	3D Mode (Nonlinear Contrast Mode)
*.iq.3d.pamode	PA-Mode 3D (Single, Multi-wavelength/NanoStepper sub-modes)
*.raw.3d.pamode	PA-Mode 3D (Single, Multi-wavelength/NanoStepper, Oxy-Hemo sub-modes)

### RF Data File Formats

File extension	Imaging mode
*.raw.paoxy	PA-Mode (Oxy-Hemo sub-mode)  <div style="background-color: #1a2b3c; color: white; padding: 5px; border-radius: 5px;"> <p><b>Note:</b> Applicable for PA-Mode (Oxy-Hemo) images acquired post software versions with V1.5.X or later; earlier versions export PA-Mode (Oxy-Hemo) data as a '*.raw.pamode' file.</p> </div>
*.iq.physio, *.rf.physio, *.raw.physio, *.iq.event, *.rf.event, *.raw.event	Physiological data and event information
*.iq.xml, *.rf.xml, *.raw.xml	Parameter XML

6 Click **OK**. Vevo LAB exports to the folder you selected and then displays the Image Export Report.

7 Click **OK**.



## Generic Measurements


---

Generic measurements are measurements you can apply to any image frame acquired.

**Note:** The contrast region measurement can only be applied to Linear and Nonlinear Contrast Mode image frames.


This appendix lists all the available generic measurements and describes how to add each one.

### To view the available generic measurements for an image

- 1 In the Study Browser open an image and then stop the cine loop at the frame you want to work with.
- 2 Click the Measurements tab . The measurement tools appear at the top of the panel.

### To replicate a generic measurement

After you place a measurement on an image in either the 2D or 3D view, you can replicate the placement of a measurement of the same type on the image. Available for 2D Area, Acceleration, Angle, Depth, Ellipse, Heart Rate, Lens Radius, Linear, PA Region, Point, Time, Traced Distance, Velocity, and VTI measurements.

- 1 After placing a measurement, click the replicate  button.
- 2 Left-click on the image and begin drawing your repeated measurement.

## To resize a generic measurement

After you place a measurement on an image, you can resize the measurement to be larger or smaller. Available for Cardiac Region, Contrast Region, LV Area Long and Short Axis, PA Region and Vevo Color measurements.

1 After placing a measurement, hover over the measurement until you see



the resize icon

2 Place the cursor over the resize button then use the left button on the mouse to activate the resize function.

3 While continually using the left mouse button, drag the mouse back and forth to resize the image larger or smaller.

4 Commit your changes by releasing the left mouse button.

## Generic measurements list



The Show Values and Labels option is on by default. Once the measurement is placed, the system displays the measurement value and editable label for the measurement in the measurement panel.

Uncheck the Show Values and Labels option to display measurements with sequential index numbers.

## 2D Area measurement

2D Area is measured in mm<sup>2</sup>.

### To place a 2D Area measurement

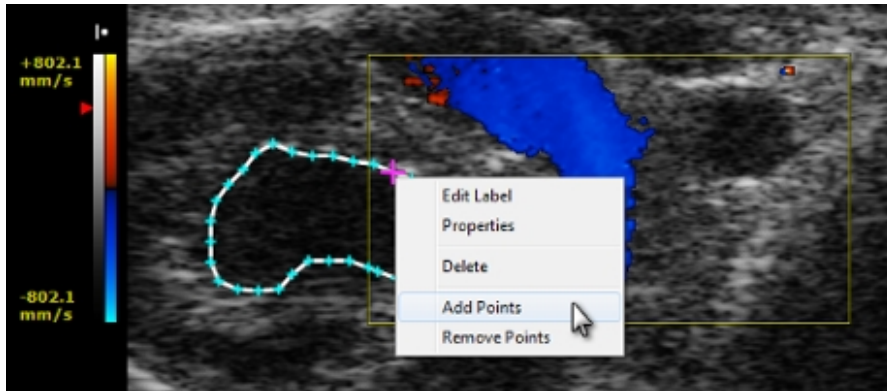
- 1 Click Measurements  then the 2D Area measurement tool .
- 2 Click on the image to place the initial caliper.
- 3 Move the cursor along the contour of the target tissue and then right-click to place your last caliper.

**Note:** If the position of the cursor is within five pixels of the previous caliper when the right-click occurs, the system sets the previously placed caliper as the last caliper and auto-closes the measurement.

- 4 The system adds the final line segment to connect your last caliper with your first.
- 5 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 6 If you need to move the entire measurement, click on the measurement line, then drag and drop.

### To modify points on a 2D Area measurement

- ◆ Right-click a point and then select either **Add Points** or **Remove Points**.




## ROI Histogram Mean and Standard Deviations

- Measure the Mean and Standard Deviation of gray levels for area measurements.
- View a Histogram of a selected area measurement.

You must select one of two source data options in the Histogram preferences when you create a Histogram from a 2D Area measurement:

- a. Raw Data calculates the Histogram from the original Image Data acquired by the transducer.

**Note:** In Power Doppler Mode, the system calculates the Histogram from the Image Data, even when the Raw Data option has been selected.

- b. Image Data calculates the Histogram from a combination of the original image data plus any modifications you make after you click the Image Processing icon . For example, if you modify the Brightness value,

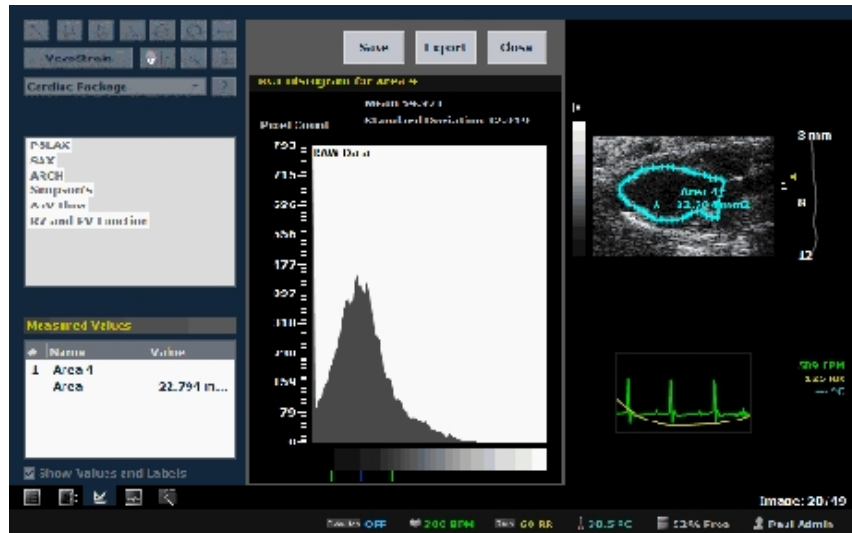
the system creates the Histogram based on the original image data plus the modified brightness.

## To create the Mean and Standard Deviation ROI Histogram

- ◆ Right-click the ROI measurement and click **Histogram**.

A pop-up window appears. It displays:

- A plot of the relative distribution of pixels across the gray scale shown on the horizontal axis.
- The Mean (blue indicator on the gray scale) and Standard Deviation (green indicators on the gray scale) values.



To save a TIFF image of a Histogram for your report

- ◆ Click **Save**.



To export the graph of a Histogram

- 1 Click **Export**.
- 2 In the Export window, browse to the directory location where you want to export the file and select that directory.
- 3 In the Options area, select the file type.
- 4 In the Save As box, if you want to create a unique file name, type the name.
- 5 Click **OK**.

## Acceleration measurement

Use the Acceleration measurement to determine the acceleration of heart tissue movement. Acceleration is measured in  $\text{mm/s}^2$ .

To place an acceleration measurement



- 1 Click **Measurements**  then the Acceleration measurement tool .
- 2 Click on the image to place the initial caliper.
- 3 Move the cursor to the location where you want to end your measurement and then click to place the end caliper.

- 4 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 5 If you want to rename the label, type a new name while the label text is selected, and then click outside the label to commit the label.
- 6 If you want to move the measurement or the label, select it, drag it and drop it.

## Angle measurement

Angles report interior angle values and are therefore always less than 180 degrees. Angles are measured in degrees.

### To place an Angle measurement

- 1 Click Measurements  then the Angle measurement tool .
- 2 Click on your image to place the initial caliper. This is the outside end of the first ray of your angle.
- 3 Move the cursor to where you want to position the vertex of your angle and then click to place the caliper. This completes the first ray.
- 4 Move the cursor to the position where you want to end the second ray and then click to place the final caliper.
- 5 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 6 If you need to move the entire measurement, click on the measurement line, then drag and drop it into position.

## AutoLV

AutoLV measurements allow for automated, curve fitting left ventricle analysis of cardiovascular data.

Please note the following:


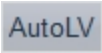
- Only available for B-Mode and EKV images acquired on a Vevo 2100 or Vevo 3100 Imaging System with physiological data (does not include ECG Trigger data for B-Mode images).
- You can only place one AutoLV measurement on an image.
- You can place both a manual LV Area Long Axis and an AutoLV measurement on an image.
- You cannot place both a manual LV Area Short Axis and an AutoLV measurement on an image.
- AutoLV is only available for the 64-bit version of Vevo LAB.

### To place an AutoLV measurement

Ensure the animal heart you are imaging is in the PSLAX orientation with the apex on the left and the aortic on the right.

1 Click and drag the triangular frame indicator to a frame that includes the end diastolic physiological trace signal.

**Note:** If you begin the AutoLV process but have used an incomplete r-wave cycle, the software will display a message.

2 Click Measurements  then the AutoLV measurement button . The software will automatically generate the AutoLV measurement.



3 Edit the measurement contours on any frame, including the frames containing the end systolic and end diastolic signals.

**Note:** Frames between the end systolic and end diastolic signals that are edited will not be morphed to reflect the edited contours.



4 Click **Cine Store** to save the cine loop.

When you play the cine loop, the system displays the contour that represents the systolic left ventricle in green, and the diastolic left ventricle in red.

## Cardiac Region measurement

The Cardiac Region measurement traces a region of interest in a Nonlinear Contrast Mode frame or Linear Contrast Mode frame, consisting of two separate traces. The system then measures the difference in area between the outer trace and the inner trace.

### To place a single Cardiac Region measurement

- 1 Click Measurements  then the Cardiac Region button .
- 2 Click along the boundary of the outer wall of the myocardium to add caliper points.
- 3 After you add three caliper points, the system creates a simple contour that connects the points. You can add caliper points by clicking anywhere along the contour.
- 4 Right-click to complete the outer wall contour.
- 5 Click on the boundary of the inner wall of the myocardium, add caliper points using the same procedure you used to create the outer wall contour, and then right-click to complete the inner wall contour.

6 The system displays the measurement value and editable label for the measurement in the measurement panel.

7 If you need to move an entire measurement, click on the center of measurement, then drag and drop it into position.

### To automatically apply Cardiac Region contours to sequential frames

1 On the cine loop, move to a frame that displays the maximum point of diastole and create the outer and inner contours for a single cardiac region measurement as described above.

**Important:** To ensure the best results with the sequential refinement process, add the first three caliper points for every contour in the same direction. For example if you start out adding the first three points for the outer wall in a clockwise direction, add the points for the inner wall in a clockwise direction also.

2 In the cine loop, move forward or backward to a frame that displays the next point of maximum systole and create a second cardiac region measurement.

**Important:** Add the first three caliper points for these contours in the same direction you added the contours for the first cardiac region.

3 Right-click the contour and then select **Replicate Forward 1 Cycle** or **Replicate Reverse 1 Cycle**.

The software:

- i. Calculates and creates Cardiac Region contours for the half-cardiac cycle frames between the maximum diastole and systole points you measured.

- ii. Plays the cine loop forward or reverse and applies the calculated contours to each individual frame.

Direction	Description
Replicate Forward 1 Cycle	Starts from the end of the half cardiac cycle and applies the system-calculated contours to the next cardiac cycle.
Replicate Reverse 1 Cycle	Starts from the start of the half cardiac cycle and applies the system-calculated contours to the previous cardiac cycle.

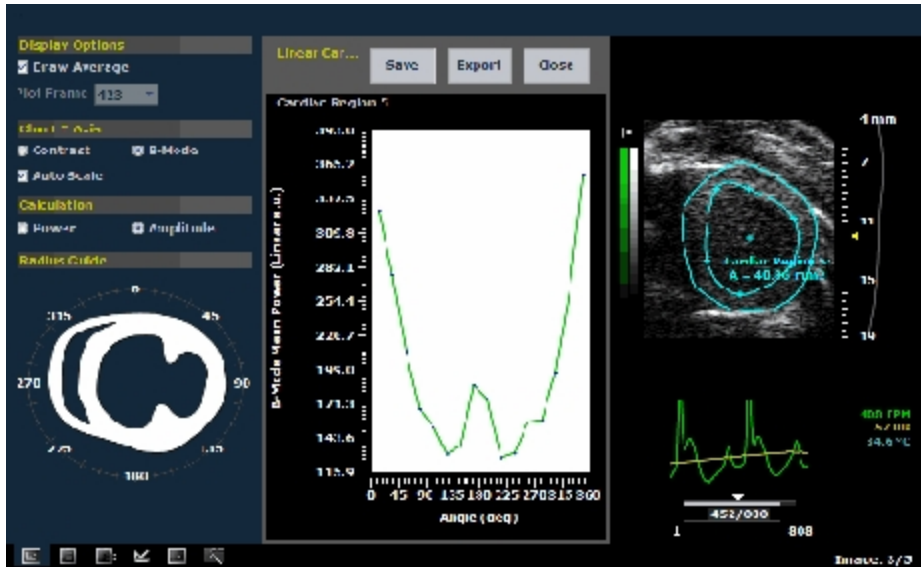
4 If you want to modify a contour in the sequence, you can add, delete or move points and then right-click **Refine Forward** or **Refine Reverse** on the contour to view the results.

### Cardiac Region Analysis

The Cardiac Region Analysis plots the contrast intensity data of a Cardiac Region over a course of a complete cine loop.

#### To chart the Cardiac Region

- 1 On an image with a Cardiac Region measurement, right-click the contour or the image label and click **Region Graph** in the menu.
- 2 The system calculates the contrast intensity within the boundaries of the region curve and displays the data in the Cardiac Region Analysis window.



## Working with the Linear Cardiac Region Analysis

The Linear Cardiac Region Analysis provides three sets of controls:

- Display Options
- Chart Y Axis
- Calculation

Use these controls to achieve different views of the cardiac data.

### Display Options

Setting	Description
Draw Average	Draws a moving average line through the data points.

### Display Options

Setting	Description
Plot Frame	Plots data points only on the frame that the Cardiac Region was placed.

### Chart Y Axis

Setting	Description
Contrast	Select to plot the contrast intensity information from the contrast data, and to make the Percent Area controls and the Calculation controls available.
B-Mode	Select to plot the grayscale intensity data from the B-Mode image.
Auto Scale	Select to view a system-calculated best-fit scale value.

### Calculation

Setting	Description
Power	Sets the Y axis to B-Mode Mean Power (Linear a.u.).
Amplitude	Sets the Y axis to B-Mode Mean Amplitude (Linear a.u.).

## Working with the Nonlinear Cardiac Region Analysis

The Nonlinear Cardiac Region Analysis provides two sets of controls:

- Display Options
- Chart Y Axis

Use these controls to achieve different views of the cardiac data.

#### Display Options

Setting	Description
Draw Average	Draws a moving average line through the data points.
Plot Frame	Plots data points only on the frame that the Cardiac Region was placed.

#### Chart Y Axis

Setting	Description
Contrast	Select to plot the contrast intensity information from the contrast data, and to make the Percent Area controls and the Calculation controls available.
B-Mode	Select to plot the grayscale intensity data from the B-Mode image.
Auto Scale	Select to view a system-calculated best-fit scale value.

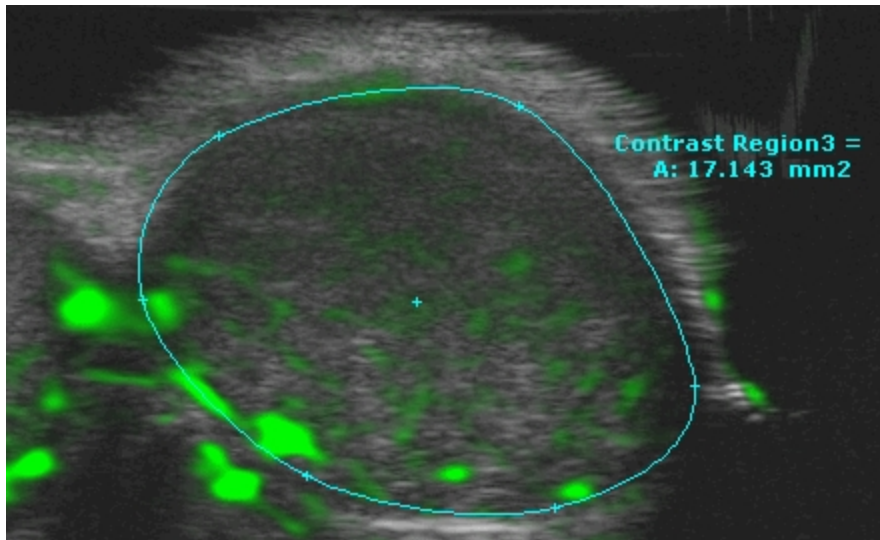
## Contrast Region measurement

The Contrast Region measurement traces a region of interest in a Nonlinear Contrast Mode frame or Linear Contrast Mode frame. The system then measures the total area of the defined contrast region.

### To place a Contrast Region measurement

- 1 Click Measurements  then the Contrast Region measurement tool .

- 2 Click on your image to place the initial caliper along the boundary of the region you want to define.
- 3 Click approximately one-third of the way around the boundary of the region.
- 4 Click across to another point on the boundary. You have now created a defined region. Typically you will continue to click to add a points to define the boundary of your region more precisely.
- 5 To complete the region, right-click your final point.



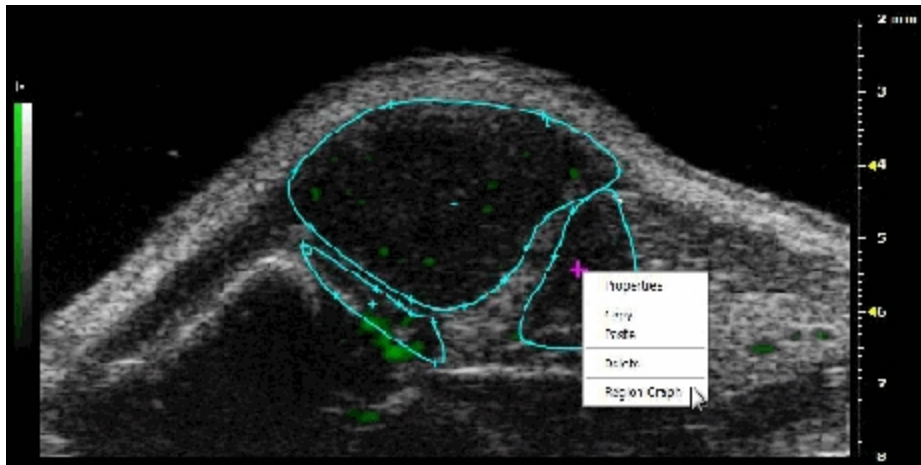
- 6 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 7 If you need to move an entire measurement, click on the center of measurement, then drag and drop it into position.

## Contrast Region Analysis

The Contrast Region Analysis plots the contrast intensity data of a Linear/Nonlinear Contrast Region measurement over the course of a complete cine loop.

### To create a Linear Contrast Region Analysis

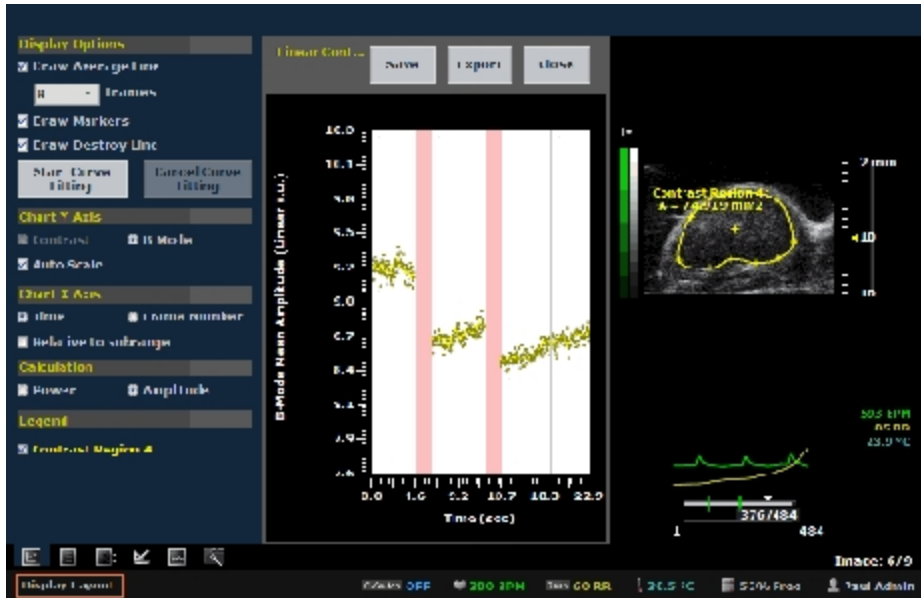
- ◆ On the Linear/Nonlinear Contrast Mode image, right-click the contour or the image label and click **Region Graph**.



The system calculates the contrast intensity within the boundaries of the region curve and displays the data in the Linear/Nonlinear Contrast Region Analysis window. Below is an example of the Linear Contrast Region Analysis window.

**Note:** Different parameters are displayed for the Linear and Nonlinear Contrast Region Analysis.





To save a TIFF image of the analysis to a report

- ◆ Click **Save**.

To export the Linear/Nonlinear Contrast Region Analysis

- 1 Click **Export**. The Export Graph window appears.
- 2 In the Export Graph window, browse to the location where you want to export the data and select the folder.
- 3 (Optional) Create a new folder. Tap **New Folder** and type a name.
- 4 (Optional) Create a custom file name by clicking in the Save As box, then type a filename using your keyboard.
- 5 Select the export type:

### Contrast Graph Export Types and Descriptions

Export Types	Description
CSV	Comma Separated Value (CSV) file format used to represent database fields. Each entry of the file represents one field and is separated from the next field by a comma.
BMP	Bitmap (BMP) file format of a static image file format. Each bit of the saved BMP file represents a piece or pixel of the image.  An additional option to export graph parameters is available. Click the <b>Export Graph Parameters for BMP/TIFF checkbox</b> .
TIFF	Tagged Image File (TIFF) Format is a standard still image file format that includes tagged fields with the image that can be read by the opening application.  An additional option to export graph parameters is available. Click the <b>Export Graph Parameters for BMP/TIFF checkbox</b> .

6 Click **OK**. The system exports the analysis.

### Working with the Linear Contrast Region Analysis

The Linear Contrast Region Analysis provides four sets of controls:

- Display Options
- Chart Y Axis
- Chart X Axis

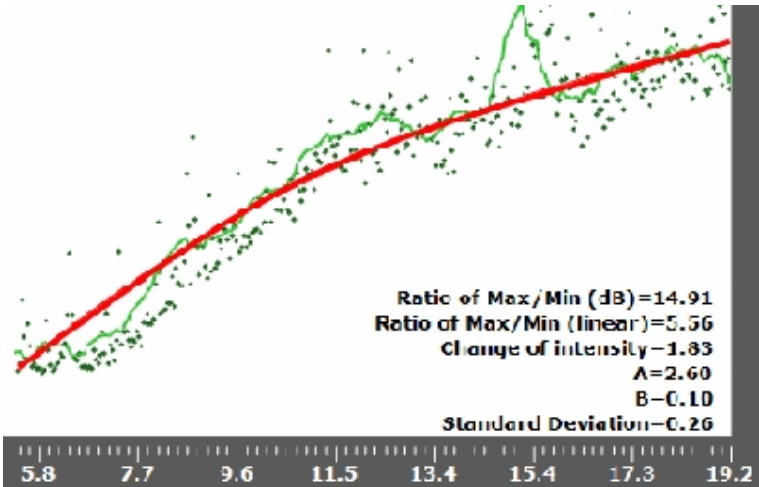
- Calculation
- Legend

Use these controls to achieve different views of the contrast intensity data.

### Display Options

Setting	Description
Draw Average Line	Draws a moving average line through the data points.
Frames	Sets the number of frames over which to complete the average. Select from 2, 4, 8, 16, 32
Draw Markers	Draws markers on the actual data points.
Draw Destroy Line	Displays a vertical red line at the frame number at which the destruction event occurred, if the event did occur.
Curve Fitting	<p>Calculates and plots a perfusion curve based on the following formula*:</p> $y = C + A(1 - e^{-\beta(t - t_0)}), \text{ where:}$ <p> y = Contrast signal (pixel intensity)  A = Plateau of the curve  <math>\beta</math> = Slope of the curve  C = Contrast signal offset  t = time  <math>t_0</math> = time offset </p>

## Display Options

Setting	Description
	<p>To create the curve</p> <ol style="list-style-type: none"> <li>1 Click <b>Start Curve Fitting</b> and select a data point on the graph at the transition from the base line to the perfusion period.</li> <li>2 Click a data point where the data begins to plateau and then click <b>Finish Curve Fitting</b>.</li> </ol> <p>The system calculates and plots the red perfusion curve.</p>  <ol style="list-style-type: none"> <li>3 Click <b>Export</b> and export the data as an image or as a CSV file for further analysis.</li> </ol> <p><i>* Wei, 1998, Quantification of Myocardial Blood Flow With Ultrasound-Induced Destruction of Microbubbles Administered as a Constant Venous Infusion.</i></p>

### Chart Y Axis

Setting	Description
Contrast	Select to plot the contrast intensity information from the contrast data, and to make the Percent Area controls and the Calculation controls available.
B-Mode	Select to plot the grayscale intensity data from the B-Mode image.
Auto Scale	Select to view a system-calculated best-fit scale value.

### Chart X Axis

Setting	Description
Time	Select to scale the length of the cine loop in second increments.
Frame Number	Select to scale the length of the cine loop in single frame increments.
Relative to subrange	Select to change the origin value from the original recorded value in seconds or frames to a temporary value of 0 seconds or frame 1.

### Calculation

Setting	Description
Power	Sets the Y axis to B-Mode mean power (linear a.u.).
Amplitude	Sets the Y axis to B-Mode mean amplitude (linear a.u.).

### Legend

Setting	Description
Contrast Region checkbox	Enable/Disable to select which Contrast Regions are displayed on the graph.

### Working with the Nonlinear Contrast Region Analysis

The Nonlinear Contrast Region Analysis provides four sets of controls:

- Display Options
- Chart Y Axis
- Chart X Axis
- Legend
- Analysis
- Results

Use these controls to achieve different views of the contrast intensity data.

### Display Options

Setting	Description
Draw Average Line	Draws a moving average line through the data points.
Frames	Sets the number of frames over which to complete the average. Select from 2, 4, 8, 16, 32

### Display Options

Setting	Description
Draw Markers	Draws markers on the actual data points.
Draw Destroy Line	Displays a vertical red line at the frame number at which the destruction event occurred, if the event did occur.

### Chart Y Axis

Setting	Description
Contrast	Select to plot the contrast intensity information from the contrast data, and to make the Percent Area controls and the Calculation controls available.
B-Mode	Select to plot the grayscale intensity data from the B-Mode image.
Auto Scale	Select to view a system-calculated best-fit scale value.

### Chart X Axis

Setting	Description
Time	Select to scale the length of the cine loop in second increments.
Frame Number	Select to scale the length of the cine loop in single frame increments.
Relative to subrange	Select to change the origin value from the original recorded value in seconds or frames to a temporary value of 0 seconds

Setting	Description
	or frame 1.

#### Legend

Setting	Description
Contrast Region checkbox	Enable/Disable to select which Contrast Regions are displayed on the graph.

#### Analysis

Setting	Description
Perfusion	Once selected, a drop down menu is displayed—select a contrast region. Click <b>Select Region</b> then select the starting and ending points for the time range on the graph. Once complete, the Results table will be populated.
Targeted	Once selected a button will be displayed for two time ranges—R1 (Region 1), R2 (Region 2). Select one of the buttons then select the starting and ending points for the time range—repeat for the other time range. Once complete, the Results table will be populated.

#### Results

Setting	Description
Name	Name of the parameter. Different parameters are displayed depending on what type of Analysis was selected. <ul style="list-style-type: none"> <li>• T.E. (r) (l.a.u.)—Targeted Enhancement ratio in linear</li> </ul>



Setting	Description
	<p>units between the two time ranges (R1, R2).</p> <ul style="list-style-type: none"> <li>• T.E. (r) (dB)–Targeted Enhancement ratio between the two time ranges in dB.</li> <li>• d.T.E. (l.a.u.)–Differential Targeted Enhancement between the two time ranges (R1, R2) in linear units.</li> <li>• P.E. (l.a.u.)–Peak Enhancement in linear units.</li> <li>• P.E. (dB)–Peak Enhancement in dB.</li> <li>• T to P (s)–Time to Peak in seconds.</li> </ul>
Value	Values of the parameter listed.

## Copying and pasting Linear and Nonlinear Contrast Region measurements

Conditions:

- You can copy a Contrast Region measurement from a Linear/Nonlinear Contrast Mode image and paste it to a Linear/Nonlinear Contrast Mode image or PA-Mode image.
- Pasting a measurement on the destination image will only be allowed if the image area is large enough to fit the copied ROI.
- Copying and pasting a measurement is only available while reviewing an image in the 2D view.
- A total of five Contrast Regions are allowed on one image.
- The measurement label will not be copied.

### To copy and paste a Contrast Region measurement

- 1 Right-click the contour and select **Copy**.
- 2 (Optional) Acquire a new image or load an image into review.
- 3 Right-click on the image area and click **Paste**. The copied region is added to the image with its original coordinates.

### To copy and paste all Contrast Region measurements


- 1 Right-click within the image area (not on a measurement contour) and select **Copy ALL ROIs**.
- 2 (Optional) Acquire a new image or load an image into review.
- 3 Right-click on the image area and click **Paste**. The copied regions are added to the loop, with their original coordinates.

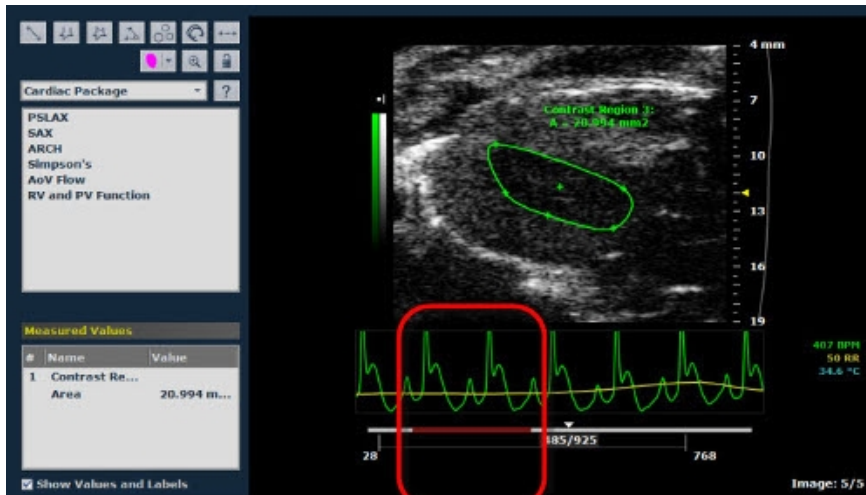
### Hiding and showing frames in the reference group

In Linear Contrast Mode and Nonlinear Contrast Mode, you can temporarily hide frames in your reference range of cine frames (minimum two frames). This feature can be useful when you want to exclude outlier data that unrealistically skews your graph and data analysis.

**Note:** This feature does not delete the data that you hide; it only prevents it from displaying in the graph.

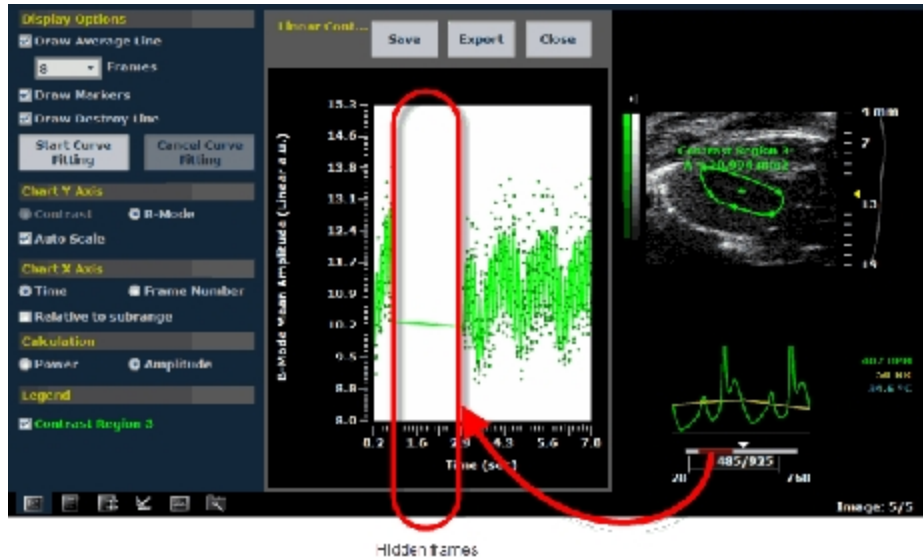
## To hide a reference range of frames

- 1 In the cine loop range control, drag the frame marker and then click to set the first frame of the range you want to hide.
- 2 Click the Image Processing tab  and in the Hide Frames section click **Start**.
- 3 Drag the frame marker forward or backward to the last frame in the range you want to hide and then click. The system applies red to the frames bar to identify the selected range.



- 4 In the Hide Frames section click **Stop**.
- 5 (Optional) Repeat the process to hide additional frame sets.

When you create a region graph, the system removes the plotted data from the frames that you hid.



To show a range of hidden frames

- ◆ To restore a range of hidden frames, follow the same start-stop frame hiding procedure but use the Start-Stop control in the Show Frames section of the Image Processing panel.

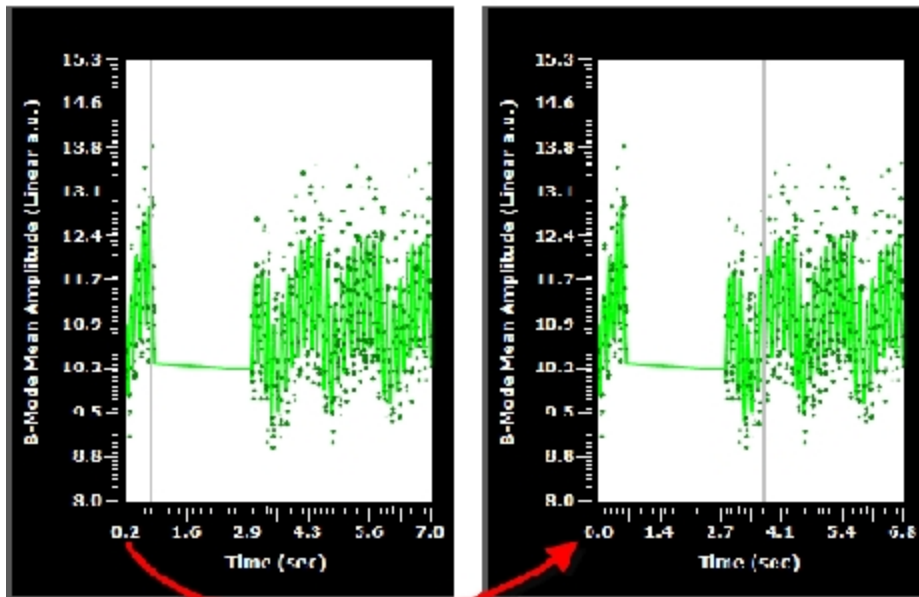
Setting the X axis origin value to 0 seconds or frame 1

To simplify graph analysis of the sub-range of the stored cine loop you are working with in your contrast measurement, you can change the origin value from the original recorded value in seconds or frames to a temporary value of 0 seconds or frame 1.

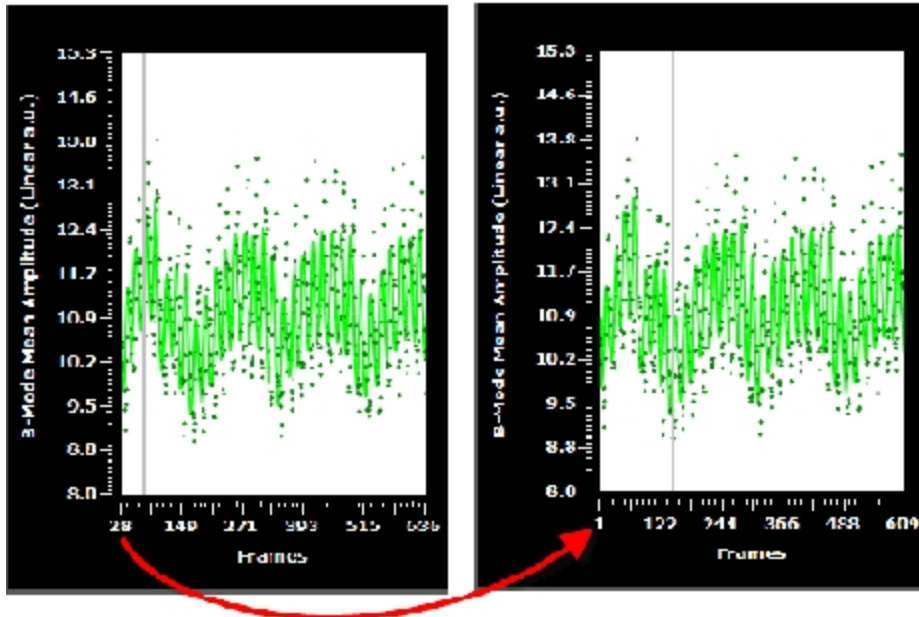
To set the X axis origin to either 0 seconds or frame 1

- 1 Right-click your contrast region measurement and select **Region Graph**.

- 2 In the Contrast Region Analysis panel in the Chart X Axis section:
  - a. Select the units you want the X axis to chart–Time or Frame Number.
  - b. Select the Relative to subrange check box.
  - c. The system resets the origin value of the X axis.



*The absolute value of the start of the X axis in this example is 0.2 seconds.  
After you select Relative to subrange, the X axis begins at 0 seconds.*





*The value of the start of the X axis in this example is frame 28. After you select Relative to subrange, the X axis begins at frame 1.*

## Depth measurement

Depth is measured in mm.

To place a Depth measurement

- 1 Click Measurements  then the Depth measurement tool .
- 2 Click on the image to place the initial caliper.

- 3 Move the cursor to the location where you want to end your measurement and then click to place the end caliper.
- 4 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 5 If you need to move the entire measurement, click on the measurement line, then drag and drop it into position.

## Ellipse measurement

An Ellipse measurement records the following properties:

- Area in mm<sup>2</sup>.
- Volume in mm<sup>3</sup>.



Ellipse measurements are available in B-Mode, Color Doppler Mode, Power Doppler Mode, Nonlinear Contrast Mode, EKV Mode, PA-Mode, 3D Mode (2D view) and 4D-Mode (2D view).

**Note:** The volume estimate from an Ellipse measurement is based on the following:

$$\text{Volume} = 0.52 \times \text{width}^2 \times \text{length}$$

The 'width' component of the formula is the lesser of the two axes of the Ellipse measurement, while the 'length' component is the greater.

To add an Ellipse measurement



- 1 Click Measurements  then the Ellipse measurement tool .
- 2 Click on the image to place the initial caliper.

- 3 Move the cursor to increase the area of the measurement and then click to place the second caliper.
- 4 Move the cursor again to shape your ellipse and click when you are done.
- 5 If you need to edit the width or length of the ellipse, click a caliper on the ellipse contour then drag and drop it into position
- 6 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 7 If you need to move the entire measurement, click on the measurement line, then drag and drop it into position.

## Heart Rate measurement

Use the Heart Rate measurement for measuring the average heart rate (in BPM) of an animal by measuring the distance over time between the displayed cardiac cycles.

### To place a Heart Rate measurement

- 1 Click Measurements  then the Heart Rate measurement tool .
- 2 Click on the image to place the initial caliper at a specific point in the cardiac cycle.
- 3 Move the cursor to the same location on the next cardiac cycle and click to place the next caliper.
- 4 Continue placing calipers on the cardiac cycles and then right-click on the last heart beat of the sequence to place your final caliper.




- 5 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 6 If you need to move the entire measurement, click on the measurement line, then drag and drop it into position.

## Lens Radius measurement

The Lens Radius measurement is only available in the Ophthalmology measurement package for B-Mode images. Lens radius is measured in mm.



### To place a Lens Radius measurement

- 1 Click Measurements  to open the Measurements panel.
- 2 In the drop-down list of measurement packages select **Ophthalmology** and in the list of measurements click **Lens Radius**.
- 3 Click on your image to place the initial caliper at one end of the radius.
- 4 Move the cursor along the contour of the lens to the center of your radius and then click to place the center caliper.
- 5 Move the cursor to the end of the radius and click to place the caliper. The system instantly transforms the angle rays to a curve. When you complete the measurement the system stores it.
- 6 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 7 If you need to move the entire measurement, click on the measurement line, then drag and drop it into position.

## Linear measurement

The Linear measurement is measured in mm.

### To place a Linear measurement



- 1 Click Measurements  then the Linear measurement tool .
- 2 Click on the image to place the initial caliper.
- 3 Move the cursor to the location where you want to end the measurement and then click to place the end caliper.
- 4 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 5 If you need to move the entire measurement, click on the measurement line, then drag and drop it into position.

## LV Area Long Axis measurement

Use the LV Area Long Axis measurement to manually trace the endocardial wall through multiple cardiac cycles.

This is an optional function, and is available only if the Automated LV Analysis package is purchased.

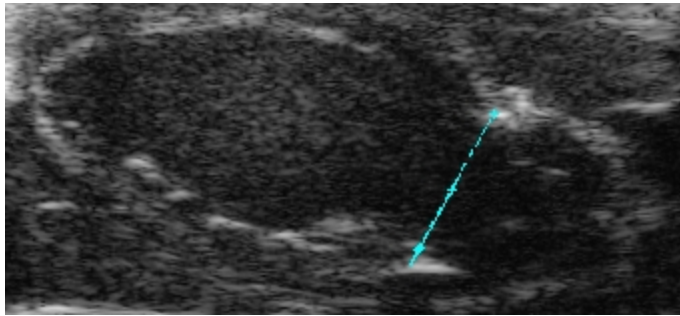
### To place an LV Area Long Axis measurement

- 1 Click Measurements  then the LV Area Long Axis measurement tool .

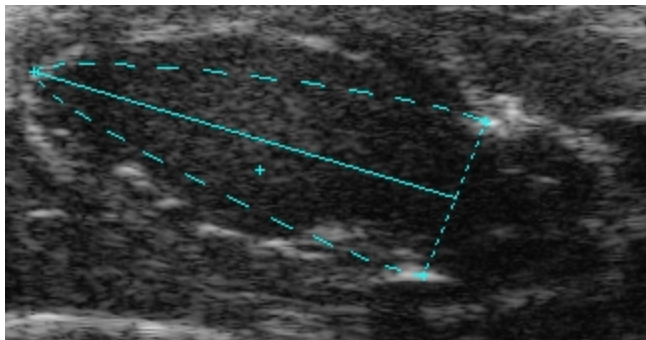
2 Click the upper wall of the aortic annulus and then the bottom wall of the annulus.

The system places a straight line between these points to define the top of the LV precisely, as shown in the following long axis example.

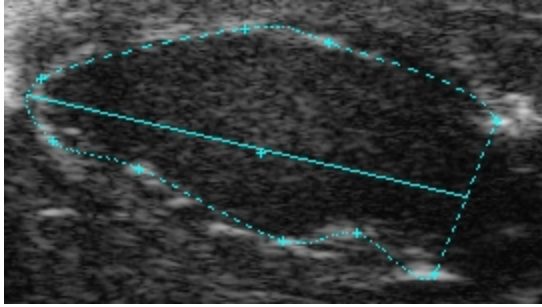
**Note:** If you selected the short axis view for analysis, the system does not insert an annulus line.



3 Click a point toward the apex on the interior wall. This creates the basic curve.



4 Continuing to click along the wall to create a contour that traces the area of the wall.



*In this example, six wall points have been added to the trace curve.*

Right-click the final point on the contour to complete the measurement.

5 The system displays the measurement value and editable label for the measurement in the measurement panel.

6 (Optional) If you want to rename the label, type a new name while the label text is selected, and then click outside the label to commit your change.

7 (Optional) If you want to move the measurement or the label, select it, drag it and drop it.

8 Move to another frame in the cine loop and place another LV Area Long Axis measurement.

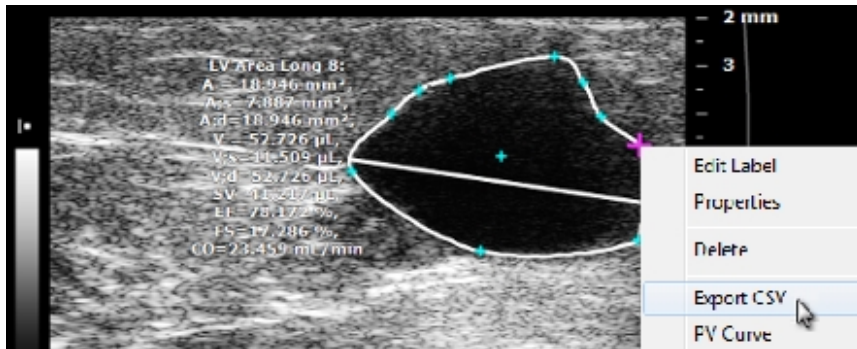
9 Click **Cine Store** to save the cine loop.

When you play the cine loop, the system displays the contour that represents the systolic LV in green, and the diastolic LV in red.

## Modifying points on an LV Area Long Axis measurement

## To modify points on an LV Area Long Axis measurement

- 1 Hover over the measurement until it becomes active (measurement label becomes white).
- 2 Left-click, hold and drag a point to a new position.
- 3 Release the left mouse button to commit your changes.
- 4 (Optional) Right-click a point and then select the modify command you want to apply.



## Modifying the LV Area Long Axis measurement

### To modify an LV Area Long Axis measurement



- To move the entire contour, click the center point of the trace, move to the new position, then click again to commit the contour.
- To resize the contour, click the contour, move the cursor inward or

outward to change the size, then click to commit the resized contour.

- To delete the contour, right-click the curve and click **Delete**.

## LV Area Short Axis measurement

### To place an LV Area Short Axis measurement

- 1 Click Measurements  then the LV Area Short Axis measurement tool .
- 2 Click to place a point along the myocardial wall in the center of the wall.
- 3 Continue to click and add additional points around the wall. The loop contour forms to the points that you add.
- 4 Right-click the final point on the contour to complete the measurement.
- 5 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 6 (Optional) If you want to rename the label, type a new name while the label text is selected, and then click outside the label to commit your change.
- 7 (Optional) If you want to move the measurement or the label, select it, drag it and drop it.
- 8 Click **Cine Store** to save the cine loop.



When you play the cine loop, the system displays the contour that represents the systolic LV in green, and the diastolic LV in red.

## M-Mode LV Wall measurements

Use the LV Wall measurement to:

- Trace the position of the upper and lower inner walls of the ventricle through a heart cycle so you can measure the parameters of the left ventricle inner area.
- Add a trace of the outer walls to the inner walls that you traced so you can measure the parameters of the outer walls of the left ventricle.

### To trace the inner LV Walls

- 1 Click Measurements  then the LV Area tool .
- 2 Adjust the sweep speed to compress or expand the cine loop so you can see the number of heart cycles you want to measure. Decrease the speed to show more cycles, increase the speed to show fewer cycles.
- 3 On the upper wall:
  - i. Start on either the left or right side of the image window (it doesn't matter which side you start on) and click to place your first caliper along the inside of the wall at either the diastolic or systolic peak or valley.
  - ii. Continue to click and place caliper points at the diastolic and systolic peaks and valleys until you have traced the number of cycles you want the system to measure.
  - iii. Right-click to complete the trace.
- 4 On the lower wall:

- i. Add caliper points the same way.
- ii. Right-click to complete the trace.
- iii. Right-click a second time to complete and display the measurements.

### **To trace the outer and inner LV Walls**

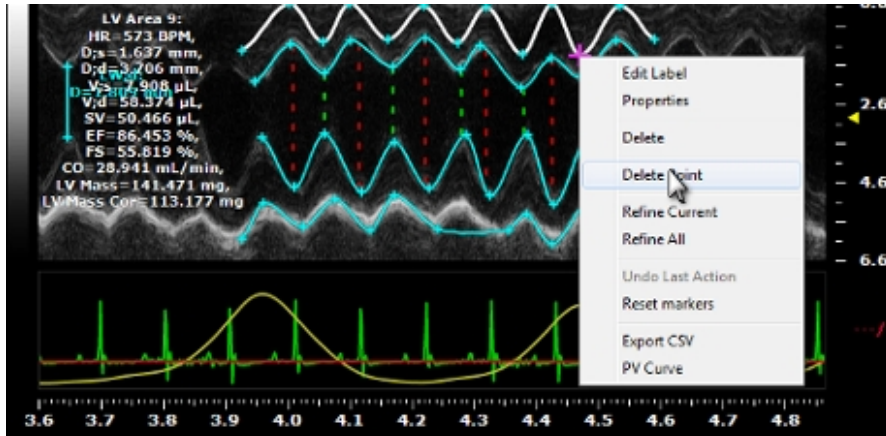
Use the same peak and valley caliper points tracing method as described in the previous procedure for inner LV Walls, but also trace the outer LV Walls using the following procedure.

- 1** On the upper wall, trace the outside wall along the number of cycles you want to measure and then right-click to complete the trace (the outside wall is far less dynamic than the inner wall).
- 2** On the upper wall, trace the inside peaks and valleys and right-click to complete the trace.
- 3** On the lower wall, trace the inside peaks and valleys and right-click to complete the trace.
- 4** On the lower wall, trace the outside wall and then right-click just once to complete the trace and to display the measurements.

### **To modify points on an LV Wall measurement**

- ◆ Right-click a point and then select the modify command you want to apply.





## PA 3D Region measurement

Please note the following:

- You can only place a PA 3D Region measurement on a PA 3D image in 2D view.
- Only one PA 3D Region measurement per image.
- PA 3D Region measurements are loadable to 3D view.

### To place a PA 3D Region measurement

1 Load a PA-Mode 3D (Single, Oxy-Hemo or Multi-wavelength/NanoStepper) image into the 2D mode window.

2 Click Measurements  then the PA 3D Region measurement tool .

3 Click on your image to place the initial caliper along the boundary of the region you want to define.

- 4 Click approximately one-third the way around the boundary of the region and then click across to another point on the boundary. You have now created a defined region. Typically you will continue to click to add a few more points to define the boundary of your region more precisely.
- 5 To complete the region, right-click your final point.
- 6 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 7 If you need to move an entire measurement, click on the center of measurement, then drag and drop it into position.

#### To export a PA 3D Region measurement

- 1 Right-click the measurement and click **Export Region Values**.
- 2 In the Export PA 3D Region window, browse to the folder where you want to export the data.
- 3 (Optional) Create a new folder by clicking **New Folder**, typing a name and click **OK**.
- 4 (Optional) In the Options section, type a name of the region other than the default name given by Vevo LAB software.
- 5 Click **OK**. The PA 3D Region measurement values are exported. The values are displayed in the exported Report correspond to the measurements on the frame as saved in the thumbnail image.

#### To interact with a PA 3D Region in 3D view

- 1 Load a PA-Mode 3D image into the 2D mode window.
- 2 Draw a PA 3D Region.

3 On the Image Processing panel, tap **Load into 3D**. The software will create the 3D Volume, save the original image, save the new 3D image and load the image into 3D view.

The parameters listed are Area (mm<sup>2</sup>) and Volume (mm<sup>3</sup>).

**Note:** The Volume value listed will be within 5% difference to what was listed for the PA 3D Region in the 2D view.

The 3D Volume will be listed on the Measurements panel and the Volume Measurement panel (select the Parallel & Rotational Methods).

Edit your measurement as you would a normal 3D Volume, see ["Editing a volume contour"](#) on page 404 and ["Adding generic 3D Mode measurements"](#) on page 411

## PA Region measurement

The PA (Photoacoustics) Region measurement traces a region of interest in a PA frame. The software then measures the total area of the defined contrast region.



Quantification is available for the average threshold signal power of each PA Region measurement displayed by the label 'PA Thresh'.

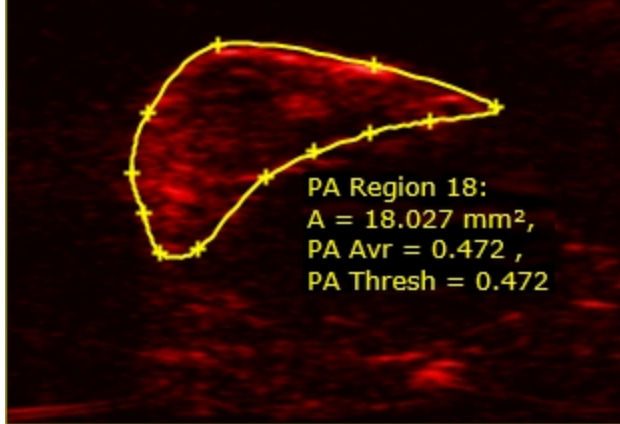
Quantification is also available for the average signal power and the average threshold signal power for Multiplexed PA Region measurements. Displayed by the label 'Avr' and 'Thresh' preceded by the Layer name.

For more details on placing a PA Region measurement on a Multiplexed image, see ["Measuring region changes in a PA-Mode loop"](#) on page 287

## To place a PA Region measurement

Vevo LAB software allows you to draw up to 20 regions of interest on one image.

- 1 Click Measurements  then the PA Region measurement tool .
- 2 Click on your image to place the initial caliper along the boundary of the region you want to define.
- 3 Click approximately one-third the way around the boundary of the region and then click across to another point on the boundary. You have now created a defined region. Typically you will continue to click to add a few more points to define the boundary of your region more precisely.
- 4 To complete the region, right-click your final point.



- 5 The system displays the measurement value and editable label for the measurement in the measurement panel.

6 If you need to move an entire measurement, click on the center of measurement, then drag and drop it into position.

**Note:** When you add a PA Region measurement on a frame in a PA-Mode cine loop, the PA average value changes when you view another frame in the cine loop. This can cause inconsistencies if you save the loop after working on a different frame.

To prevent inconsistencies, resave the loop at the same frame you were working on when you first saved your measurements.

To export a PA Region measurement

- 1 Right-click the measurement and click **Export Region Values**.
- 2 In the Export PA Region page, browse to the folder that contains the folder where you want to export the data.
- 3 In the Options section, type the name of the region and click **OK**. The region measurement values are exported.

**Note:** PA measurements are cine loop measurements. The values displayed in the report or the exported report correspond to the frame saved in the thumbnail image.

## Copying and pasting a PA Region measurement

Conditions:

- You can copy a PA Region measurement from a PA-Mode image and paste it to a PA-Mode image or a Linear/Nonlinear Contrast Mode image.
- Pasting a measurement on the destination image will only be allowed if the image area is large enough to fit the copied ROI.
- Copying and pasting a measurement is only available while reviewing an image in the 2D view.
- A total of 20 PA Regions are allowed on one image.

### To copy and paste a PA Region measurement

- 1 Right-click the contour and select **Copy**.
- 2 (Optional) Acquire a new image or load an image into review.
- 3 Right-click on the image area and click **Paste**. The copied region is added to the loop, with its original coordinates.

### To copy and paste all PA Region measurements


- 1 Right-click within the image area (not on the measurement contour) and select **Copy ALL ROIs**.
- 2 (Optional) Acquire a new image or load an image into review.

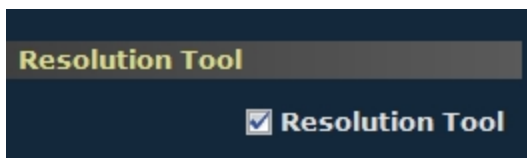
3 Right-click on another cine loop image area and click **Paste**. The copied regions are added to the loop, with their original coordinates.

## Resolution Tool

The Resolution Tool is a B-Mode-only feature that applies a range of color mapping to the refined areas.

### To activate the Resolution Tool

- 1 Click  to open the Image Processing panel.
- 2 In the Resolution Tool section select the Resolution Tool check box. (To hide the resolution tool effects, clear the Resolution Tool check box.)





## Point measurement

Use the Point measurement tool to place a single caliper dot on the image. A Point measurement records the following properties of the dot:

- Cine loop time point measured in ms.
- Doppler frequency measured in kHz.
- Velocity measured in mm/s.



### To place a single point measurement

- 1 Click Measurements  then the single point measurement tool .
- 2 Click on the image to place the single caliper dot.
- 3 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 4 If you want to rename the label, type a new name while the label text is selected, and then click outside the label to commit the label.
- 5 If you want to move the measurement or the label, select it, drag it and drop it.

### Time measurement for physiological display

Time interval is measured in ms.

### To place a Time measurement

- 1 Click Measurements  then the Time measurement tool .
- 2 In the physiology data trace window below the image mode data, click to place the initial caliper.
- 3 Move the cursor to the location where you want to place your end caliper and then click to place the caliper.
- 4 The system displays the measurement value and editable label for the measurement in the measurement panel.





5 If you need to move the entire measurement, click on the measurement line, then drag and drop it into position.

## Time measurement for M-Mode images

The Time measurement is measured in ms.



### To place a Time measurement

- 1 Click Measurements  then the Time measurement tool .
- 2 In the image mode data, click to place the initial caliper.
- 3 Move the cursor to the location where you want to place your end caliper and then click to place the caliper.
- 4 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 5 If you need to move the entire measurement, click on the measurement line, then drag and drop it into position.

## Time measurement for PW Doppler Mode images

The Time measurement is measured in ms.

### To place a Time measurement



- 1 Click Measurements  then the Time measurement tool .
- 2 In the spectrum window or the physiology data trace window click to place the initial caliper.

- 3 Move the cursor to the location where you want to place your end caliper and then click to place the caliper.
- 4 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 5 If you need to move the entire measurement, click on the measurement line, then drag and drop it into position.

## Time measurement for Color Doppler Mode images

The Time measurement is measured in ms.



### To place a Time measurement

- 1 Click Measurements  then the Time measurement tool .
- 2 In the physiology data trace window below the image mode data, click to place the initial caliper.
- 3 Move the cursor to the location where you want to place your end caliper and then click to place the caliper.
- 4 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 5 If you need to move the entire measurement, click on the measurement line, then drag and drop it into position.

## Traced Distance measurement

Traced Distance is measured in mm.



### To place a Traced Distance measurement

- 1 Click Measurements  then the Traced Distance measurement tool .
- 2 Click on your image to place the initial caliper.
- 3 Move the cursor along the contour of your target tissue and then right-click to place the final caliper of your trace.
- 4 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 5 If you need to move the entire measurement, click on the measurement line, then drag and drop it into position.

## Velocity measurement

Use the Velocity measurement tool to determine the velocity of vascular flow. Velocity is measured in mm/s.

### To place a Velocity measurement

- 1 Click Measurements  then the Velocity measurement tool .
- 2 Click on the image to place the initial caliper.
- 3 Move the cursor to the location where you want to end the measurement and then click to place the end caliper.

- 4 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 5 If you need to move the entire measurement, click on the measurement line, then drag and drop it into position.

## Vevo Color tool



Vevo Color is a tool you can use to:

- Add color to any area of interest on an image frame.
- Add color to any area on any frame in a cine loop so you can track how the area morphs over the period between the frames on the cine loop.

**Note:** Vevo Color does not provide area measurements.

**Note:** Vevo Color is only available for frame based modes—B-Mode, PA-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode, 3D Mode (in 2D view only), 4D- Mode (in 2D view only) and EKV mode.

To add a Vevo Color area to an image

- 1 Click Measurements  then the Vevo Color tool .
- 2 (Optional) Change the area color by clicking the drop-down list and selecting a color.
- 3 Click on your image to place the initial caliper along the boundary of the region you want to define and continue to click to add additional points to define the boundary of your region more precisely.

- 4 To complete the region, right-click your final point. The system applies the color area to all frames in the cine loop.
- 5 (Optional) To move the entire area, place the cursor near the center of the area until the cursor changes to a cross and then drag the area.
- 6 (Optional) To add a label or modify the area properties, right-click the contour and in the menu click **Properties**.

### To morph a Vevo Color area over a range of frames

- 1 Move the cine loop to a frame where you can start a range of frames and then add your first Vevo Color area.
- 2 Move the cine loop to an end frame for the range.
- 3 Move the area or change the boundary points to define the changed area.
- 4 To view the area morphing, drag the cine loop between the two points.
- 5 Repeat the area redefinition procedures on any frame in the cine loop. The system applies the morphing between each of the frames where you have defined the area properties.

### Coloring a measured area

You can also add color to measurements that create an observable area. These include:

- 2D Area measurement
- Angle measurement
- Ellipse measurement

- Traced Distance measurement
- VTI measurement


### To add a color to a measurement

- 1 Add your measurement and then right-click it and select **Properties**.
- 2 In **Fill Color**, select the color you want to add.
- 3 In **Fill Opacity**, set the percentage of transparency you want for the entire color area.
  - 0 = Totally invisible
  - 50 = Half transparency
  - 100 = Totally opaque


### VTI measurement with automatic frequency trace

When you want to measure VTI over a series of cycles, use the automatic frequency trace feature to instantly plot the caliper points on the frequency waveform before you apply the VTI measurement.

### To place a VTI measurement with automatic frequency trace

- 1 Click  to open the Measurements panel.
- 2 Select the appropriate auto trace option in the Peak or Mean drop-down boxes.

**Important:** You must select a Peak and Mean option other than none to activate the auto-trace functionality for an acquired image.

- 3 Click the VTI tool .
- 4 Along the frequency baseline click on the beginning of a cardiac cycle waveform to place the initial caliper, then click at the end of the cycle waveform.
- 5 Continue adding points at the start and end of cardiac cycle waveforms until you have selected the range of cycles you want to measure.
- 6 Right-click to apply your final caliper at the end of the last cycle. The system plots individual caliper points along the range.
- 7 The system displays the measurement value and editable label for the measurement in the measurement panel.
- 8 If you want to rename the label, type a new name while the label text is selected, and then click outside the label to commit the label.
- 9 If you want to move the measurement or the label, select it, drag it and drop it.

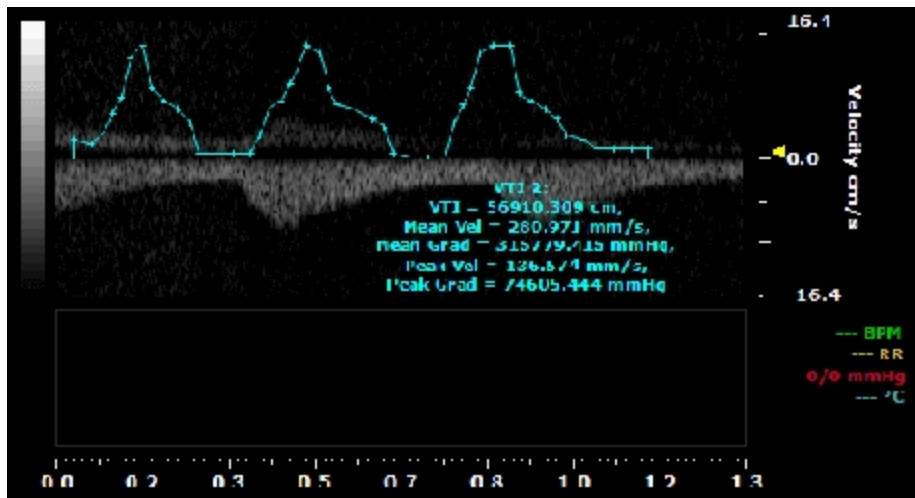
## VTI measurement without real-time frequency trace enabled

The VTI (Velocity Time Integral) is measured through a manual trace when no real-time traces are selected.

### To manually trace a VTI measurement

- 1 Click Measurements  then the VTI tool .

- 2 Click on your image to place the initial caliper at a specific point on the waveform.
- 3 Move the cursor along the contour of the waveform. The system automatically places points at the spacing density that you specify in the Auto Point Spacing section of the Measurement tab in the Preferences window.
- 4 Right-click to place your final caliper at the end of the last cardiac cycle.
- 5 The system displays the measurement value and editable label for the measurement in the measurement panel.



*The system constrains your VTI measurement to either the top or bottom side of the baseline, depending on the placement of the initial caliper. The system prevents your trace from crossing the baseline.*

- 6 If you want to position points more accurately over regions where the signal changes rapidly, drag them into position.



7 If you want to rename the label, type a new name while the label text is selected, and then click outside the label to commit your change.

8 If you want to move the measurement or the label, select it, drag it and drop it.

## Vevo CQ User Guide

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This guide describes how to use Vevo CQ to process cine loops of contrast images that you acquire with a Vevo Imaging System.

Vevo CQ is a software application designed for quantifying perfusion in small-animal models by contrast-enhanced ultrasound imaging. Vevo CQ provides quantitative measurements by computing perfusion parameters by means of a dedicated curve-fitting algorithm applied on contrast-uptake kinetics (or time intensity curves).

In addition, Vevo CQ offers the possibility to visualize the spatial distribution of these perfusion parameters as color-coded parametric images, useful for qualitative analysis. Finally, Vevo CQ can save computed results in different forms (numerical data, images, cine loops) for statistical analysis and reporting purposes.

**Note:** The responsibility of interpreting Vevo CQ results rests entirely with the user.

To ensure reliable perfusion quantification results with Vevo CQ, it is essential to follow certain rules during the acquisition of contrast-enhanced cine loops with a Vevo Imaging System. If the primary objective of the study is to perform therapeutic monitoring or screening of bioactive agent, make sure that:

- The imaging settings of the ultrasound system remain identical throughout the course of the study.
- The chosen scanning plane is optimal in order to minimize any out-of-plane motion by keeping respiratory movement within the plane.
- The scanning plane is the same from one study or series to another on a given animal.

- The duration of the recorded cine loops is at least 20 seconds.
- The probe is kept steady for the entire duration of the recording.

## Data for Vevo CQ analysis

Only Nonlinear Contrast Mode images acquired on the appropriate Vevo Imaging System can be analyzed with Vevo CQ.

The following types of data are not suitable for Vevo CQ Analysis:

- Single frames.
- 3D Mode cine loops.
- Cine loops acquired with the Vevo 1100 Imaging System.
- Loops or sub-ranged cine loops of less than 10 frames.

## Typical Vevo CQ workflow

The following describes the two typical workflows used to perform a Vevo CQ analysis—Perfusion and Targeted.

Select up to 5 images to load into Vevo CQ.

### Perfusion quantification

#### Bolus analysis

- 1 Select a cine loop in the Study Browser.

2 Click **Vevo CQ**.

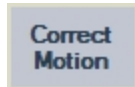
3 Define the frames to be included/excluded from the analysis in the Clip Editor.

4 Draw ROIs.

**Note:** For cine loops that display motion artifacts use Motion Correction.

**Note:** Quantification can be done without using Motion Correction.

5 Move the image slider to choose a reference image for Motion Correction.

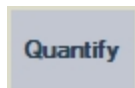


6 Click .

7 Review the cine loop using the image slider.

8 If Motion Correction was unsuccessful, try one of the following:


- a. Select another reference image and click **Correct Motion** again.
- b. Use the functions in Edit Clip to exclude any images thought to be degrading from the result of Motion Correction (such as out of plane movements), then click **Correct Motion**.



9 Click .

10 Accept or select another instant in the Contrast Arrival Detection dialog.

11 If needed, adjust the gain and dynamic range sliders for each parametric image or check **Apply Preset** to apply the user preferences.

12 Click the  button to export data.

13 Click the  button to store the current analysis for the data.

### Replenishment analysis


1 Select a cine loop in the Study Browser.

2 Click **Vevo CQ**.

3 Select the replenishment segment to be analyzed (   ).

4 Draw ROIs.

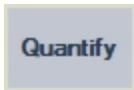
5 Move the image slider to choose a reference image for Motion Correction.

6 Click .

7 Review the cine loop using the image slider.

8 If Motion Correction was unsuccessful, try one of the following:

- a. Select another reference image and click **Correct Motion** again.
- b. Use the functions in **Edit Clip** to exclude any images thought to be degrading from the result of Motion Correction (such as out of plane movements), then click **Correct Motion**.

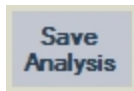


9 Click .

10 If needed, adjust the gain and dynamic range sliders for each parametric image or check **Apply preset** to apply the user preferences.



11 Click the  button to export data.

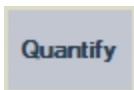


12 Click the  button to store the current analysis for the data.

## Targeted


### Targeted enhancement (no destruction)

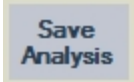
- 1 Select a cine loop in the Study Browser.
- 2 Click **Vevo CQ**.
- 3 Define the images to be excluded from the analysis in the Clip Editor.
- 4 Draw ROIs.
- 5 Move the image slider to choose a reference image for Motion Correction.



6 Click .

7 If needed, adjust the gain and dynamic range sliders for each parametric image or check **Apply preset** to apply the user preferences.

8 Click the  button to export data.

9 Click the  button to store the current analysis for the data.

### Differential targeted enhancement (destruction)

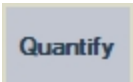
1 Select a cine loop in the Study Browser.

2 Click **Vevo CQ**.

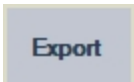
3 Select the destruction segment to be analyzed (   ).

4 Draw ROIs.

5 Move the image slider to choose a reference image for Motion Correction.

6 Click .

7 If needed, adjust the gain and dynamic range sliders for each parametric image or check **Apply preset** to apply the user preferences.

8 Click the  button to export data.

9 Click the  button to store the context.

## Analyzing data

Vevo CQ is divided into 3 main modules: Clip Editor, Motion Correction and Quantification. These modules are called in a consecutive manner to provide perfusion quantification results.

The first module (Clip Editor), allows inclusion/exclusion of images into/from the Quantification mode and allows the tracing of the ROI.

The second module (Motion Correction), applies a movement compensation by spatially realigning successive images in order to minimize respiration artifacts.

The third module (Quantification), performs a quantitative analysis of contrast agent perfusion, both at the pixel level and in regions of interest, by computing amplitude and time-related perfusion parameters with a curve-fitting algorithm. This algorithm is based on mathematical models for either bolus-kinetics or replenishment-kinetics following microbubble destruction under infusion mode.

### Clip Editor

The Clip Editor allows you to limit the analysis to a specified time window while excluding unwanted images from processing (either isolated or in ranges). In graph (a) below, the Clip Editor may be used to include—within the wash-in and wash-out phases of a bolus—only the images within a relevant time interval. If the destruction-replenishment technique is applied during the experiment, the Clip Editor automatically detects selectable replenishment segments by including images between two destruction events only as depicted in graph (b) below.

For targeted analysis, using targeted microbubbles, the Clip Editor automatically proposes a selection of images to be processed. This selection depends on the presence or absence of destruction frames in the cine loop. During the imaging process, it is useful to apply destruction frames in a late



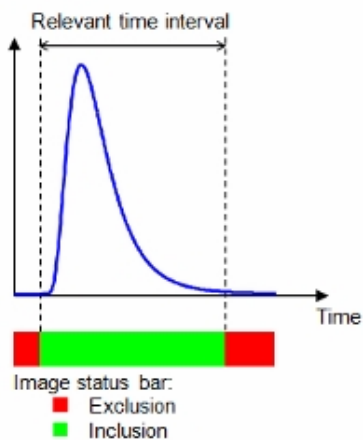
phase, after the bubble-binding process has been completed and most of the circulating bubbles have been washed-out to maximize destruction of all bound bubbles.

The images before destruction display signal from both bound and circulating microbubbles while the images after destruction correspond to bubbles still in circulation at that moment and also represent any residual tissue-echoes, which are not representative of the binding process.

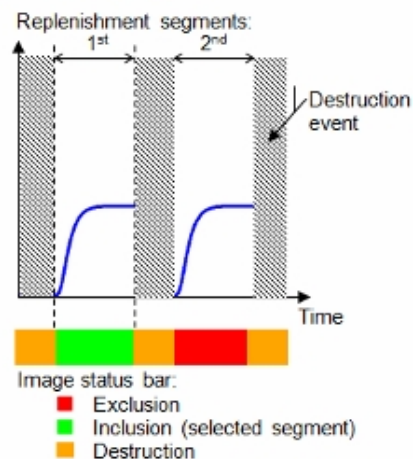
Vevo CQ, in the targeted mode, is able to express the specific binding as a difference between the echo power averaged in a segment before destruction and the residual echo power averaged in a segment after destruction. Graph (c) depicts the case with destruction frames, where the Clip Editor proposes two sets of images; one right before and another at 1 second after the destruction frames. By default, the numbers of frames included in each set are remembered from the previous analysis.

In the case where there are negligible contributions from circulating bubbles or residual tissue-echoes, the investigator may have omitted to apply destruction frames, Vevo CQ is also able to process such cine loops by applying quantification in a single segment of frames in a late phase. As shown in graph (d), Vevo CQ proposes, in this case, a set of frames for assessing microbubble-binding at the end of the cine loop.

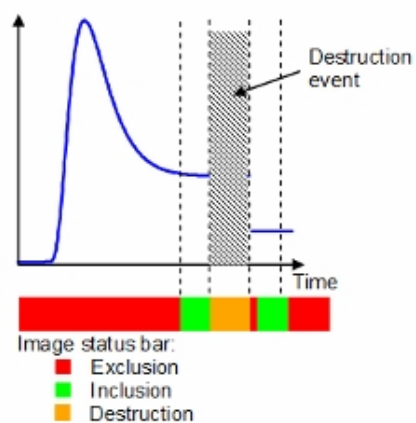
(a) BOLUS



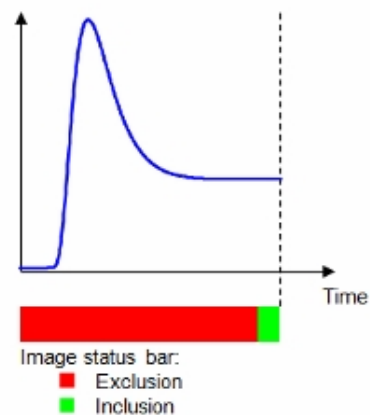
(b) REPLENISHMENT



(c) TARGETED (destruction)

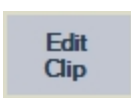


(d) TARGETED (no destruction)


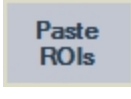


## Clip Editor interface

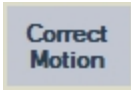
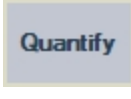
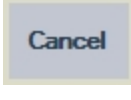
### Clip Editing

Button	Description
	Mode where the cine loop can be edited prior to entering the quantification mode. The Edit Clip function will be used to include/exclude images in/from the quantification process.

### Copy/Paste

Button	Description
	Copies a selected set of ROIs into the clipboard.
	Pastes a selected set of ROIs from the clipboard.

### Image Processing

Button	Description
	Applies spatial realignment in order to minimize motion artifacts from the images within the cine loop to be analyzed.
	Starts the quantification process for the cine loop of interest.
	Cancel the current processing state and restores the previous mode.

Button	Description
<b>User Settings</b>	Rename the file, select/deselect optional bolus parameters, copy user settings from an external location, save and export user settings.

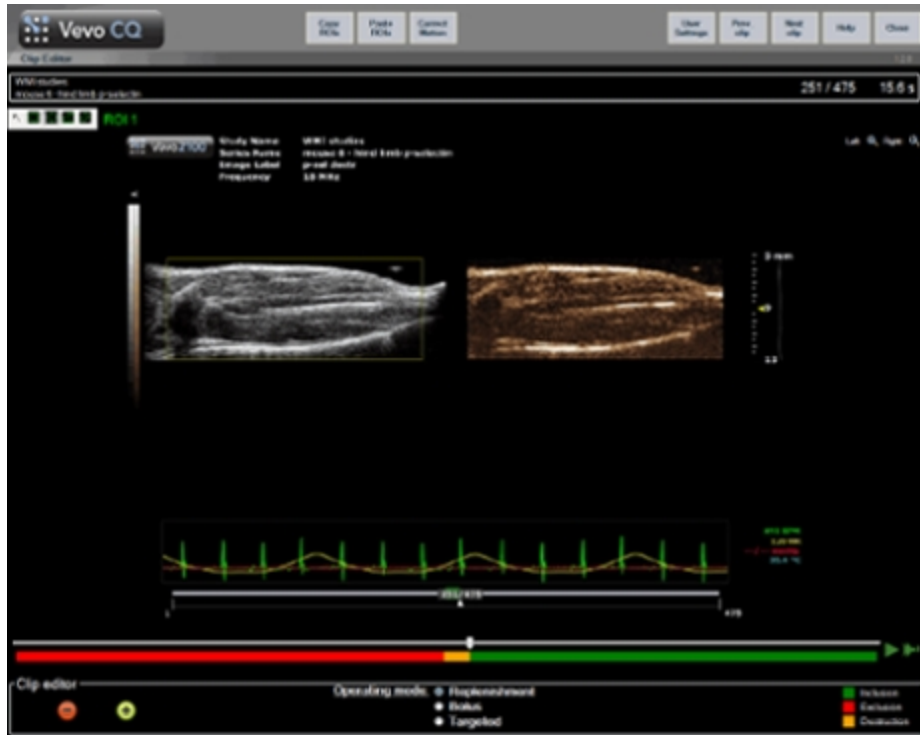
#### Data Management

Button	Description
<b>Export</b>	Exports data in various formats– image, cine loop, numerical, or to a user-defined location.
<b>Save Analysis</b>	Saves the analysis with the associated Nonlinear Contrast Mode cine loop data.

#### Study Management

Button	Description
<b>Next Clip</b>	Navigates to the next cine loop in the current opened cine loops.
<b>Prev. Clip</b>	Navigates to the previous cine loop in the current opened cine loops.
<b>Close</b>	Closes the current cine loop or the Vevo CQ Analysis application and returns to Vevo LAB.








## Clip Editor interface elements





Workspace for Clip Editor mode.


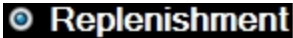

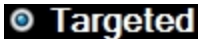

### Image Display

Element	Name	Function
	Image number	Shows the number of the currently displayed frame as well as the total number of images available in the cine loop.



Element	Name	Function
	Time indicator	Shows the time instant of the currently displayed frame.
	Zoom in	Increases the image size.
	Zoom out	Restores the initial image size.
	Image slider	Selects the frame to be displayed. If the cursor points to an excluded image, a red frame appears around it.
	Frame status bar	Shows excluded and included frames in red and green, respectively. Destruction images are shown in orange.
	Play	Runs the movie player.
	Fast play	Runs the movie player in fast mode, up to 8X.


#### Clip Editor

Element	Name	Function
	Exclude	Sets the exclusion mode.
	Include	Sets the exclusion mode.

Element	Name	Function
	Reset	Resets the cine loop to default (for targeted mode only).
	Replenishment	Enables the destruction/replenishment mode (only available if cine loop contains destruction images).
	Bolus	Enables the bolus mode.
	Targeted	Enables the targeted mode.
	Replenishment selector	Selects the previous/next replenishment segment (only available if the cine loop includes destruction/replenishment segments).

## Clip Editor workflow

- 1 Play the cine loop using the play  or fast play  controls.
- 2 (Optional) Edit the cine loop to exclude or include images from the analysis using the Clip Editor controls.

Exclude = 

Include = 

With the exclude button on, all frames scrolled through will be marked with red and will be excluded from the analysis. A red frame around the whole image area will also suggest the exclusion.

- To reverse the state of the frame, use the include button to mark the frame with green.
- To change the state for a range of frames, move the cursor on the frame status bar, and drag to the desired position.

3 Draw a region of interest (ROI) on the image by selecting one of the predefined shapes.



Tracing the contour is similar to placing measurements within the Vevo Imaging System:

- i. Select the region.
- ii. Left-click to place the first point.
- iii. Follow the shape on the image while placing the rest of the points.
- iv. When you are done, double left-click to complete the measurement.

The ROI can be traced on either the B-Mode or Nonlinear Contrast Mode image as they will be replicated in the other image simultaneously.

A default label will be placed next to the contour selection bar. The label can be edited in the window or later in the analysis window.

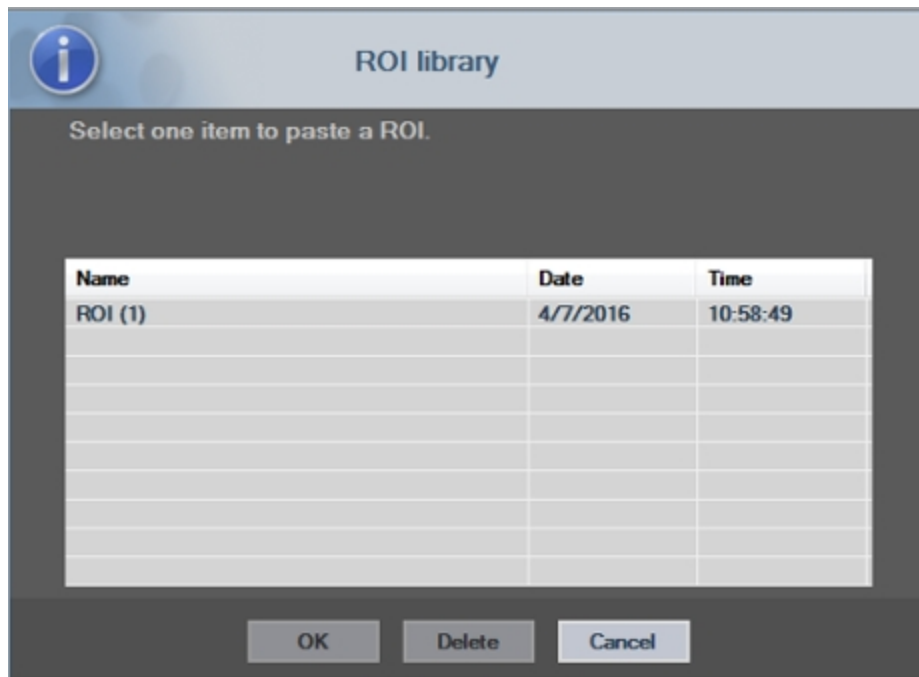
A set of ROIs can be saved and reused.




## To reuse the regions of interest on multiple images

- ◆ To reuse the regions of interest on multiple images, use the copy and paste controls from the menu bar.

When you select either copy or paste, the ROI library window appears. Here you can save or retrieve a region of interest depending on the control you selected.



- 4 Click .

Motion Correction is part of the available post-processing tools. When you activate this feature it applies spatial realignment to all the frames in the cine loop. You can reverse this type of processing at any time during analysis.

## Functional reference


Vevo CQ is interfaced with the Study Browser of the Vevo Imaging System, which allows up to 5 cine loops to be processed.

**Note:** Vevo CQ can also be started from the measurement panel of the mode window with a Nonlinear Contrast Mode cine loop.

### To start Vevo CQ from the Study Browser

- 1 Select a Nonlinear Contrast Mode cine loop.
- 2 Click **Vevo CQ**.

### To start Vevo CQ from the mode window

- 1 Load a Nonlinear Contrast Mode cine loop into review.
- 2 Click measurements .
- 3 Click **Vevo CQ**.

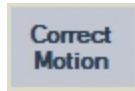
### To perform perfusion quantification

- 1 Select a Nonlinear Contrast image from the Study Browser.
- 2 Click **Vevo CQ**.

3 (Optional) Edit the cine loop for excluding images from the analysis via



4 Draw regions of interest.




5 Click



6 Click



7 Click

8 Click  to store the context.



## Modifying images


To exclude a range of images

1 Move the image slider to the first image to be excluded.



2 Click .

3 Move the image slider to the last image to be excluded.




### To include a range of images:

- 1 Move the image slider to the first image to be included.
- 2 Click  .
- 3 Move the image slider to the last image to be included.

### To change the range of excluded images

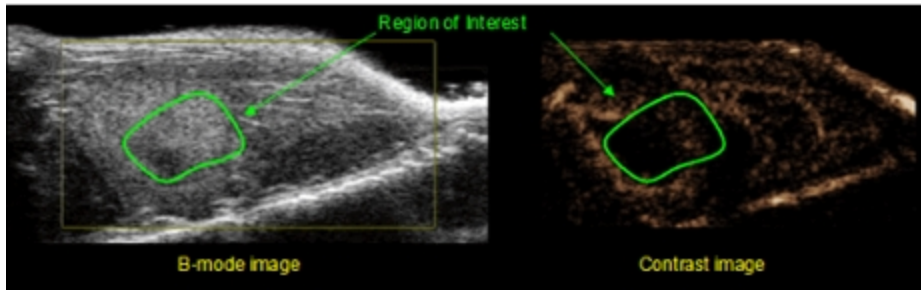
- 1 Move the mouse pointer over the frame status bar to any border of a range of excluded images ().
- 2 When the pointer's shape changes to a vertical split  , drag the border to change the range of excluded images.

### To move the range of excluded images

- 1 Move the mouse pointer over the frame status bar to any border of a range of excluded images ().
- 2 When the pointer's shape changes to a vertical split  , drag to include or exclude more frames, depending on the direction of the move.
- 3 (Optional) Press **Shift** on your keyboard and  , to move the entire exclusion range to a different location—without changing the number of frames that are excluded.

## Regions of Interest (ROI)

With the help of the ROI toolbar, one to four regions of interest may be drawn on the B-Mode image (left side) or the Nonlinear Contrast Mode image (right side). As the B-Mode and Nonlinear Contrast Mode images represent the same anatomical location, an ROI drawn on one image is automatically duplicated on the other image, as shown in the following illustration.








### Interface elements

The ROI toolbar (located in the upper-left corner of the image viewer) offers four different drawing tools. The ROI label on the right of the toolbar identifies the current region to be drawn, and may be edited by clicking on it.





ROI Toolbar Buttons

Button	Name	Function
	Select	Allows the selection/modification of a region of interest.
	Rectangle	Draws a rectangular shape.



Button	Name	Function
	Ellipse	Draws an elliptical shape.
	Polygon	Draws a polygonal shape.
	Closed curve	Draws a closed curvilinear shape.

## Drawing ROIs


### To draw a rectangular or elliptical ROI

- 1 Select a shape in the ROI toolbar ( or .
- 2 Move the mouse pointer to the desired location in the B-Mode image (left side) or the Nonlinear Contrast Mode image (right side).
- 3 Click and drag to draw the ROI.



### To draw a polygonal or closed curved ROI

- 1 Click a shape in the ROI toolbar ( or ) to select it.
- 2 Move the mouse pointer to the desired location in the B-Mode image (left side) or the Nonlinear Contrast Mode image (right side).
- 3 To add anchor points, click repeatedly while moving the mouse pointer.
- 4 Double left-click at any time to close the shape.

### To delete a ROI


- 1 Right click on the image to set the ROI selection mode or click the  button.
- 2 Move the mouse pointer to any border of the ROI.
- 3 Select the ROI using the left mouse button.
- 4 Press either the **Delete** or **Backspace** key on your keyboard.

### To change the location of a ROI


- 1 Right click on the image to set the ROI selection mode or click the  button.
- 2 Move the mouse pointer to any border of the ROI.
- 3 Select the ROI using the left mouse button.
- 4 When the pointer shape changes to a , click and drag the ROI to a new location.

### To change the location of anchor points of a ROI


- 1 Right click on the image to set the ROI selection mode or click the button.
- 2 Move the mouse pointer to any anchor point of the ROI.
- 3 Select the ROI using the left mouse button.

- 4 When the pointer shape changes to a , click and drag an anchor point to a new location.

To copy all the ROIs currently drawn

- 1 Click .
- 2 Set a name or accept the default generated one and click **OK**.

To paste ROIs from the library

- 1 Click .
- 2 Select an item from the ROI library list and click **OK**.

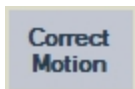
## Motion Correction

This section describes the Motion Correction module, which is a key tool for allowing reliable perfusion assessments. Motion in a cine loop can be due to internal organ movements, such as breathing, or to slight probe movements. Manual alignment of the individual images is extremely time-consuming and thus not practical. Vevo CQ provides an automatic Motion Correction tool to spatially realign images with respect to a user-selected reference image.


To apply Motion Correction

- 1 Move the image slider to choose a reference image.





2 Click

3 Once Motion Correction is applied, the Clip Editor is replaced by the Motion Correction Clip Editor, where the cine loop from the Motion Correction can be edited further. At this stage, colors of the frame status bar () representing excluded and included image ranges are set to blue and pink, respectively.

4 Check the accuracy of the Motion Correction by scrolling through the cine loop using the image slider (Motion Correction is considered a success if the images are spatially realigned and any residual motion is deemed acceptable).

5 If Motion Correction was unsuccessful, try one of the following:

- a. Select another reference image and click **Correct Motion** again.
- b. Use Edit Clip to exclude any images thought to be degrading the result of Motion Correction, such as out of plane movements, and click **Correct Motion** again.

## Quantification

Perfusion quantification represents the core of the Vevo CQ functionality and performs quantification in two steps. Video data is first converted into echo-power data, a quantity directly proportional to the instantaneous concentration of contrast agent concentration at each location in the field of view.

This conversion process, called linearization, takes into account the dynamic range used for cine loop acquisition and compensates for contrast gain as well as mean Time-Gain Compensation (TGC) value within the contrast box, as long as pixel intensity is not truncated or saturated. The echo-power data as a

function of time, or linearized signals, are then processed to assess blood perfusion, using a curve fitting approach with a parametric Perfusion model.

The parameters derived from such a model are called perfusion parameters and are useful for relative estimates of local perfusion (e.g. in terms of relative blood volume or relative blood flow). For instance, these parameters may be particularly useful for assessing the efficacy of given therapeutic agents at different times. The concepts of linearized signal, perfusion modeling and parametric imaging are explained further in the next sections.

### **Linearized signal**

A linearized (or echo-power) signal represents echo-power data as a function of time at either the pixel level or in a region of interest. The linearized signal results from a linearization process of the video data and is proportional to the local ultrasound agent concentration. As it is expressed in arbitrary units, only relative measurements are possible.

For instance, consider echo-power amplitudes at a given instant both in a tumor and in surrounding parenchyma. If the echo-power amplitude is twice as high in the tumor than the parenchyma, this means that the concentration of ultrasound contrast agent in the lesion is close to double that in the parenchyma.

### **Perfusion modeling**

Perfusion estimates in Vevo CQ are made by a curve fitting process that adjusts the parameters of a mathematical model function to best fit the experimental linearized signal.

In the context of ultrasound contrast imaging, the mathematical function is called perfusion model and is chosen to represent either bolus kinetics or replenishment kinetics following bubble destruction. Such a model serves to estimate a set of perfusion parameters for quantification purposes.

These parameters can be divided into three categories: amplitude, time and a combination of amplitude and time. Firstly, amplitude related parameters are expressed as relative echo-power. Typical amplitude parameters are the peak enhancement in a bolus kinetics, or the plateau value in a replenishment kinetics, which may be associated with relative blood volume.

Secondly, time related parameters are expressed in seconds and refer to the timing of the contrast-uptake kinetics. As an example of time parameter, the mean transit time measures the average time that blood takes to transit through a portion of tissue.

Finally, amplitude and time parameters may be combined so as to produce quantities related to the blood flow (blood flow = blood volume/mean transit time) for replenishment kinetics or the wash-in rate (wash-in rate = peak enhancement/rise time) for bolus kinetics.

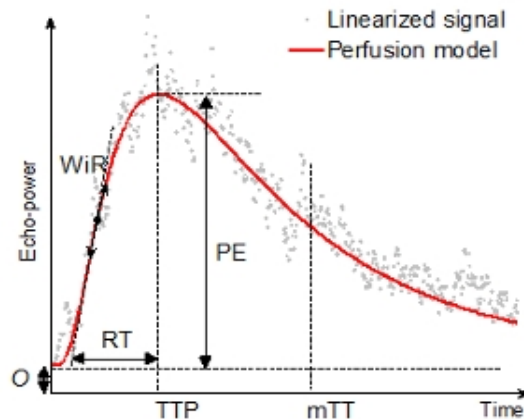
### *Bolus perfusion model*

Quantification of the bolus perfusion model is defined as:

$$f(t) = O + AUC \frac{1}{st\sqrt{2\pi}} e^{-\frac{(\ln(t)-m)^2}{2s^2}}$$

where

$$m = \ln(mTT) - \frac{s^2}{2}$$



### Bolus Perfusion Quantification Definitions

Abbreviation	Definition	Unit
$f(t)$	Best-fit function of echo-power (or fitted signal).	[a.u, dB]
$t$	Time variable.	[s]
$AUC$	Area Under the Curve to infinite time.	[a.u]
$mTT$	Mean Transit Time corresponding to the center of gravity of $f(t)$ .	[s]
$O$	Offset amplitude.	[a.u]
<i>Where [a.u] and [s] are arbitrary unit and second, respectively.</i>		

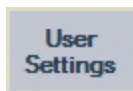
Additional perfusion parameters, derived from the bolus perfusion model, available in Vevo CQ are:

### Additional Bolus Perfusion Parameters Definitions

Abbreviation	Definition	Unit
PE	Peak Enhancement - representative of Blood Volume	[a.u, dB]
WiAUC	Area Under the Curve (Wash-in)	[a.u, dB]
RT	Rise Time	[s]
TTP	Time To Peak	[s]
WiR	Wash-in Rate (maximum slope)	[a.u, dB]

Abbreviation	Definition	Unit
WiPI	Wash-in Perfusion Index (WiAUC / RT) - representative of blood flow	[a.u., dB]
QOF	Quality Of Fit between the echo-power signal and $f(t)$	[%]
<i>Where [a.u.] and [s] are arbitrary unit and second, respectively.</i>		

**Note:** PE (Peak Enhancement) is calculated as a difference between the peak and the baseline. For the contrast measurement tools that are used within Vevo LAB (not in Vevo CQ), a different method is used to calculate the measurements.



Additional optional parameters are available via  as follows:

**Note:** The optional parameters are calculated from the fitted curve using extrapolated data and they can vary with size of cine loop.

#### User Settings Parameters

Abbreviation	Definition	Unit
AUC	Area Under the Curve	[a.u., dB]
mTT	mean Transit Time	[s]
PI	Perfusion Index (AUC / mTT)	[a.u., dB]
Fit	Fitted signal	[a.u., dB]

Abbreviation	Definition	Unit
Lin	Linearized signal	[a.u, dB]
<i>Where [a.u] and [s] are arbitrary unit and second, respectively.</i>		

### *Destruction-replenishment perfusion model*

Quantification of destruction-replenishment perfusion model is defined as:

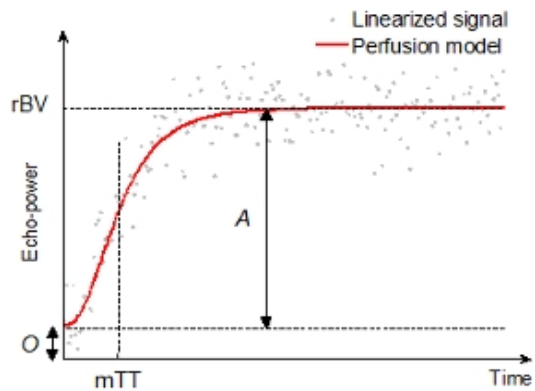
$$f(t) = O + \frac{A}{2} \left[ 1 + \operatorname{erf} \left( \frac{\ln(t) - m}{s\sqrt{2}} \right) \right]$$

where

$$m = \ln(mTT) - \frac{s^2}{2}$$

with the error function  $\operatorname{erf}$ , defined as

$$\operatorname{erf}(t) = \frac{2}{\sqrt{\pi}} \int_0^t e^{-u^2} du$$



### Destruction-Replenishment Perfusion Quantification Definitions

Abbreviation	Definition	Unit
$f(t)$	Best-fit function of echo-power (or fitted signal)	[a.u]
$t$	time variable	[s]

Abbreviation	Definition	Unit
<b>A</b>	Amplitude of the plateau	[a.u.]
<b>mTT</b>	mean Transit Time	[s]
<b>O</b>	Offset amplitude	[a.u.]
<i>Where [a.u.] and [s] are arbitrary unit and second, respectively.</i>		

Additional perfusion parameters, derived from the destruction-replenishment perfusion model, available in Vevo CQ are:

#### Additional Destruction-Replenishment Perfusion Quantification Definitions

Abbreviation	Definition	Unit
rBV	relative Blood Volume <b>A + O</b>	[a.u.]
mTT	mean Transit Time	[s]
rBF	relative Blood Flow (rBV / mTT)	[a.u.]
QOF	Quality Of Fit between the echo-power signal and <b>f(t)</b>	[%]
<i>Where [a.u.] and [s] are arbitrary unit and second, respectively.</i>		

#### Targeted contrast imaging

Targeted contrast imaging may be quantified with Vevo CQ in the late phase, in two possible modes—Targeted Enhancement and differential Targeted Enhancement.

Late phase Targeted Enhancement reflects the average signal intensity, proportional to the quantity of bubbles (i.e. including targeted bubbles attached to specific receptors), remaining after a given period of time. This parameter is calculated by computing the mathematical expectation (or mean) of the experimental linearized signal over the last 2 seconds in the cine loop being analyzed.

**Note:** This default time interval is a suggestion only and may be extended, shortened or moved according to your preferences. Additionally, the default time also reflects the quantity of attached bubbles as well as any residual bubbles still in circulation.

Differential Targeted Enhancement, or dTE, is computed for estimating the quantity of targeted bubbles after subtraction of any residual contribution from circulating bubbles. For that purpose, a destruction of all targeted bubbles must be applied during acquisition, in order to assess, immediately after the flash, the quantity of bubbles still in circulation and replenishing the region under observation.

Therefore, the calculation requires the definition of two time intervals; one immediately before the destruction flash, and another one shortly after, when any bubbles still in circulation have replenished the region. In this way, by subtracting the mean signal intensity coming from circulating bubbles, from the signal intensity reflecting both circulating and targeted microbubbles, it provides a better estimate of the quantity of target bubbles alone.

**Note:** A delay of 1 second is introduced by default after the agent destruction phase, to exclude the replenishment phase from the analysis. Again, these periods are suggestions only.



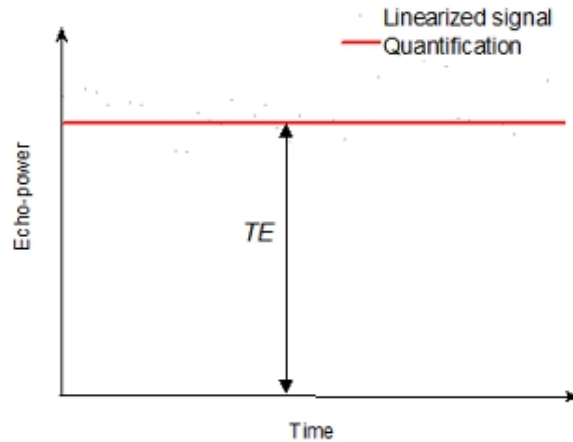
### Late phase Targeted Enhancement

Quantification of late phase Targeted Enhancement is defined as:

$$TE = E[s(t)]$$

where  $E[\cdot]$  is the mathematical expectation (mean)

$$CV(TE) = \frac{E[(s(t) - TE)^2]}{TE}$$



Late Phase Targeted Enhancement Quantification Definitions

Abbreviation	Definition	Unit
$t$	time variable	[s]
$s(t)$	linearized signal	[a.u.]
$TE$	Targeted Enhancement (mean value of $ep(t)$ )	[s]
$CV(TE)$	Coefficient of Variation (standard deviation $ep(t)$ of normalized by $TE$ )	[%]

Abbreviation	Definition	Unit
<i>Where [a.u] and [s] are arbitrary unit and second, respectively.</i>		

### Differential targeted enhancement

Quantification of differential targeted enhancement (destruction applied) is defined as:

$$\Delta TE = TE_{bd} - TE_{ad}$$

with

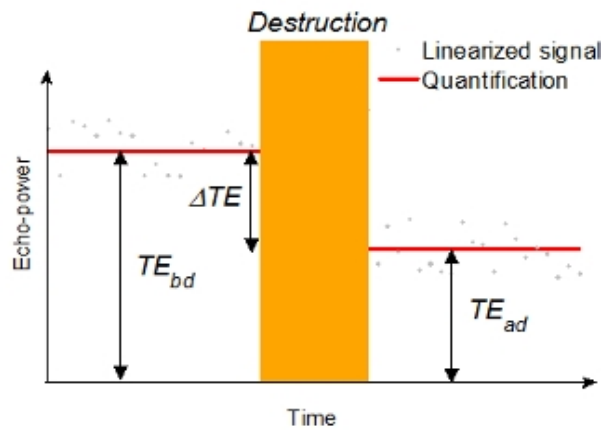
$$TE_{bd} = E[s_{bd}(t)]$$

and

$$TE_{ad} = E[s_{ad}(t)]$$

where  $E[\cdot]$  is the mathematical expectation (mean)

$$CV(\Delta TE) = \frac{E[(s_{bd}(t) - TE_{bd})^2]}{\Delta TE}$$



### Differential Targeted Enhancement Quantification Definitions

Abbreviation	Definition	Unit
$t$	time variable	[s]
$s_{bd}(t)$	linearized signal before destruction	[a.u]
$s_{ad}(t)$	linearized signal after destruction	[a.u]
$\Delta TE$	differential Targeted Enhancement	[a.u]

### Differential Targeted Enhancement Quantification Definitions

Abbreviation	Definition	Unit
$CV(\Delta TE)$	Coefficient of Variation before destruction (standard deviation of $ep_{bd}(t)$ normalized by $\Delta TE$ )	[%]
<i>Where [a.u] and [s] are arbitrary unit and second, respectively.</i>		

### Parametric imaging

Vevo CQ can perform spatial rendering of any perfusion parameter, in the form of a parametric map. This map synthesizes the time sequence of images into a single parametric image. Parametric imaging may enhance the information content of the contrast examination.

This technique may be particularly useful for making qualitative analysis in the course of a therapeutic monitoring performed on a given small-animal. In the example of using the destruction-replenishment technique, the efficacy of a substance inhibiting angiogenesis may be assessed by observing parametric images of relative blood volume (rBV) in a tumor, before and in the course of therapeutic treatment, reflecting the state of tumor perfusion resulting from the neo-vasculature.

A second benefit of parametric images is the spatial visualization of tumor response to the treatment, or its effects on healthy surrounding parenchyma.

In order to perform qualitative analysis on the basis of parametric images, certain conditions must be met:

- The cine loops must represent the same anatomical cross-section from one exam to another on a given small animal.

- Acquisition of contrast-ultrasound sequences must be performed using identical system settings (transmit power, display settings, gain, TGC and dynamic range).
- Only parametric images of the same perfusion parameter can be compared.

## Interface elements

### *Quantification mode*

Once the perfusion quantification processing is completed, Vevo CQ switches from the Edit Clip mode to the Quantification mode. The display layout in the Quantification mode comprises of four quadrants (Q1-Q4).

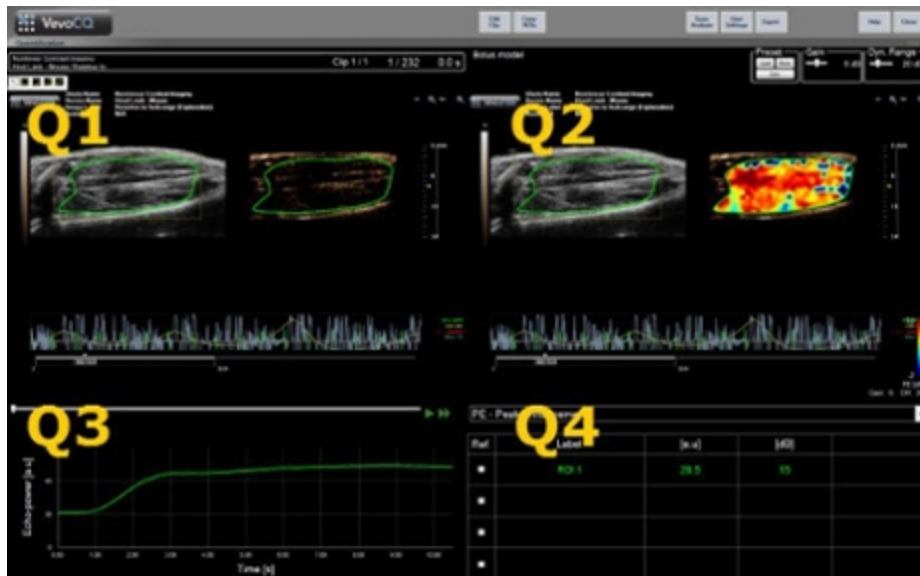
The four-quadrant representation combines all results within one display as follows:

- Original cine loop (Q1).
- Processed cine loop or parametric image (Q2).
- Chart displaying time intensity curves (linearized and fitted signals) in each ROI (Q3).
- Table listing the computed value in each ROI (Q4).

Q1 displays the original cine loop and Q2 the processed cine loop or the parametric image, depending on the selection in the parametric image view menu. Each parametric image has its own color map, which is rendered in the color bar located in the lower-right corner of Q2. For amplitude perfusion parameters, the color map ranges from blue to red, representing low to high amplitudes, respectively; for the time parameters, the color map is a reversed version of the previous one, from red to blue, or low to high.


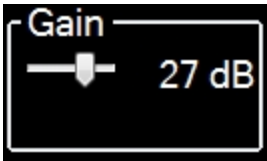


In Q3, with the colors matching the traces from the ROI, are the graphs representing the linearized and fitted signals. When a ROI is moved or modified, the calculated values are automatically updated corresponding to the position and displayed in Q4. The ROI labels may be changed by editing the name in the label column (Q4).

Above Q2, sliders are provided to adjust the gain and the dynamic range (log compression) of the processed image displayed in Q2, in a way similar to a standard ultrasound scanner.



*User interface in Quantification window.*

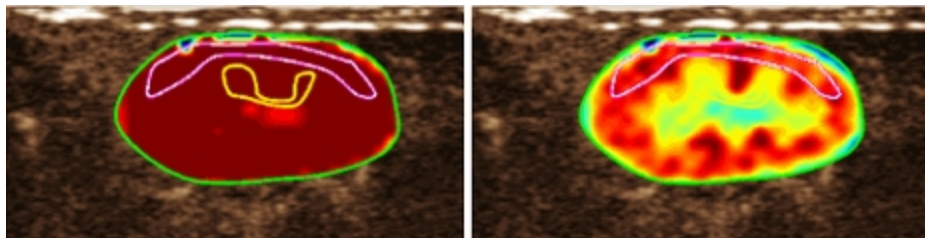
### Quantification Mode Controls function

Slider/control	Name	Function
	Preset	Stores/restores display presets (including gain and dynamic range of all parametric images).
	Gain	Controls the gain for the parametric image (Q2).
	Dynamic range	Controls the dynamic range for the parametric image (Q2).
	Parametric image view	Allows you to select a parameter to be displayed on the parametric image (Q2).

Slider/control					Name	Function																				
<div style="border: 1px solid black; padding: 2px;"> <div style="background-color: #e0e0e0; padding: 2px;">WiR - Wash-in Rate</div> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Ref.</th> <th style="width: 30%;">Label</th> <th style="width: 15%;">[a.u]</th> <th style="width: 15%;">Ref [%]</th> <th style="width: 10%;">Ref [dB]</th> </tr> </thead> <tbody> <tr> <td>■</td> <td>Whole Kidney</td> <td>79.4</td> <td>266.52</td> <td>4.26</td> </tr> <tr> <td>■</td> <td>Medulla</td> <td>29.8</td> <td>100.00</td> <td>0.00</td> </tr> <tr> <td>■</td> <td>Cortex</td> <td>91.9</td> <td>308.34</td> <td>4.89</td> </tr> </tbody> </table> <p style="text-align: center; margin-top: 5px;"><i>Relative measurements for an amplitude-related parameter (WiR).</i></p> </div>					Ref.	Label	[a.u]	Ref [%]	Ref [dB]	■	Whole Kidney	79.4	266.52	4.26	■	Medulla	29.8	100.00	0.00	■	Cortex	91.9	308.34	4.89	Relative measurements table	Relative measurements can be displayed in the Q4 table by selecting a reference ROI (in the Ref. column).
Ref.	Label	[a.u]	Ref [%]	Ref [dB]																						
■	Whole Kidney	79.4	266.52	4.26																						
■	Medulla	29.8	100.00	0.00																						
■	Cortex	91.9	308.34	4.89																						

### *Auto-scaled display presets*

Display presets (i.e. Gain & Dynamic Range) for each parametric image are automatically adjusted once the perfusion quantification processing is completed using the built-in auto-scaling function. However, this adjustment is to be seen as a suggestion and may need further manual fine tuning. See the example below, of a parametric image prior and after auto-scaling is applied.




*Parametric image prior (left) and after (right) display presets auto-scaling.*


### *Storing or loading display presets*

Display presets can be stored into a dedicated library and loaded at later time.

## To store a preset for all parametric images

- 1 Click the  button in the preset toolbar. The Display Preset Library dialog will appear.
- 2 Enter a name or accept the default generated one and click the **OK** button.

## To load display presets from the library

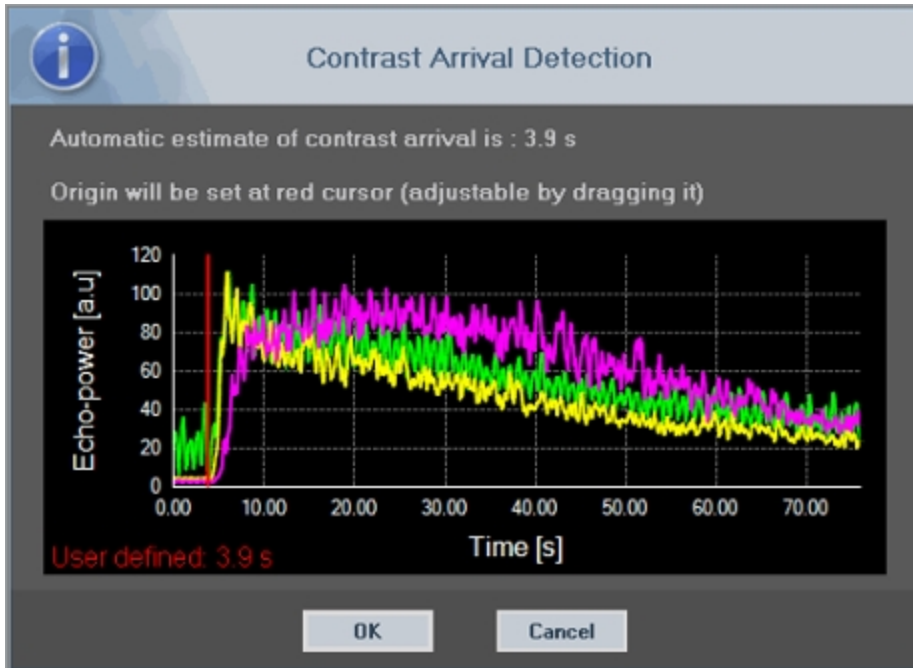
- 1 Click the  button in the preset toolbar. The Display Preset Library dialog will appear.
- 2 Select the item in the list and click **OK**.

## *Contrast arrival detection (for bolus only)*

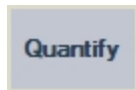
At the beginning of the perfusion quantification process, the arrival of contrast is detected within the ROIs. The time of contrast arrival is automatically determined at the instant when the echo-power amplitude rises above the background (wash-in phase), and is represented by a red line.

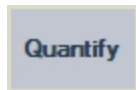
As shown in the Contrast Arrival Detection dialog, this instant remains a suggestion which may be modified by dragging the red cursor line. After clicking **OK**, all images preceding the selected instant will be excluded from the analysis and the cine loop time origin will be updated accordingly.





To launch perfusion quantification



- 1 Click the  button.
- 2 In the Contrast Arrival Detection dialog, click **OK** to accept the new time origin or **Cancel** to skip it.

### Exporting analysis data

Vevo CQ offers the possibility to export numerical, image and cine loop data to a user defined directory. For example, the numerical data are particularly

useful for carrying out further analysis in a spreadsheet type program.

The image data are a set of screen capture containing both the regions of interest and parametric images. These images allow qualitative comparisons between successive studies in the course of a therapeutic follow-up on a given small animal.

As a second example of qualitative analysis, the processed cine loops may provide a better assessment of the contrast-uptake over time.

Finally, still images or processed cine loops may also be useful for documentation or presentation purposes.

### *Interface elements*



*Export screen*

#### Data

Option	Description
TSV (Tab	Exports a tabulated text file (XLS extension) including

Option	Description
Separated Values)	time intensity curves and perfusion estimates.
Export Screenshot to Vevo Report	Exports a screen capture of the current analysis to Vevo Report.

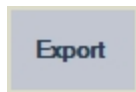
### Images

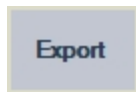
Option	Description
Full screen	Exports a screen capture of the front panel (A3 4 quadrants).
Ultrasound Image (current)	Exports the current ultrasound image with its ROIs (Q1).
Parametric Images	Exports all parametric images (Q2).
Time Intensity Curve	Exports an image of the chart (Q3).

### Cine loop

Option	Description
None	Does not export the cine loop.
Original	Exports the original cine loop.
Parametric	Exports the processed cine loop.
Original & Parametric	Exports the original and the processed cine loops in a side-by-side view.

To export data

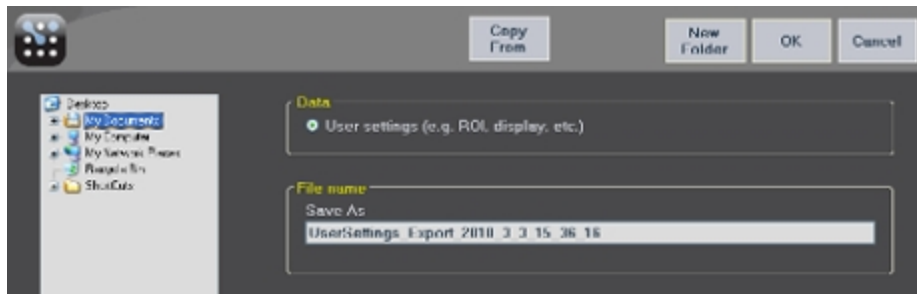


- 1 Click the  button.
- 2 Select a target directory.
- 3 Under the Data, Images and Cine Loop sections, select the type of results to export.
- 4 Under Folder Name, type a folder result name.
- 5 Click OK.

### Exporting and importing user settings

You can export and import user settings included in the ROI Library and Display Presets Library.

#### *Interface elements*

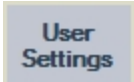


*Export user settings user interface*

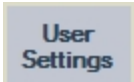
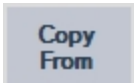


*Import user settings user interface*

To export user settings

- 1 Click the  button.
- 2 Select a target directory.
- 3 Update the default file name if needed.
- 4 Click OK.

To import user settings

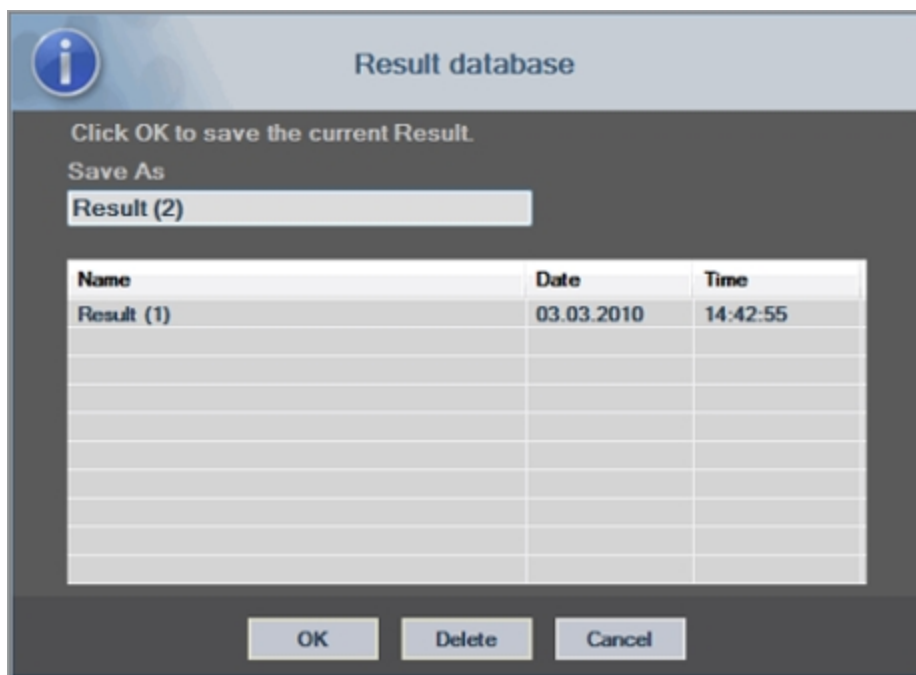
- 1 Click the  button.
- 2 Click the  button.
- 3 Select the user settings file location.

- 4 Pick the user settings file in the bottom panel list.
- 5 Click OK.

### Saving results

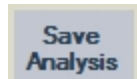
Each cine loop associates a result database in which the whole context of each analysis result can be stored—this enables restoration of the result at a later time by selecting the corresponding cine loop (previously analyzed) in the Study Browser.

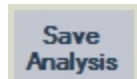
#### *Interface elements*



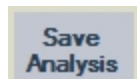
*Result database dialog*

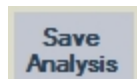
### To save the current result



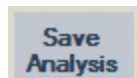
- 1 Click the  button in the main toolbar.
- 2 Under **Save as**, type the result name.
- 3 Click **OK**.

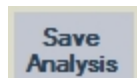
### To overwrite a result



- 1 Click the  button in the main toolbar.
- 2 Select a result in the list.
- 3 Click **OK**.

### To delete a result



- 1 Click the  button in the main toolbar.
- 2 Select a result in the list.
- 3 Click **OK**.
- 4 Click **Delete**.

## Vevo Strain User Guide

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This document is designed as a user guide for processing and analyzing clips of B-Mode and EKV (700 Hz) images acquired by a Vevo Imaging System.

Vevo Strain Analysis Software is available on Vevo LAB, the Vevo 2100 and Vevo LAZR Imaging Systems. It is not available on the Vevo 1100 Imaging System, nor can it be used to analyze images acquired with the Vevo 1100 Imaging System. Images from the Vevo 3100 and Vevo LAZR-X Imaging Systems can be analyzed with Vevo Strain in Vevo LAB.

Vevo Strain is a multifunctional cardiac analysis application with advanced speckle tracking. The software enables calculations of velocity, displacement, strain and strain rate over a selected period of cardiac cycles, based on an acquired B-Mode image (please refer to "[Appendix 1](#)" on page 590 for further details on strain and strain rate calculations). Data are illustrated in parametric and graph displays, and are exportable as multiple formats. Global Longitudinal Strain (GLS) or Global Circumferential Strain (GCS) (for long axis or short axis image analysis, respectively) values are automatically displayed to summarize results and expedite comparisons within studies. Strain and strain rate can not only be measured across the entire left ventricle, but also for specific regions of interest (depending on the model being used and the outcomes desired). To identify regions of interest users can choose specific points across the left ventricular (LV) wall for tracking.

To begin, prepare the Vevo Imaging System by choosing the highest frequency probe appropriate for your model, a Cardiology scanning application package, and an optimized image. Speckle tracking requires very fast sampling for animals with high heart rates, so the highest possible frame rate for image acquisition is desirable. The animal should be on the handling platform with limbs fixed to the electrodes to enable recording of ECG signals. A good ECG signal (with the entire signal visible in the physiological data trace) will assist with correctly marking R-waves during the first step of Vevo Strain. Optimize the parasternal long axis (PSLAX) for analysis and ensure the image is as narrow as possible, without cutting out any of the ventricle. The



quality of the image determines the quality of the data resulting from Vevo Strain. Therefore, it is best to optimize the image so that the entire wall can be seen clearly, with minimal image artifacts.

**Note:** For long-term studies, users may find it useful to save a B-Mode or EKV preset specifically for acquiring images destined for Vevo Strain.

The first part of Vevo Strain allows selection of the cycles that will be used for measurement and analysis. The second part of Vevo Strain involves tracing the endocardial and epicardial borders—tracing both allows for endocardial and epicardial strain/strain rate measurements, as well as calculations of the radial motion components. In addition to strain and strain rate calculations, traditional long and short axis functional calculations are provided (please refer to "[Appendix 2](#)" on page 596 for the reference used in these calculations).

**Note:** Similar to using the parasternal long axis (PSLAX) protocol to optimize the image for analysis, a similar optimization can be performed with the short axis (SAX) protocol.

## Data for Vevo Strain analysis

Only B-Mode and certain EKV Mode images acquired on the appropriate Vevo Imaging System can be analyzed with Vevo Strain.

The following types of data are not suitable for Vevo Strain Analysis:

- Single frames
- 3D Mode cine loops
- EKV Mode images acquired with a frame rate other than 700 Hz

- EKV Mode images acquired on a Vevo 3100 Imaging System using a software version earlier than V2.1.x
- EKV Mode images acquired on a Vevo 2100 Imaging System using a software version earlier than V2.1.x
- B-Mode cine loops acquired using ECG Triggering
- B-Mode cine loops acquired using Respiratory Gating
- B-Mode cine loops acquired with the Vevo 1100 Imaging System
- B-Mode cine loops acquired with a heart rate greater than 1000 bpm
- B-Mode images acquired at low frame rates (i.e. below 120 frames per second)
- B-Mode loops or sub-ranged cine loops of less than 10 frames or greater than 300 frames

## Typical Vevo Strain workflow

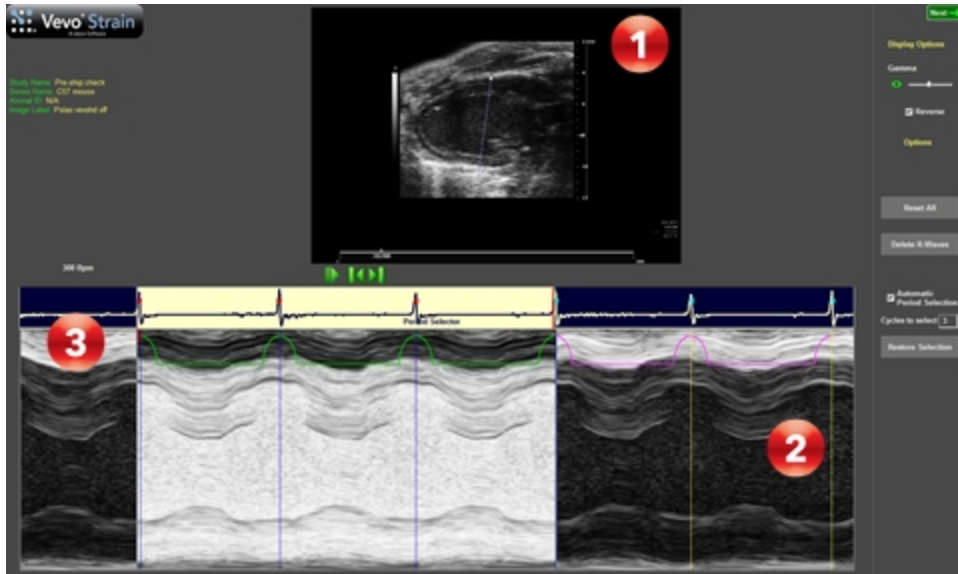
The following is an overview of Vevo Strain analysis workflow.

### To perform an analysis in Vevo Strain

- 1 Select up to 5 cine loops, according to ["Data for Vevo Strain analysis"](#) on the previous page.
- 2 From the Study Browser, click **Vevo Strain** in the main tool bar or from the mode window, go to the measurement panel and click **Vevo Strain**.

The software processes the cine loop and then displays it within the Vevo Strain Analysis Workspace.


The selected image will be displayed in the image area (see **1** in the image below)




3 Within the image area click above the anterior LV epicardial wall and drag the pointer down across the chamber to beyond the opposite (posterior) wall at an angle that optimizes visualization of the walls in M-mode.

4 Right-click to set the Anatomical (A) M-mode cross-section. The selected axis will then appear in the AM-Mode spectrum area (see **2** above).

5 Use the playback controls below the B-Mode image to locate the cardiac cycles you would like included in the analysis. Select the **Reverse** check box if you want to switch the grayscale assignment values for either a white or black background.

6 In the AM-Mode image area (see  above), manually select the best cycles for analysis from within the physiological data or ECG trace.

- i. On the left side drag the single red slider to the position where you would like the analysis area to begin (see  above).
- ii. On the right side drag the double red slider to the end of the desired data area. In the example above (step 2), the desired area includes three R-waves.

**Note:** The area chosen for analysis must include at least one complete cardiac cycle.

7 If the ECG signal is clear, the software will automatically place blue vertical lines demarcating all R-waves.

These markers should line up with the end diastole on the AM-Mode image. If the R-wave markers do not appear or are misaligned with the end-diastole, they should be moved to better reflect the AM-Mode image.

8 If all markers are incorrectly placed, click the **Delete R-Waves** button on the right side of the screen, then manually insert them:

- i. Click on the R-waves from all cardiac cycles within your desired analysis area. The system applies a blue line with every click and connects adjacent blue vertical lines (marking R-waves) with a green line. For best results, your desired AM-Mode area should not include cardiac cycles during inspiration, as movement of anatomy during inspiration distorts the normal pattern.
- ii. If you want to change the position of a line, double-click it to delete, and then click again at the new position.

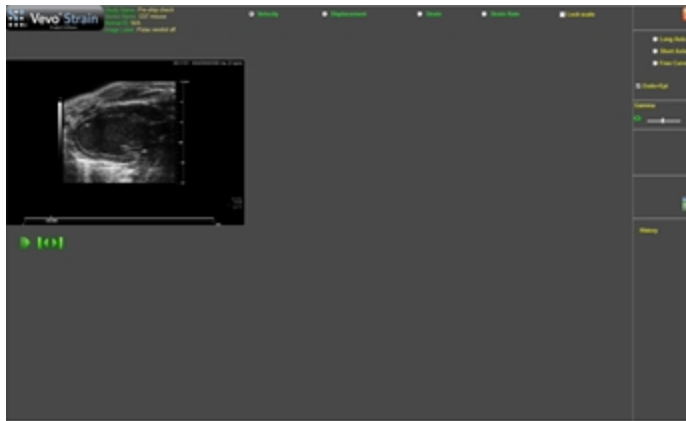
- iii. If you want to return to the automatically defined R-wave selection, click **Reset All**.

**9** As an alternative to the manual period selection process outlined above, **Automatic Period Selection** is available.

Define the number of cardiac cycles you would like to include in your desired analysis area automatically. This setting will be saved and re-applied each time the software is used. An automatically selected window can be shifted right or left by manually deleting or adding R-waves on the AM-Mode trace.

**10** Once your cycles of interest are selected and all R-waves are labeled, in the upper-right corner click **Next**.

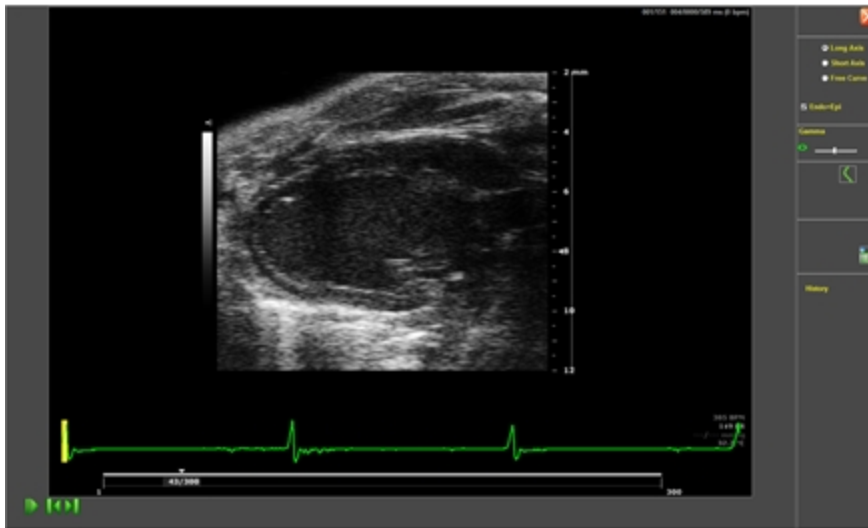
The cine loop will then appear in the tracing workspace.




**11** At the top right of the screen, select the type of trace you will create based on the type of image you are analyzing: Short Axis, Long Axis or Free Curve.



Free Curve can be used for right ventricular measurements (if visible), non-traditional views, or measurement of motion and deformity in other tissue. The displayed image will become larger to allow for more accurate placement of the trace. Adjust the gamma settings as needed to change the grey scale brightness and improve your ability to accurately see and trace the walls.



12 If you select **Endo/Epi** at the top right of the screen, the system will simultaneously trace both the endocardium and the epicardium (based on your trace of the endocardium).

**Note:** This setting is on by default. After tracing the endocardium, the automatic outer wall trace can be expanded or contracted to fit the outer wall using the +/- arrow control  or by clicking on and dragging individual points in the trace. Applying both traces is recommended.

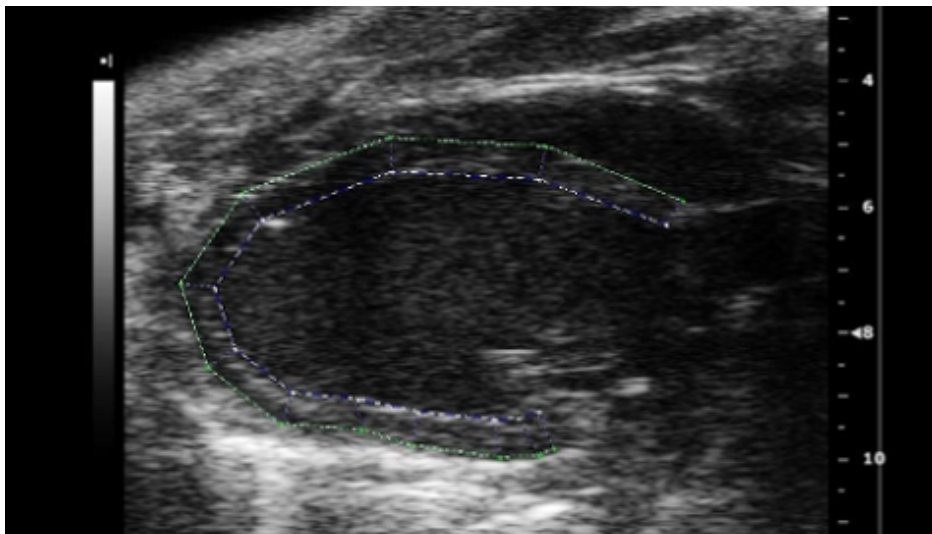
**13** Use the playback controls at the bottom left of the screen to select a frame where the endocardial and epicardial walls are most visible/clear.


The frame selected can be anywhere in the cardiac cycle (it does not matter if it is in systole versus diastole).


**14** Within the image, click to add points all along the endocardial wall. Right-click to complete the trace.


Optimize the width to ensure the outer line is tracing the epicardium accurately. Individual points can be moved by clicking and dragging them to a new location.

**Note:** For a trace in the long-axis view, it is recommended to start at the anterior and place points around to the posterior. For the short-axis view, it is recommended to start at the top dead-center of the anterior and place points in a counter-clockwise direction.



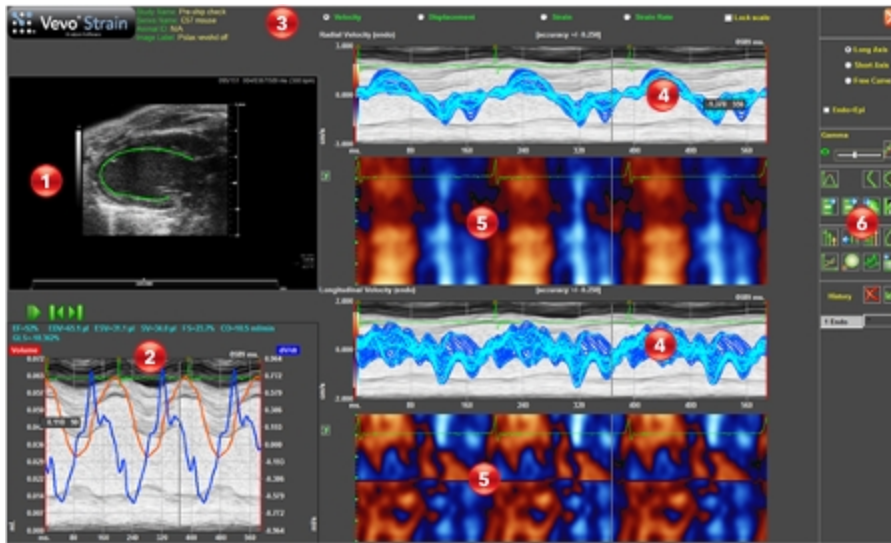
15 (Optional) To delete the entire trace and start again select the **New Trace** button  button.

16 (Optional) To return to the AM-Mode view to select a new cardiac period, click the **Sequence** button .

17 Once you are satisfied with your trace click the **Start Analysis** button .

18 For a comprehensive view, Vevo Strain builds the dynamic LV wall trace for all selected frames in the cine loop and displays the results in the analysis workspace, see "[Vevo Strain workspace](#)" on page 578 for detailed descriptions of the workspace.



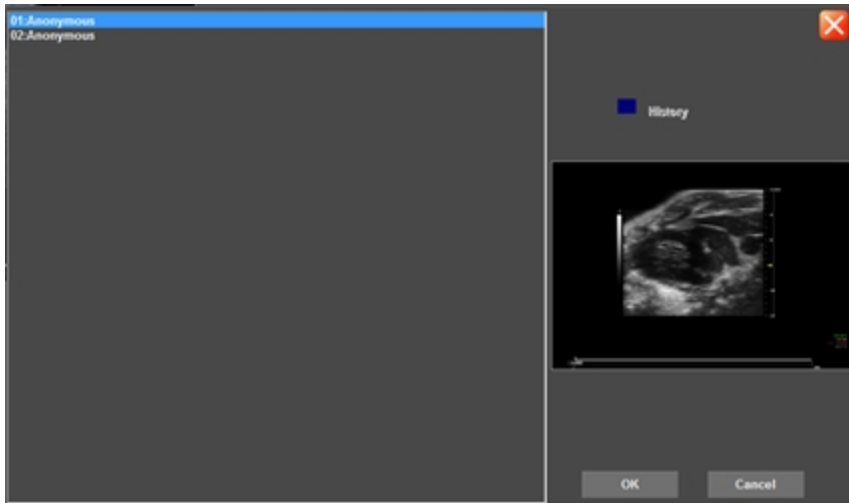


19 Up to five B-Mode loops can be loaded into Vevo Strain at one time. This is done by selecting multiple B-Mode cine loops in the Vevo LAB Study Browser and then clicking the Vevo Strain button.

You will only be able to analyze data for one cine loop at a time. To switch to one of the other loaded cine loops, within the Vevo Strain Trace workspace

click **Select Clip**  .

Within the Select Clip dialog, a list of the loaded cine loops is displayed. The current history, state and thumbnail of the selected cine loop is also displayed.



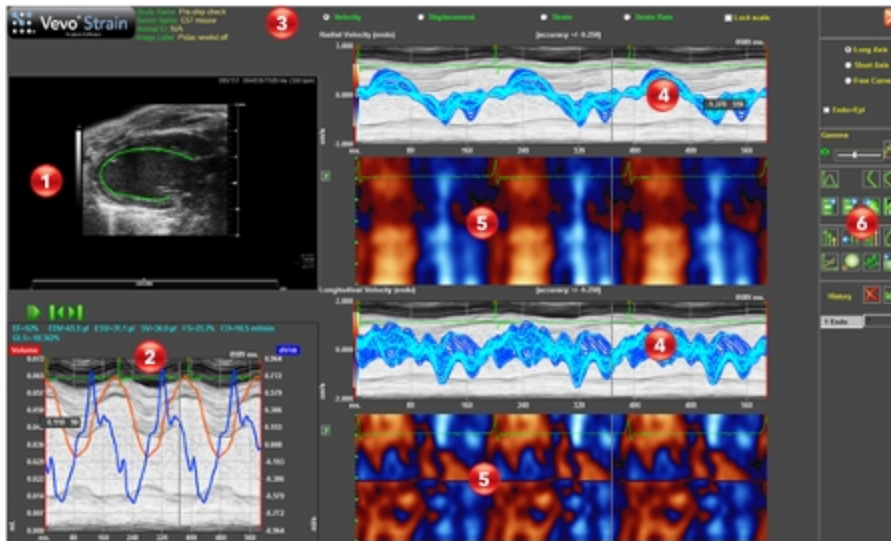
When the History box in the above dialog is **blue**, this indicates that an analysis has not been completed on the selected cine loop.

When the History box in the above dialog is **green**, this indicates that an analysis has been successfully completed on the selected cine loop.

## Analyzing data

### Vevo Strain workspace




The following illustration describes the information and features in the Vevo Strain workspace.



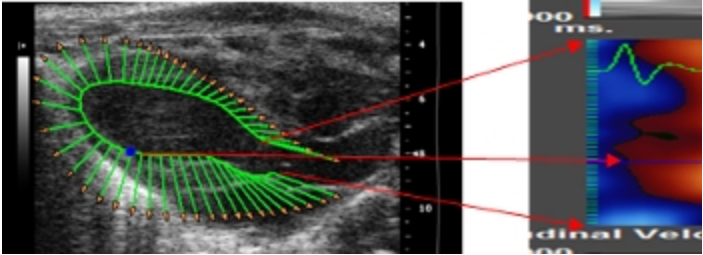
### Vevo Strain Workspace Descriptions

Number	Description
1	LV wall trace on the cine loop. This area features the automatic endocardial (and epicardial) wall trace through all frames. Use the playback controls to move through the cine loop frames. As you move through the cine loop, the time lines in the other graphs match that position.
2	<p>Derivative distribution graph. For the long axis, the graph displays the volume and volume derivative. For the short axis, the graph displays the area and area derivative. Above this graph is a list of functional and structural parameters measured.</p> <p>In PSLAX the following measurements are provided: EF (Ejection Fraction), EDLVM (End Diastolic Left Ventricular Mass), ESLVM (End Systolic Left Ventricular Mass), EDV (End Diastolic Volume), ESV (End Systolic Volume), SV (Stroke Volume), FS (Fractional Shortening), CO (Cardiac Output) and GLS (Global Longitudinal</p>

### Vevo Strain Workspace Descriptions

Number	Description
	<p>Strain).</p> <p>In SAX the following measurements are provided: FAC (Fractional Area Change), A(s) (Area in systole), A(d) (Area in diastole) and GCS (Global Circumferential Strain).</p>
	Graph type/analysis options. Includes Velocity, Displacement, Strain, and Strain Rate as options for output parameters.
	Velocity distribution along the radial axis (top graph), and longitudinal/circumferential axis (for PSLAX/SAX, respectively) (bottom graph). This graph displays velocity/displacement/strain/strain rate (depending on which parameter is selected in 3 above) trace (y-axis) for each point along the traced contour over time (x-axis).
	<p>Parametric distribution for data in the radial axis (top graph), and longitudinal/circumferential axis (for PSLAX/SAX, respectively) (bottom graph). The parametric graphs give an idea of wall motion along each point of the contour. For the radial graph, movement at each point is displayed as blue (moving away from the center of the heart) or red (moving towards the center of the heart) over time (x-axis). For the longitudinal graph, movement at each point is displayed as blue when the tissue is moving away from the apex and red when the tissue is moving towards the apex. For the circumferential graph, movement at each point is displayed as blue when the movement is clockwise and red when the movement is counter-clockwise.</p> <p>White areas represent fast movement while black areas represent slow movement. Each point along the traced contour is displayed horizontally on the graph. The first anterior point at the base of the</p>




## Vevo Strain Workspace Descriptions

Number	Description
	<p>heart is represented at the top of the graph, and the last posterior point at the base of the heart represented at the bottom of the graph. When individual points are selected they appear as color-matched horizontal lines on the graph.</p> 
<p style="text-align: center;"><b>6</b></p>	<p>Analysis tools, see <a href="#">"Analysis tools"</a> on the next page.</p>




## Analysis tools



Vevo Strain Analysis Tools

Number	Tools
	Restore Gamma Settings, Gamma slider, Toggle Filtered/Unfiltered Plots.
	Time-to-Peak Analysis, New Trace, Edit Trace.
	Export AVI, Export Picture, Export Data, Export Graph to Vevo Report.  <b>Note:</b> You can export images, videos and data from Vevo Strain independently from Vevo LAB or a Vevo Imaging System.

## Vevo Strain Analysis Tools


Number	Tools
	Decrease Vector Size, Reset Vector Size, Increase Vector Size, Toggle contour/vector/orbit line/B-Mode.
	Reset graphs display, Zoom in/out, background M-Mode display, Sequence/M-Mode selection.
	Delete selected contour, Undo.

### Visualizing wall trace tendencies

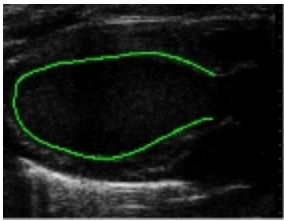
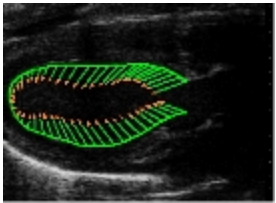
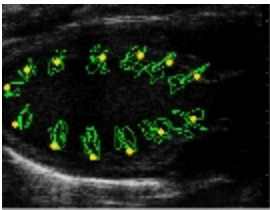
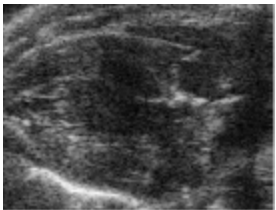
Every point used for calculations is displayed with an associated vector. As the cine loop is played, directional tendencies for different parts of the cardiac contour at different points in the cardiac cycle can be visualized.

To view the directional tendencies of the LV wall trace



- ◆ Click the  button and toggle the button as needed to display the required wall trace tendency.

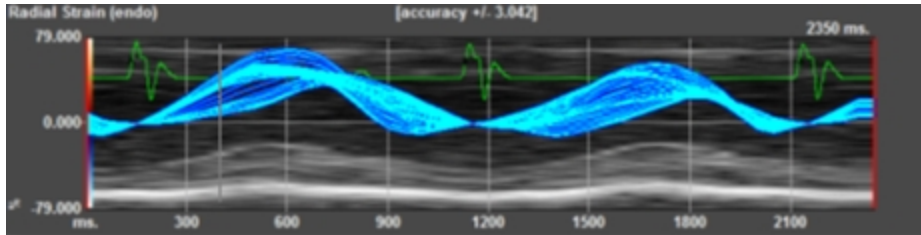
### Wall Trace Tendency Display Options

Image	Toggle description
 <p>A grayscale ultrasound image of a vessel wall with a bright green contour line tracing the inner boundary of the vessel lumen.</p>	Contour
 <p>A grayscale ultrasound image of a vessel wall with a green contour line and a series of small red arrows (vectors) pointing outwards from the contour, representing strain or movement.</p>	Vector
 <p>A grayscale ultrasound image of a vessel wall with several small green and yellow markers (orbit lines) scattered across the vessel wall area.</p>	Orbit line
 <p>A grayscale B-mode ultrasound image showing the vessel wall and lumen without any overlays.</p>	B-Mode



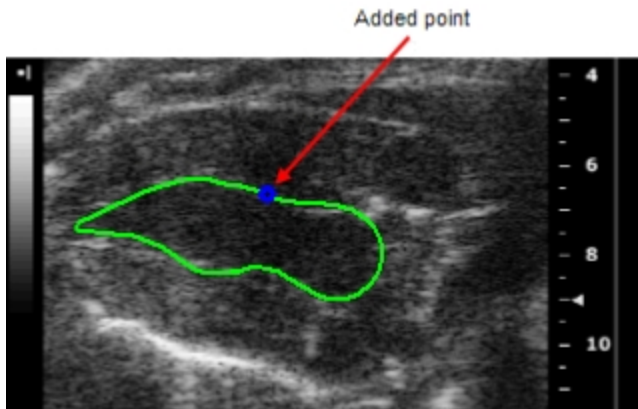
## Displaying curves

By default, the system displays curves for all of the individual points along the trace.

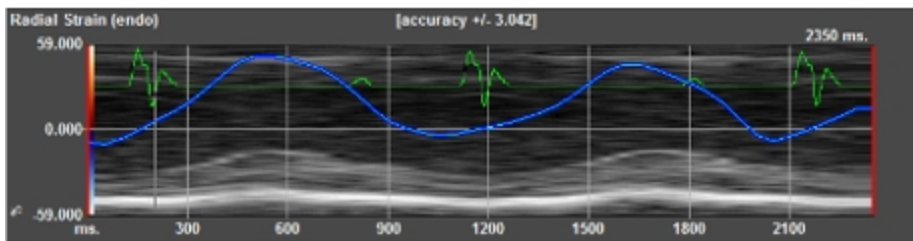


To assess specific regions of interest

- 1 Click on the contour to create a point (or points).

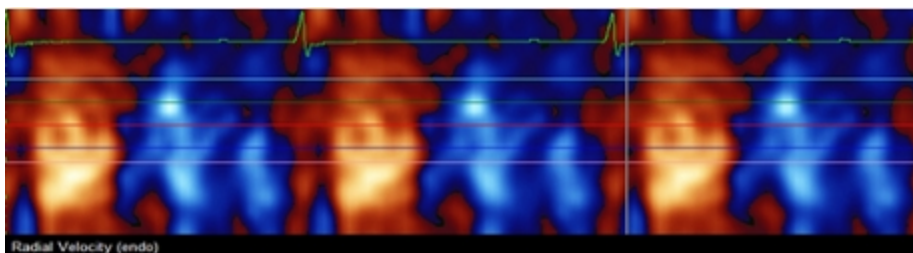
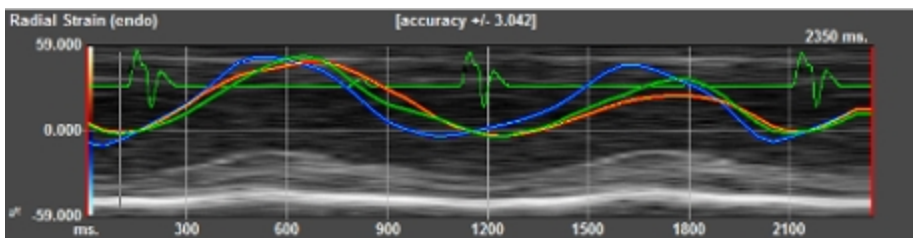


The graph displays a curve for the individual point.




2 (Optional) Add additional points onto the trace.

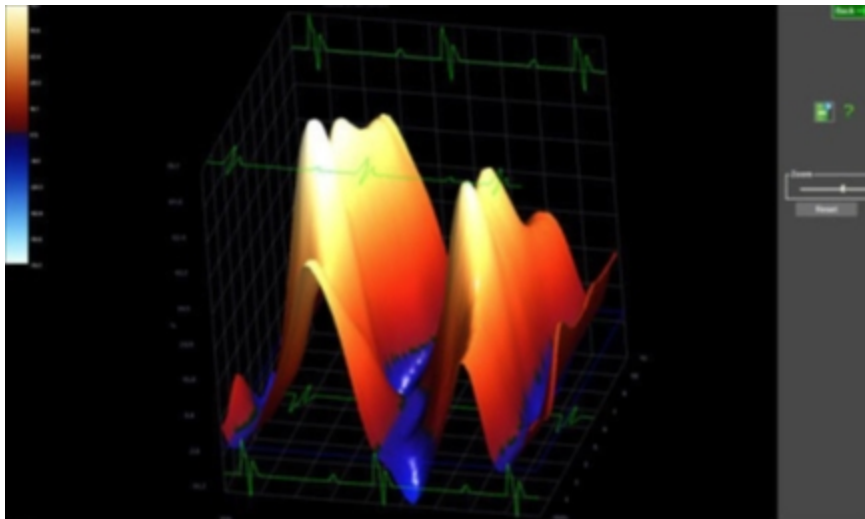
The software will apply unique colors to the additional points and to the corresponding curves and horizontal lines on the graphs



## Visualizing data in 3D

To visualize data in 3D

1 From the Vevo Strain Analysis window, click the  button that is located to the left of the parametric distribution graph. The system displays the parametric data in three dimensions.



2 (Optional) Modify your view of the data by dragging the image to rotate it on any axis, or move the zoom slider as needed.

**Note:** The data being viewed in 2D (i.e. Velocity, Displacement, Strain, or Strain Rate) determines what is shown in 3D.

3 Click  to save the 3D image.

## Analyzing Time-to-Peak

Time-to-Peak analysis displays the segmental synchronicity and phase for different segments of the heart, as well as globally. The display for the segments varies depending on the view of the heart: long or short axis. Only the first cardiac cycle is initially selected for Time-to-Peak analysis (indicated in the red box). Other cardiac cycles can be added, excluded, or assessed individually using buttons in the upper right of the screen.

Time-to-Peak is calculated as the time from the reference axis, 0.000 (the R-wave is considered the reference point), to the maximum peak velocity, for each of the segments of the heart.

Low Time-to-Peak is displayed in blue and high in red in the segmental C-graphs in the middle of the screen.


The phase measures the synchronicity between regions of the heart for a selected time interval. For more information on time-to-peak and phase calculations see "[Appendix 1](#)" on page 590.

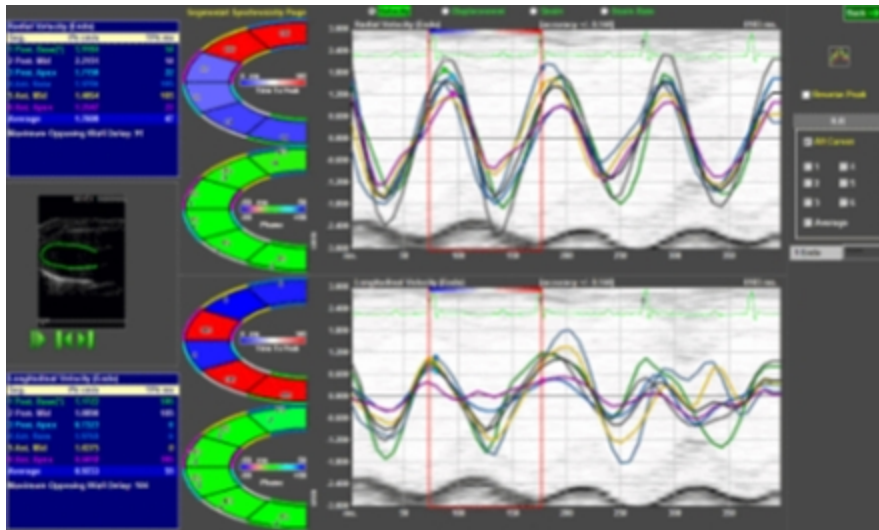
Each of the heart sectors is represented by a corresponding graph and a designated color. You can display all of the curves simultaneously or select them separately using the curve options on the right side of the screen.

Time-to-peak and phase are quantified on the pictographs displayed to the right of the charts. The minimum and maximum range displayed in the center of the pictographs is calculated based on the contour that is traced on the B-Mode image.

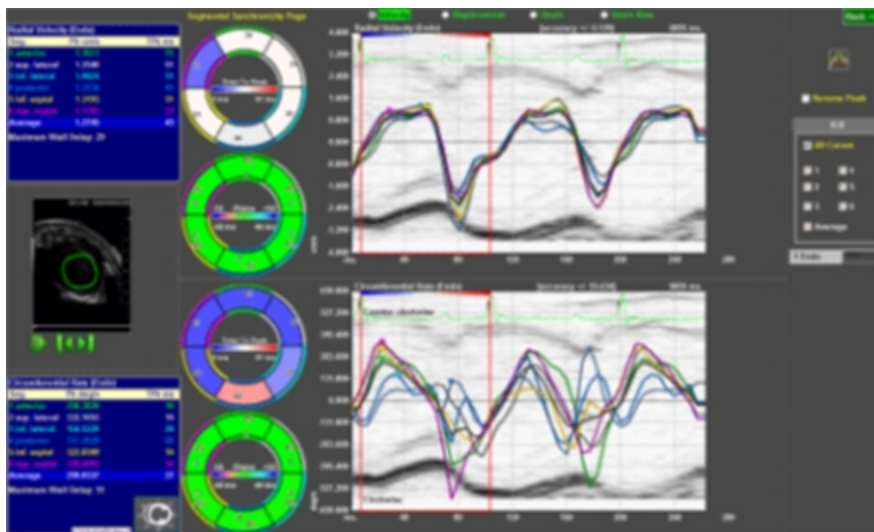
Time-to-Peak analysis can be applied for Velocity, Displacement, Strain, and Strain Rate.

To view the Time-to-Peak analysis

- ◆ Click . The Time-to-Peak window will appear for your selected cardiac period.



*Time-to-Peak window for long axis wall data.*



*Time-to-Peak window for short axis wall data.*

## Appendix 1

### Vevo Strain calculations

#### Introduction

Vevo Strain was developed as a sensitive and reproducible method of quantifying cardiac function and contractility. Using speckle-tracking technology on ultrasound images, the software analyzes LV wall motion, deformation and synchrony in multiple axes over the cardiac cycle. Regional and global measures of Velocity, Displacement, Strain, and Strain Rate are calculated. These measures are able to detect subtle and early changes in myocardial performance.

## Strain and Strain Rate

Strain is a measure of the extent of deformation (lengthening or shortening of the tissue) the heart undergoes throughout the cardiac cycle, relative to its original shape. Deformation occurs when various parts of the heart wall are not moving with the same velocity throughout the cardiac cycle. Strain Rate (**SR**) represents the measure of strain per unit of time, or the rate at which deformation occurs.

To calculate strain at a particular point along the endocardium, the distance/length between that point and a secondary point inside the myocardium (outside of the endocardium) is measured at the baseline time-point in the cardiac cycle (always the R-wave). This is then compared to the distance between the same two points at another instant in the cardiac cycle. The difference between these distances is then represented as a percentage of the original distance; this percentage is the Strain.

The equations used to calculate Strain (**S**) and Strain Rate (**SR**) are as follows:

$$S = \frac{\Delta L}{L_0} = \frac{L - L_0}{L_0} \quad SR = \frac{S}{\Delta t} = \frac{(\Delta L / L_0)}{\Delta t} = \frac{(\Delta L / \Delta t)}{L_0} = \frac{\Delta V}{L_0}$$

where:

**S** is the longitudinal Strain

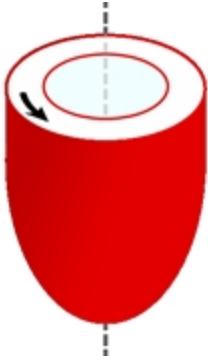

$\Delta L$  is the absolute change in length

**L**<sub>0</sub> is the baseline length (at end diastole/ the R-wave)

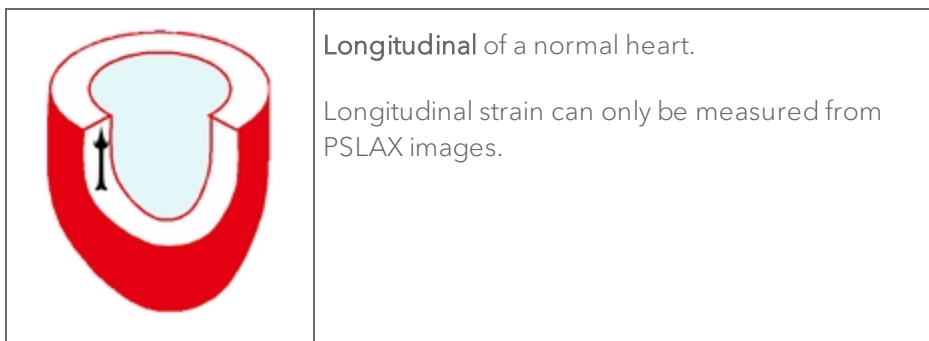
$\Delta V$  is the Velocity gradient in the segment.

The speckle-tracking algorithms used in strain analysis involve tracking natural acoustic markers (called speckles) in the B-Mode cine loop across the cardiac cycle and estimating velocity vectors. The tracing pattern delineated on the B-Mode image is replicated within the cardiac cycle and across all cycles included in the analysis. As such, strain analysis is considered angle independent with lower inter-user variability than other echocardiographic measures of cardiac function.

Due to the dynamic nature of the natural movement of the heart, Strain and Strain Rate can be measured in 3 different planes, based on 3 different directions of deformity that is detected and see in the table below.

	<p><b>Circumferential</b> of a normal heart.</p> <p>Circumferential strain can only be measured from SAX images.</p>
	<p><b>Radial</b> of a normal heart.</p> <p>Radial strain can be measured from both SAX and PSLAX images.</p>





Strain can be measured either globally throughout the entire LV, or in specific regions of the heart wall. Global Longitudinal Strain (**GLS**) and Global Circumferential Strain (**GCS**) are calculating taking into consideration the entire LV wall throughout the entire cardiac cycle. The equations to calculate **GLS** and **GCS** are as follows:

$$\frac{GLS=L_{ES}-L_{ED}}{L_{ED}} \quad \frac{GCS=C_{ES}-C_{ED}}{C_{ED}}$$

where:

$L_{ED}$  represents the original length of the LV contour (at the R-wave in diastole) and  $L_{ES}$  represents the length of the LV contour in systole.

**GLS** as a measure of cardiac function (mathematically correlated with ejection fraction (**EF**) in vivo:

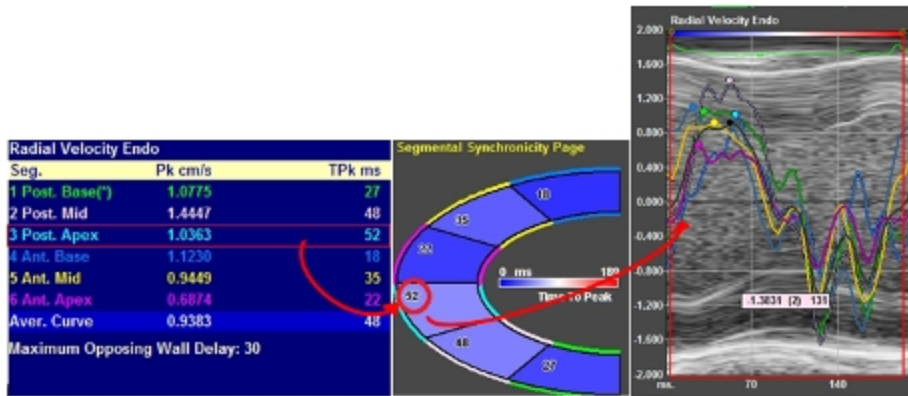
$$GLS = (1 - EF)^{2/3}(1 + SF) - 1$$

where:

**SF** is a shape function representing a change in shape from end -diastole to end systole.

### Time-to-Peak

Time-to-Peak is defined as the time from the R-wave (baseline) to when the maximum peak is reached for each of 6 automatically determined segments of the LV wall. This can be calculated for Velocity, Displacement, Strain or Strain Rate, depending on which parameter is selected. Each pre-determined LV segment considers 9 individual points within. The time it takes for each segment to reach its peak (for the parameter selected) is displayed on the C-graph (below). The graph is also color-coded according to the scale depicted in the center of the graph. The colors along the inner and outer borders of each segment correspond to the traces on the graph (on the right, below). The data is also included in the table (on the left, below). In the table, Pk is the highest point achieved for that segment in the parameter chosen (the units will change depending on the parameter); TPk ms is the time it took to achieve that highest point from the baseline time-point (R-wave). The table also lists an Average Pk and TPk ms, which takes into account all 6 segments and averages the Time-to-Peak data. Maximum Opposing Wall Delay (MOWD) is calculated by looking at the difference between the highest and lowest segmental TPk ms values. The units for this measure are also ms. MOWD, therefore, represents a lag between one segment of the LV and another, and indicates level of asynchronicity.



## Phase

Phase calculations look at the entire cardiac cycle rather than just one point (as is used in Time-to-Peak analysis with the point of maximum Velocity/Displacement/Strain/Strain Rate). The system calculates Phase for each velocity curve using a Fourier Transformation, which essentially involves using a calculation to deconstruct each waveform into its sinusoidal components. Segmental Phase looks at the deconstructed sinusoids from the velocity waveforms of each segment, as well as their average velocity waveform. The times at which a component of each segmental sinusoid reaches their peak are then compared to the peak of the average sinusoid component (of all LV segments) and each segment is assigned an absolute value (in ms). This value is also presented as a percentage (from -50 to +50%) and both values are displayed on the segmental Phase C-graph (below). Similar to the Time-to-Peak analysis, the color along the borders of the segments corresponds to each particular segment, however, the data are not presented in a table. The color filling in each segment is based on the scale illustrated in the center of the C-graph.



## Appendix 2

### Key Vevo Strain References

#### Cardiac Functional Measurements Calculated Using Vevo Strain

Otto, Catherine M. (2013). Cardiac Functional Measurements Calculated Using Vevo Strain, *Textbook Of Clinical Echocardiography* (5th ed.) Philadelphia: Saunders, ISBN: 978-1-4557-2857-2.

#### Global Longitudinal and Circumferential Strain Calculations

Pedrizzetti G, Mangual J, Tonti G. (2014). Global Longitudinal and Circumferential Strain Calculations. On the geometrical relationship between global longitudinal strain and ejection fraction in the evaluation of cardiac contraction. *J Biomech*: 47:746-9.

## Vevo Vasc User Guide

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Vevo Vasc is a software application designed to measure vessel wall anatomy and motion in small-animal models. Vevo Vasc includes support for a speckle-based vascular wall motion, thickness, strain and stiffness analysis.

This document is designed as a user guide for processing and analyzing clips of B-Mode and EKV 2D images acquired with the Vevo Imaging System.

Vevo Vasc is only available on Vevo LAB and is not available on the Vevo Imaging Systems.

### Data for Vevo Vasc analysis

Only B-Mode and EKV images (not EKV AM-Mode images) acquired on a Vevo 2100, Vevo 3100 or Vevo LAZR-X Imaging System can be analyzed with Vevo Vasc.

The following B-Mode/EKV data is not suitable for Vevo Vasc analysis:

- ECG triggered cine loops
- Single B-Mode or EKV frames
- Loops or sub-ranged cine loops with less than 15 frames
- Loops or sub-ranged cine loops with more than 1000 frames (500 - 750 frames is suggested)
- Cine loops acquired with less than 15 frames per heart cycle

The following table notes the minimum B-Mode acquisition frame rate required for a set heart rate (BPM).

Heart Rate (BPM)	B-Mode Acquisition Frame Rate
300	83

Heart Rate (BPM)	B-Mode Acquisition Frame Rate
325	89
350	96
375	103
400	110
425	117
450	124
475	131
500	138
525	144
550	151
575	158
600	165


**Note:** Although cine loops acquired using Respiration Gating can be loaded into Vevo Vasc, the ECG trace will be not be correctly displayed due to the acquisition method used.

**Note:** For EKV images acquired using V1.5.X builds 5085 or earlier, when the data is loaded into Vevo Vasc, the ECG trace will not be loaded or displayed.


## Typical Vevo Vasc workflow

The following is a quick workflow overview of a Vevo Vasc analysis.

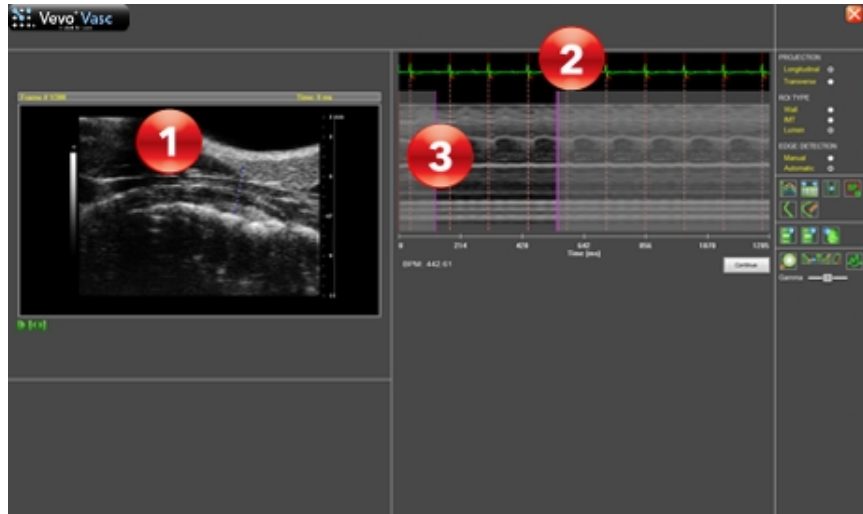
### To perform an analysis in Vevo Vasc

- 1 Select an appropriate B-Mode or EKV cine loop from the Study Browser.
- 2 Click the **Vevo Vasc** button in the main tool bar at the top of the Study Browser. You can also access Vevo Vasc from the mode window, click Measurements  and then click **Vevo Vasc**.

The application processes the cine loop and then displays it within the Vevo Vasc AM-Mode Selection Window.

- 3 In the Image area (see  below):
  - i. Use the playback controls below the image to locate the frame you want to work with.





- ii. Click above the vessel wall, drag the pointer across the vessel to beyond the opposite wall, and then right-click to set the AM-Mode cross-section.

4 In the Physiological Data/AM-Mode Image area (see **2** and **3** above):

- i. Define the cycle to be analyzed within the Physiological Data (ECG Trace).

On the left side drag the single purple slider to the position where you want the data period to begin (see **3** above).

On the right side drag the purple slider to the end of the desired data period.

**Note:** The period must include at least one complete cardiac cycle.



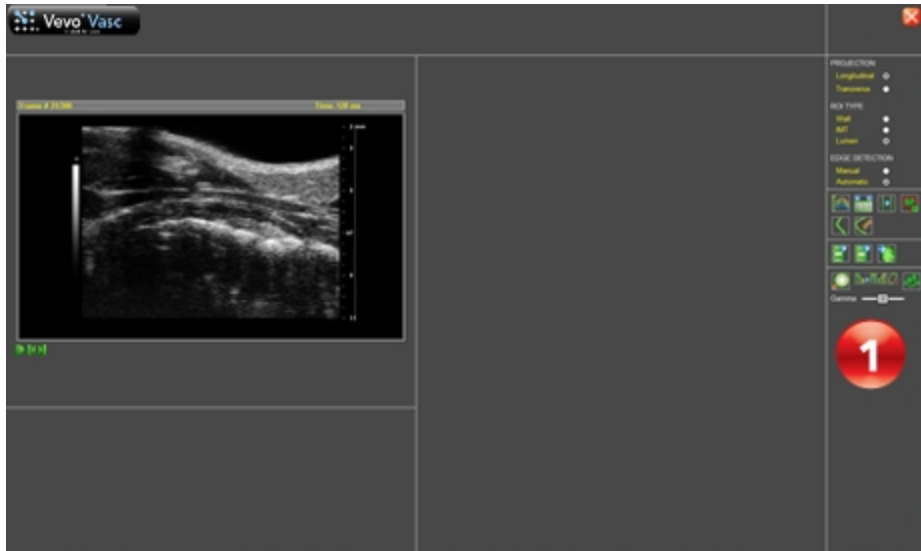
- ii. Define (or redefine) the location of the R-Waves within the Physiological Data (ECG trace).

Right click on the R-Wave for the first cardiac cycle. The system places a red line with a small red 'R' indicated.

Right click on the other R-Wave locations to add the remainder of your cardiac cycles (see **2** above). For best results, create your selection period between one respiration cycle and the next.

If you want to change the position of a line, right click on it to delete it, and then right click again at the new position.

5 Below the AM-Mode image, click **Continue**. The cine loop now appears in the Vevo Vasc ROI Analysis workspace.



6 In the tool panel (see **1** above):

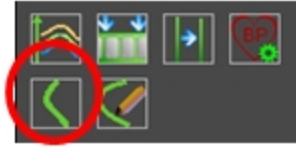
- i. Select the type of Projection to create—Longitudinal, Transverse (see **1** below).
- ii. Select the type of ROI to be placed—Wall, IMT, Lumen (see **2** below).
- iii. Select the Edge Detection method to use—Manual, Automatic (see **3** below).



- iv. Within the image, click and then drag to add points of the ROI. Right-click to complete the ROI trace.

For Automatic Longitudinal/Transverse Projections, and Manual Longitudinal Projections, a floating window is displayed for ROI adjustment.

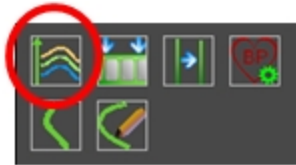
- v. If you want to delete the trace and start again, delete the old ROI from the thumbnail context menu and then click the **Trace New ROI** button.



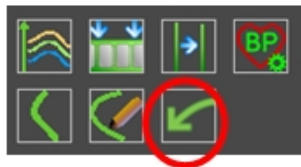
- vi. If you want to modify the current ROI, click the **Modify ROI** button and then adjust the ROI displayed.



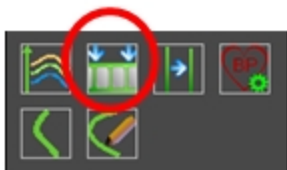
When ROI tracing is complete, click the **Process** button.



- vii. Once you have edited and processed an ROI, an Undo Editing button is displayed (see below). Click **Undo Editing** to undo the just completed ROI edit.



- viii. If you want to return to the AM-Mode view to select a new cardiac period, click the Select Sequence/AM-Mode Selection, to create the new period and then click **Continue** again.



One of two messages will be displayed, dependent on the changes completed within the AM-Mode view:

- a. If the changes are relatively minor (eg. reducing the range of data to be analyzed), a message is displayed noting that Vevo Vasc will reprocess the data using the updated parameters.

**Note:** While proceeding to the ROI Analysis workspace, the current ROIs will be automatically processed.

- b. If the changes are more extensive, a message is displayed noting that Vevo Vasc will discard the current ROIs, AM-Mode cross-section and associated data.

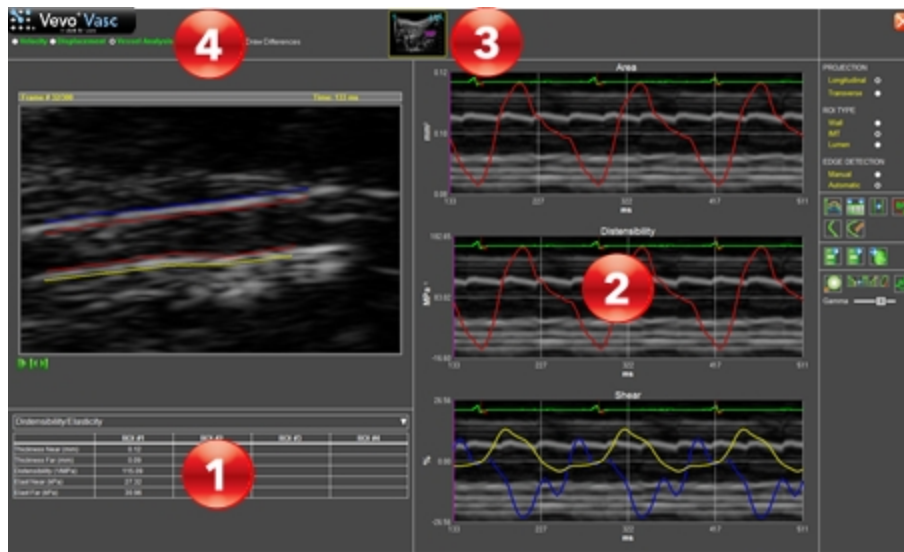
**Note:** While proceeding to the ROI Analysis workspace, the current ROIs and associated results will be deleted.

In both cases, you will need to either click **Yes** to proceed to the ROI Analysis workspace, or **No** to discard your changes but remain in the AM-Mode view.

7 The software will analyze the ROI for all included frames in the cine loop and graphs the results in both the analysis workspace and within the Results

Table (see **1** and **2** below). A thumbnail of the analyzed ROI is displayed at the top of the ROI Analysis Workspace (see **3** below). At the top of the screen, select the appropriate analysis graphs to be displayed—Velocity, Displacement, Strain or Vessel Analysis (see **4** below).

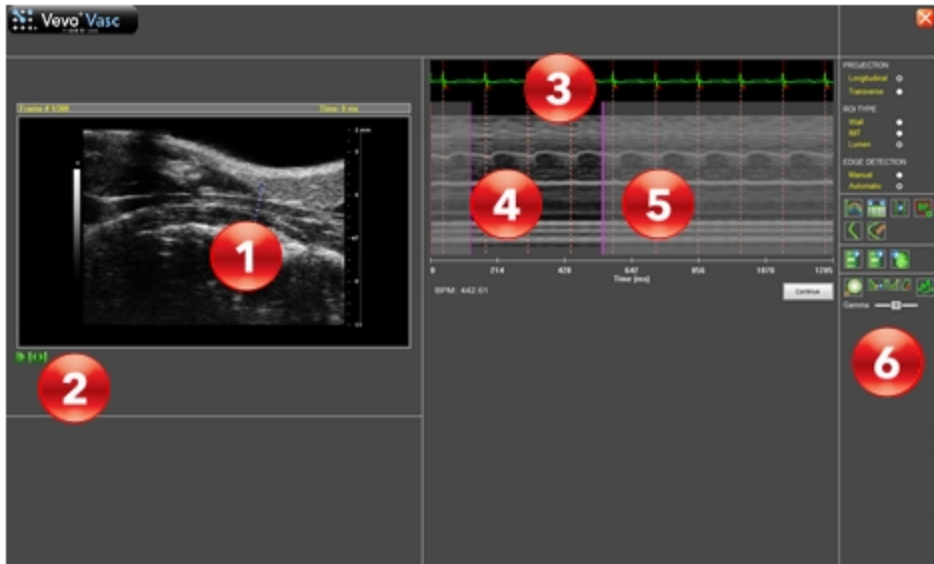
**Note:** Strain is only available when Longitudinal ROIs are placed on the image.



## Analyzing data

### AM-Mode selection workspace

When a cine loop is initially loaded into Vevo Vasc, the initial Vevo Vasc workspace displayed is the AM-Mode selection workspace.



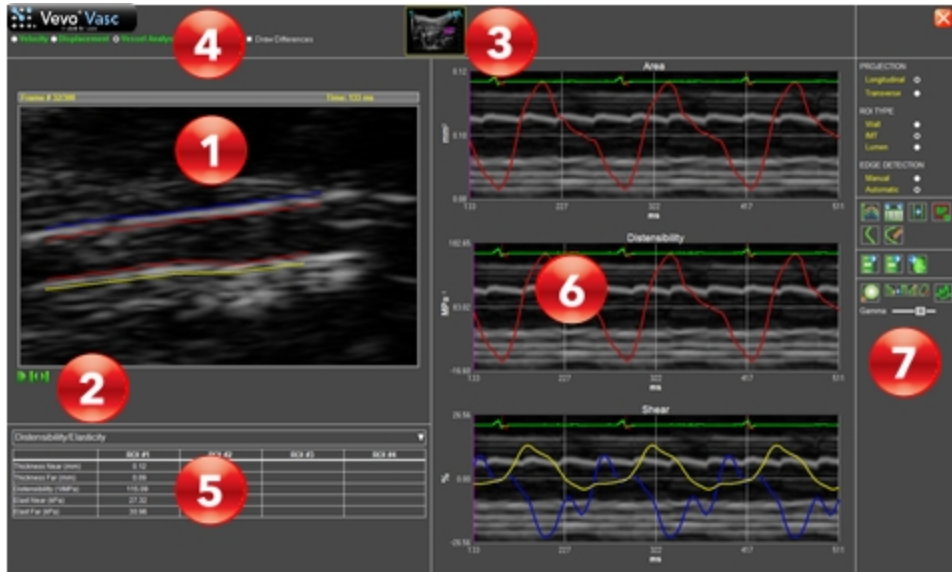
This workspace contains the following:

1	Image area. AM-Mode overlay is placed within this image, which generates the AM-Mode image displayed.
2	Playback controls. Includes PLAY/STOP, PREVIOUS FRAME, and NEXT FRAME functions.
3	Physiological Data. ECG trace with R-Wave indicators either manually or automatically applied.
4	AM-Mode image included cycles. Cardiac cycles which have been selected and will be included in the analysis.
5	AM-Mode image excluded cycles. Cardiac cycles which have not been selected for the analysis.

**6** Tool Panel. Containing ROI, Zoom, and Gamma controls.






## ROI analysis workspace

Once the R-Waves and AM-Mode data have been selected, the next workspace displayed is the ROI Analysis Workspace.



This workspace contains the following:

- 1** The image with the ROI displayed.
- 2** Playback controls. Includes PLAY/STOP, PREVIOUS FRAME, and NEXT FRAME functions.

	ROI thumbnails.
	Analysis graph selector. <div style="background-color: #1a3d4d; color: #c8e6c9; padding: 5px;"><b>Note:</b> Strain is only available for Longitudinal ROIs.</div>
	Results table.
	Analysis graphs.
	Tool panel. Includes ROI, Export, Zoom, Vector and Gamma controls.



## Tool panel



This tool panel contains the following:

1	ROI Projection options–Longitudinal and Transverse.
2	ROI Type options–Wall, IMT and Lumen.

<b>3</b>	ROI Edge Detection options–Manual and Automatic.
<b>4</b>	ROI Control options–Process, Sequence/AM-Mode Selection, Pulse Propagation Velocity, Blood Pressure Modification, Trace New ROI, Modify Existing ROI and Undo Editing.  <b>Note:</b> The PPV button is only available for Longitudinal ROIs.
<b>5</b>	Export options–Export Video, Export Images and Export Data.
<b>6</b>	Image, Trace and Analysis Graphs options–Zoom/Restore, Decrease Vector Size, Reset Vectors Size, Increase Vector Size, Toggle Border/Velocity Vectors/Trajectory, Toggle AM-Mode Background, and Gamma Slider.
<b>7</b>	Exit Vevo Vasc button.

## Defining and modifying ROIs

### Longitudinal projections

Once Longitudinal has been selected on the tool panel, three different longitudinal ROIs can be traced:

- Wall ROI. Composed of four borders placed on the two sides of a vessel, defining the internal and external boundaries of the vessel.
- IMT ROI. Composed of four borders placed on the two sides of a vessel, defining the internal boundaries and the IMT.

- Lumen (vessel diameter) ROI. Composed of two borders that define the internal dimension of a vessel without IMT thickness.


## To place a longitudinal ROI

- 1 Within the tool panel, click **Longitudinal**.

**Note:** Only one type of projection can be placed on an image. Once a Longitudinal ROI exists on the image, the user will be unable to select or place a Transverse ROI.

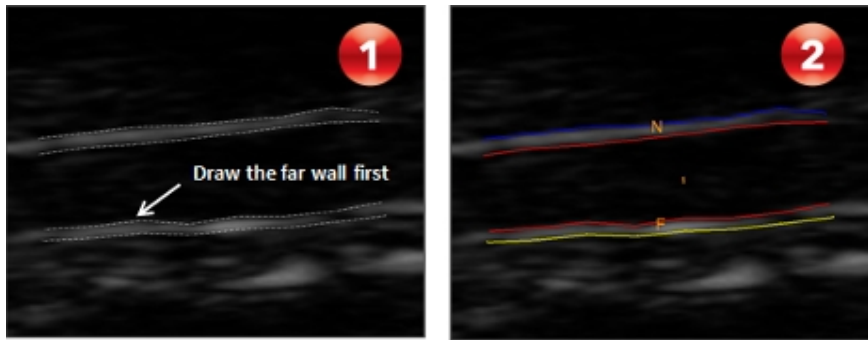
- 2 Select the edge detection method to be used—Manual or Automatic.
- 3 Select the type of ROI to be traced—Wall, IMT or Lumen.
- 4 Within the image displayed, use the cine loop review buttons to select a reference frame to be used for ROI placement.
- 5 To start tracing the ROI within the image, click **Trace New ROI**, or click within the image when no other ROI has been previously placed. When placing a manual drawn ROI, a floating window will appear.
- 6 First and subsequent points are placed by left clicking on the image during manual tracing. The last point and the ROI are committed by a final right click.
- 7 Place your ROI.
  - a. Manual edge detection

Manual IMT or Wall ROIs are placed by defining the FAR inner wall

(labeled as 'F') first (see  below). The other three contours are then

automatically traced. Each wall can be moved and defined, however, if the inner wall of the ROI is moved, the external wall moves with it.

**Note:** ROI labels within the image can be enabled via the 'Toggle ID Numbers on ROIs' context menu option. When this option is enabled for a Wall or IMT ROI, the ROI ID 'N' (Near) and 'F' (Far) walls are identified.




The number of points within the new ROI can be increased or decreased using the Increase Sampling and Reduce Sampling context menu option. The user is able to zoom into the image via the Zoom In and Zoom Out context menu options.

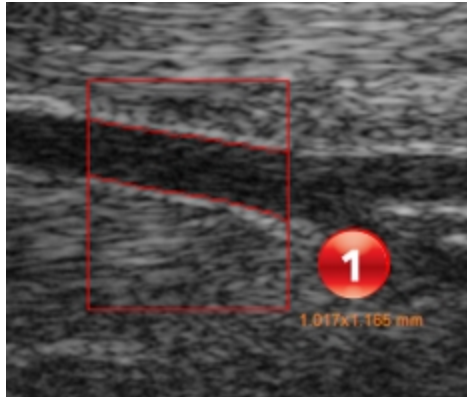
Once the ROI is initially placed, its walls and points can be adjusted as required.

Once the ROI is correctly placed, three options are available on the bottom of the window—Discard (select if you want to delete the newly placed ROI), Accept (select if you want to process the newly placed ROI)

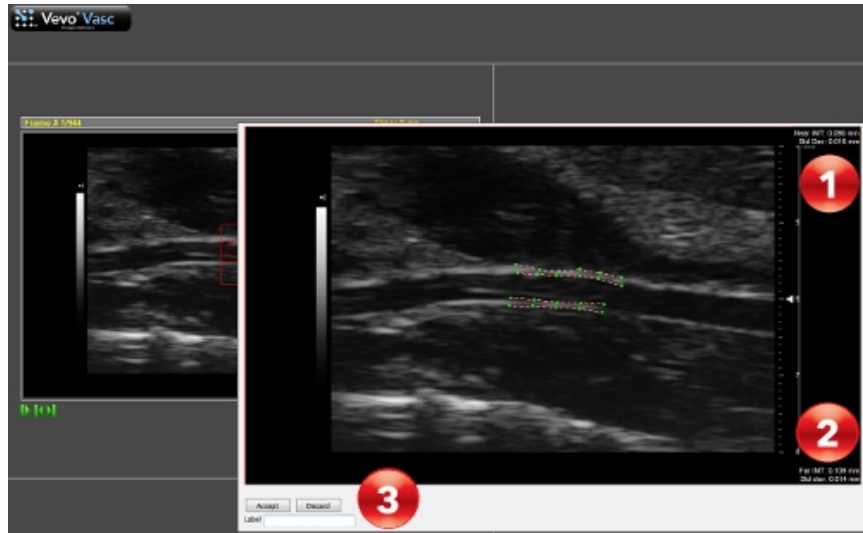
and Label (type text to label the ROI). See **3** below.

b. Automatic edge detection

Automatic ROIs are traced by drawing a horizontal rectangle by pressing the left mouse button and releasing it on the last point (see  below).



When the left mouse button is released, a floating window appears (see below).



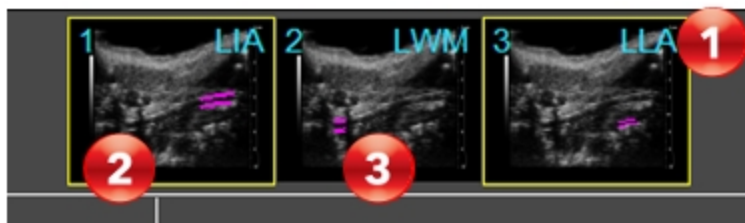
When an IMT ROI is being placed, IMT measurements are displayed within the floating window for both near (Near IMT see **1** above) and far (Far IMT, see **2** above) regions.

Once the ROI is initially placed, its walls and points can be adjusted separately, to correctly define shape and distance. The image in the floating window can be zoomed in/out, and points can be increased and decreased by acting on the ROI's context menu.

Once the ROI is correctly placed, three options are available—Discard (select if you want to delete the newly placed ROI), Accept (select if you want to process the newly placed ROI) and Label (type text to label the ROI). See **3** above.

8 Once a ROI is committed on an image, the ROI's thumbnail is displayed on the top of the Vevo Vasc screen. Text on the top right corner of the ROI thumbnail indicates the Projection, ROI Type and Edge Detection used to create it (see **1** below).

- The first letter indicates the Projection: **L**ongitudinal or **T**ransverse.
- The second letter indicates the ROI Type: **W**all, **I**MT, or **L**umen.
- The third letter indicates the Edge Detection used: **M**anual or **A**utomatic.



9 The user is able to select which ROI data to be displayed, by toggling the available ROI thumbnails. An ROI thumbnail with a yellow border is toggled on (see **2** above). An ROI thumbnail without a border is toggled off (see **3** above).

10 (Optional) More than one ROI can be placed on an image. To add another ROI, click **Trace New ROI**.

11 (Optional) An ROI can be further modified, even after processing. Click **Modify Existing ROI** and then click **Process**. To cancel the editing mode without applying changes, click **Esc** on your keyboard.

12 (Optional) Click **Undo Editing** to undo the just completed ROI edit.

## Transverse projections

Once Transverse has been selected on the tool panel, two different Transverse ROIs can be traced:

- Lumen ROI. Composed of one ellipse placed along the internal vessel wall.
- IMT ROI. Composed from two ellipses placed on the internal and IMT walls.

### To place a Transverse ROI

1 Click Transverse from the tool panel.

**Note:** Only one type of projection can be placed on an image. Once a Transverse ROI exists on the image, the user will be unable to select or place a Longitudinal ROI.

2 Select the edge detection method to be used—Manual or Automatic.

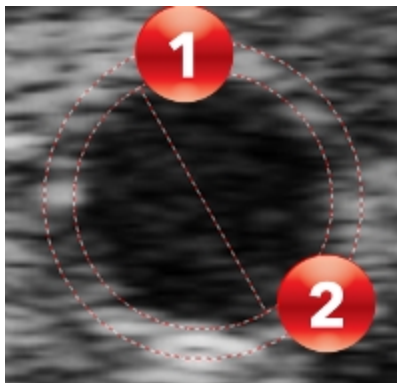
3 Select the type of ROI to be traced—IMT or Lumen.

4 Within the image displayed, use the cine loop review buttons to select a reference frame to be used for ROI placement.

5 Manually drawn ROIs are traced by clicking on the first point (see  below) and clicking again on the last point of the inner diameter line (see

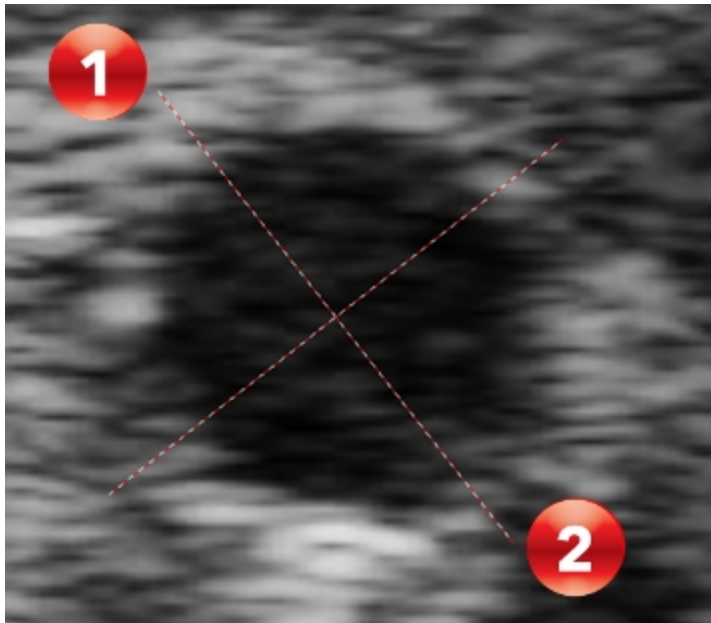
 below). After tracing, the ellipses created can be modified.



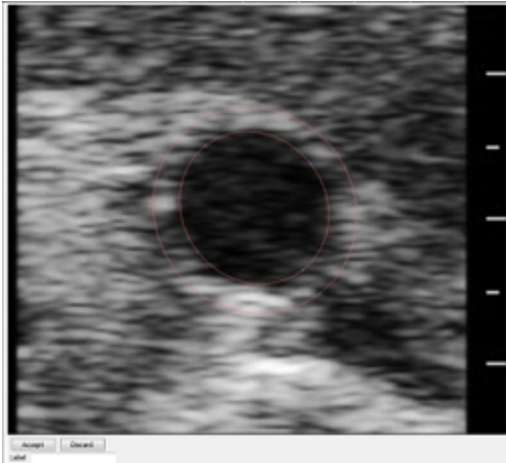


6 ROIs can be moved, resized, rotated or deleted, and the inner ellipse can be moved beyond the outer one, if no intersection between ellipses exists and if the center of outer ellipse is contained in the inner one.

Automatically detected ROIs are created by defining an inclusive area. An orthogonal axis is placed and used as the principal axis. The axis is traced by left clicking on the first point which is on the outside edge of the vessel wall (see **1** below) and then left clicking again on the last point orthogonal to border line, again on the outside edge of the vessel wall (see **2** below).



7 After the ROI's axis is defined, a floating window panel appears in order to further define the points on the walls of the ROI, three options are available—Discard (select if you want to delete the newly placed ROI), Accept (select if you want to process the newly placed ROI) and Label (type text to label the ROI). See below.



8 (Optional) More than one ROI can be placed on an image. To add another ROI, click **Trace New ROI**.

9 (Optional) An ROI can be further modified, even after processing. Click **Modify Existing ROI** and then click **Process**. To cancel the editing mode without applying changes, click **Esc** on your keyboard.

10 (Optional) Click **Undo Editing** to undo the just completed ROI edit.

## Processing Data

In order to obtain analysis data from an ROI, the ROI needs to be processed.

Processing can be done in two ways:

- a. Clicking **Process** on the tool panel after ROIs have been placed and modified on the image.

**Note:** When processing via the Process button, all unprocessed ROIs will be processed.

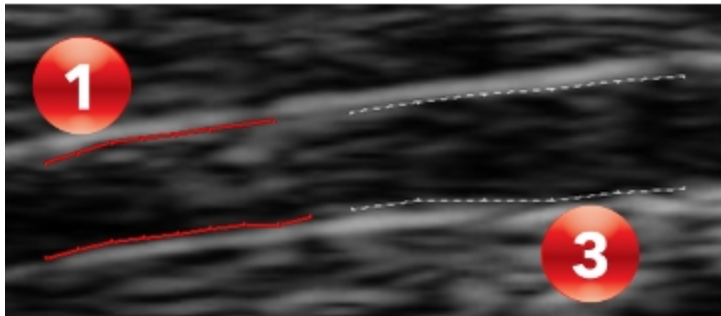
- b. Within the floating ROI definition window, clicking **Accept**.

### To view the processing state of an ROI

There are visible indications of the processing state of an ROI on the image and the ROI thumbnail.

#### 1 View the ROI trace on the image.

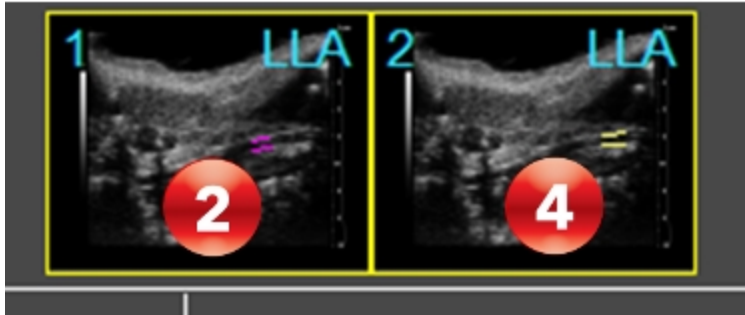
- If an ROI on the image has a solid line of color, it has been processed (see **1** below).
- If an ROI on the image has a dashed line, it has not been processed (see **3** below).



#### 2 View the trace of the ROI within the thumbnail.

- If the trace within the thumbnail is purple with a solid number digit, the ROI has been processed (see **2** below).

- If the trace within the thumbnail has a dashed line, the ROI has not been processed (see **4** below).



### To display analysis results

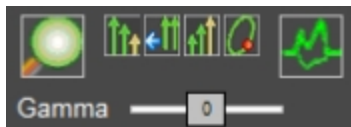
After processing, select how you would like your analysis to be displayed.

1 Click either the Velocity, Displacement, Strain and Vessel Analysis radio button found on the top-left of main window.





By selecting the available ROI thumbnail(s), the user can select to display specific ROI results within the graphs and image.

**Note:** Strain is only available for Longitudinal ROIs.

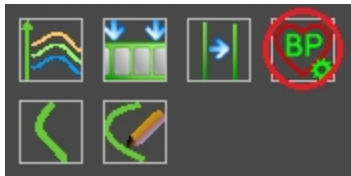
2 Velocity vectors or time trajectories can be displayed on the ROI within the image by clicking the **Toggle Border/Velocity Vectors/Trajectory** button in the tool panel.



The availability and size of the Velocity vectors displayed can be adjusted using the following controls:

	Decrease Vector Size
	Reset Vector Size
	Increase Vector Size
	Toggle Border/Velocity Vectors/Trajectory

3 Systolic and diastolic pressure must be manually modified to match the subject's data by clicking the **Blood Pressure Modification** button (see below) from the tool panel and entering the actual values for each.



4 The results table in the lower left of the main window displays analysis results for each ROI.

**Note:** Enable the Toggle ID number on ROIs command from the image context menu or refer to the thumbnails to know which data belongs to which ROI.

In the Results Table, user can choose between the data to be displayed:


- a. Pulse Propagation Velocity. Analysis results for ROIs on which PPV measurements have been performed.
- b. Intima Media Thickness. Analysis results for IMT measurements obtained on ROIs (both in Automatic and Manual Edge Detection).
- c. Diameter/Area. Analysis results after tracking in all the processed frames:
  - Max, min, mean value and percentage spread of diameter.
  - Max, min, mean value and percentage spread of area.
- d. Distensibility/Elasticity: Analysis results after tracking in all the processed frames:
  - Mean thicknesses of sectors (Transverse ROI) or walls (Longitudinal ROI).
  - Distensibility (see appendix A).
  - Elasticity of sectors (Transverse ROI) or walls (Longitudinal ROI).
- e. Wall. Vessel thickness analysis results are displayed and are only for Wall ROIs.

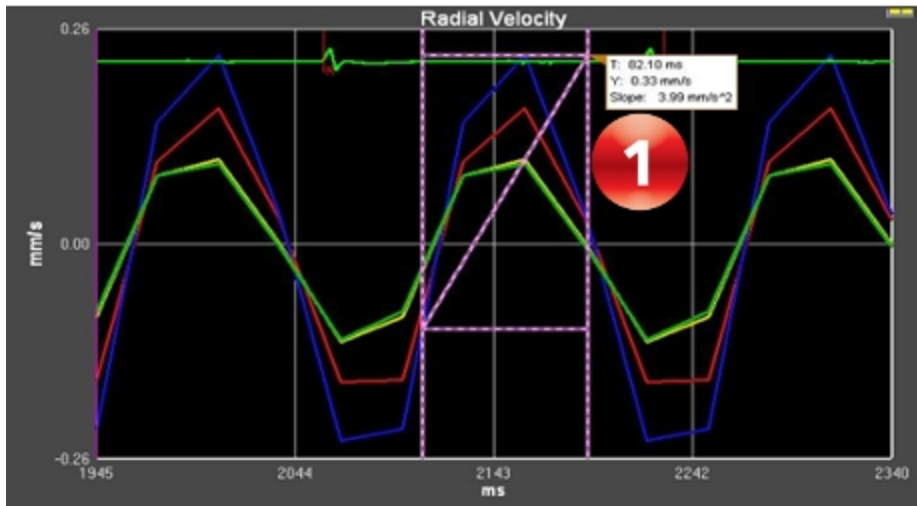
**Note:** In Transverse mode, only Distensibility/Elasticity and Diameter/Area analysis results are available.

Within the results table, the corresponding measurement units are shown in brackets next to each parameter listed (see below). See "[Appendix 2](#)" on page 642 for details of the parameters available.

Diameter/Area				
	ROI #1	ROI #2	ROI #3	ROI #4
Mean Diameter (mm)	0.41	0.50	0.48	0.47
Mean Area (mm <sup>2</sup> )	0.13	0.19	0.18	0.18
Max Diameter (mm)	0.41	0.50	0.48	0.48
Max Area (mm <sup>2</sup> )	0.13	0.19	0.18	0.18
Min Diameter (mm)	0.41	0.50	0.48	0.47
Min Area (mm <sup>2</sup> )	0.13	0.19	0.18	0.18
Dia Perc Spread (%/100)	0.00	0.00	0.00	0.01
Area Perc Spread (%/100)	0.01	0.00	0.01	0.01

## Longitudinal ROIs

In each analysis graph, a ruler can be activated for additional measurements. Right-click on a measurement wall, then click **Activate Ruler** in the context menu (see  below as an example on a Radial Velocity graph).





### *Velocity data*

Each wall of an ROI can be separately activated or deactivated by pressing left mouse button on the wall itself.

Analysis graphs are displayed for each velocity—Radial and Tangential—and the graph colors correspond to the wall colors (see below).

Velocities are intended as radial positive if moving toward the lumen and tangential positive if moving rightward.

If the Draw Differences box is checked, then for each pair of walls selected, the velocity difference is shown on the Analysis graphs.

The positive addend border is painted with a continuous colored line, while the negative addend is drawn with a dotted line of the same color. Each colored pair corresponds to the color on the Analysis graphs. Walls can be selected from different ROIs.

### *Displacement data*

Each wall of a Longitudinal ROI can be separately activated or deactivated by pressing left mouse button on the wall itself. Once activated, its corresponding color will be displayed in the Analysis graphs.

Displacements are intended as radial positive if moving toward the lumen and tangential positive if moving rightward. In each graph, by acting on its context menu, a ruler can be activated to perform further measurements.

If the Draw Differences box is checked, then for each pair of walls selected, the velocity difference is shown on the Analysis graphs

The positive addend border is painted with a continuous colored line, while the negative addend is drawn with a dotted line of the same color. Each

colored pair corresponds to the color on the Analysis graphs. Walls can be selected from different ROIs.

### *Strain analysis*

Each wall of a Longitudinal ROI can be separately activated or deactivated by pressing left mouse button on the wall itself. Once activated, its corresponding color will be displayed in the Analysis graphs.

Analysis graphs are displayed for each velocity—Radial and Tangential—and the graph colors correspond to the wall colors (see below).



Strain is a measure of the extent of deformation (lengthening or shortening) that tissue undergoes. Here, it is measured against the cardiac cycle through data obtained from physiological monitoring of the subject animal.

To calculate strain at a particular point, the distance/length between that point and a secondary point next to (Tangential) or across from (Radial) it is measured at one time-point in the cardiac cycle. This is then compared to the same measure at another instant in the cardiac cycle. The differences between these samples, represented as a percentage, is the strain.

If the Draw Differences box is checked, then for each pair of walls selected, the velocity difference is shown on the Analysis graphs.

The positive addend border is painted with a continuous colored line, while the negative addend is drawn with a dotted line of the same color. Each colored pair corresponds to the color on the Analysis graphs. Walls can be selected from different ROIs.

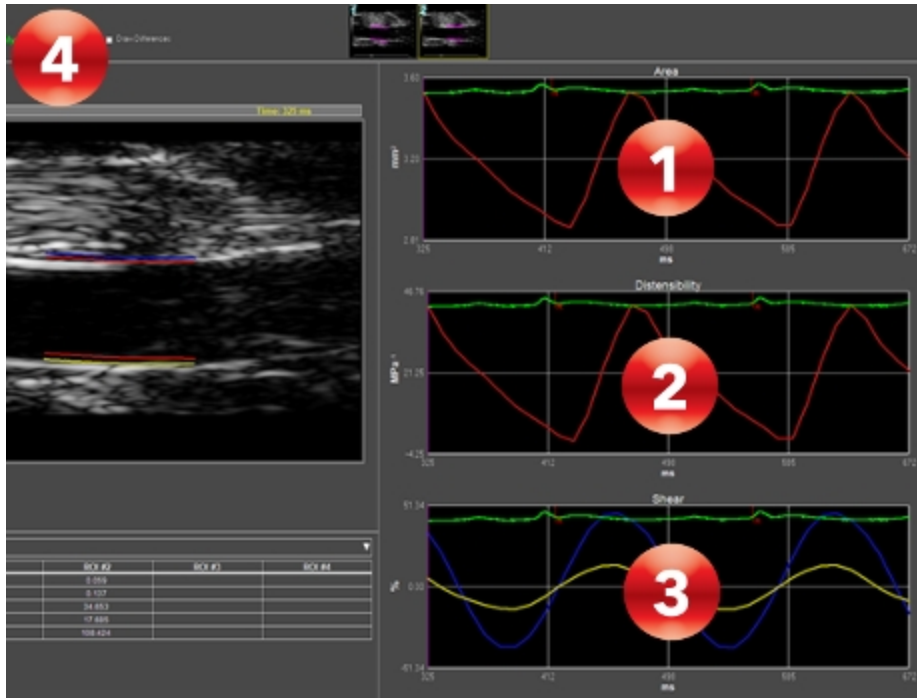
### *Vessel analysis*

Area (see  below) and Distensibility (see  below) is displayed in the Analysis graphs. For Wall and IMT ROIs, the inner walls must be selected. See

"Appendix 1" on page 638 for further Distensibility details.

External ROI walls will be displayed on a Shear graph (see **3** below).

Shear is positive when the outer border shifts rightward with respect to the corresponding inner border.



If the Draw Differences box is checked (see **4** above), then for each pair of inner walls selected, the Area and Distensibility difference are shown in the Analysis graphs.

Again, the positive addend ROI borders are painted with a continuous colored line, while the negative addend ROI borders are drawn with a dotted line of

the same color. Each pair is associated to the corresponding Analysis graph color.

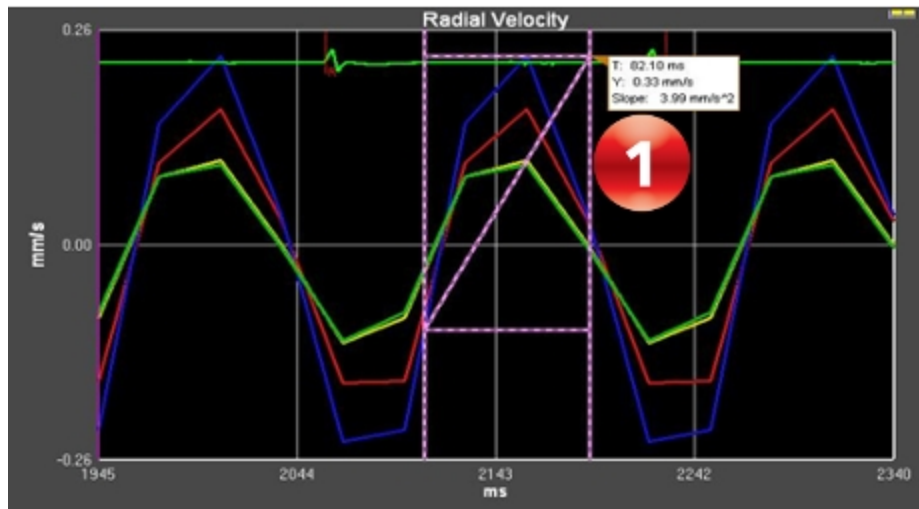
In the top right corner of the graphs, the percentage of difference versus maximum area or shear is displayed in the corresponding color.

Toggle the Area graph to Diameter graph to display the y axis in mm via right-click on the measurement wall and click **Toggle to Diameter View** in the context menu.

### Transverse ROIs

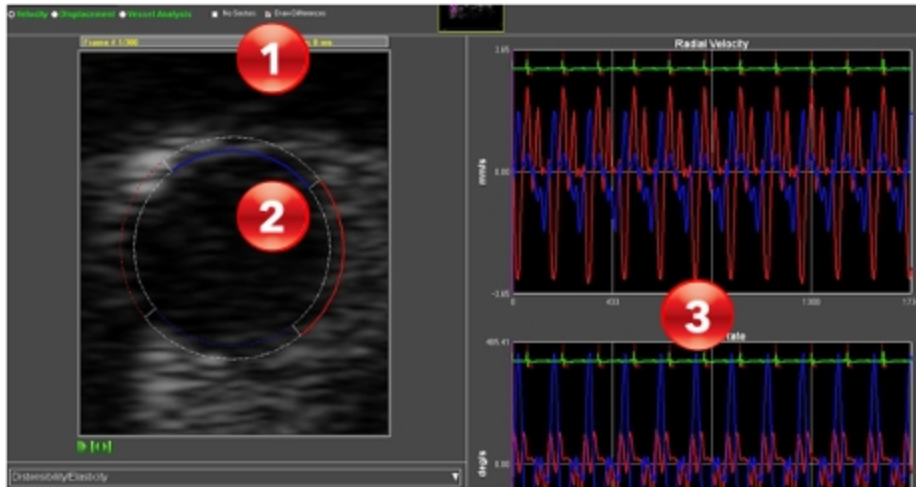
In each analysis graph, a ruler can be activated for additional measurements. Right-click on a measurement wall, then click **Activate Ruler** in the context

menu (see  below as an example on a Radial Velocity graph).



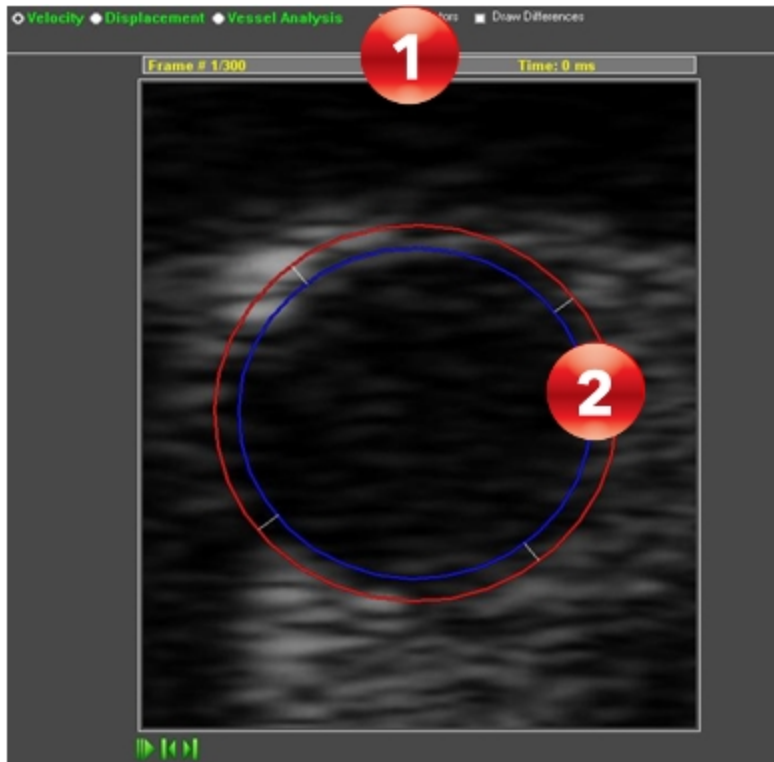


If the Draw Difference box is checked (see **1** below), then for each pair of sectors selected (see **2** below), the velocity difference is shown on the Analysis graphs (see **3** below).



The positive addend border is displayed with a continuous colored line, while the negative addend is displayed with a dotted line of the same color. Each colored pair corresponds to a single colored line of data on the Analysis graphs. Sectors can be selected from different ROIs.

If the No Sectors box is checked (see **1** below), each ROI sector will be displayed as a whole contour (see **2** below).



### *Displacement data*

Each sector of an ROI can be separately activated or deactivated by clicking on the line itself.

Analysis graphs for Radial Displacement (micron) and Rotation (deg/s) are displayed and the analysis trace colors correspond to the displayed sector colors.

Displacements will be radial positive if moving toward the lumen and tangential positive if moving rightward.

If the Draw Differences box is checked, then for each pair of sectors selected, the velocity difference is shown on the Analysis graphs.

The positive addend border is painted with a continuous colored line, while the negative addend is drawn with a dotted line of the same color. Each colored pair corresponds to the color on the Analysis graphs. Sectors can be selected from different ROIs.

If the No Sectors box is checked, each ROI sector will be displayed only as a whole contour.

### *Vessel analysis*

Area ( $\text{mm}^2$ ) and Distensibility ( $\text{MPa}^{-1}$ ) for each frame can be shown in the Analysis graphs, although for IMT ROIs only the inner diameter can be selected. See "[Appendix 1](#)" on page 638 for further information.

If the Draw Differences box is checked, then for each pair of diameters selected, the Area and Distensibility difference are shown in the Analysis graphs.

Again, the positive addend ROI diameter is painted with a continuous colored line, while the negative addend is drawn with a dotted line of the same color. Each pair is associated to the corresponding graph color.

In the top right corner of the graphs, the percentage of difference versus maximum area or distensibility is displayed in the corresponding color.

If the No Sectors check box is set on ROI Analysis Workspace, each ROI border is displayed only as a whole contour.

Toggle the Area graph to Diameter graph to display the y axis in mm via right-click on the measurement wall and click **Toggle to Diameter View** in the context menu.



## Sequence AM-Mode selection

When loading an image not previously processed in Vevo Vasc, or by clicking **Sequence/AM-Mode Selection**, the data is displayed within the "[AM-Mode selection workspace](#)" on page 605.

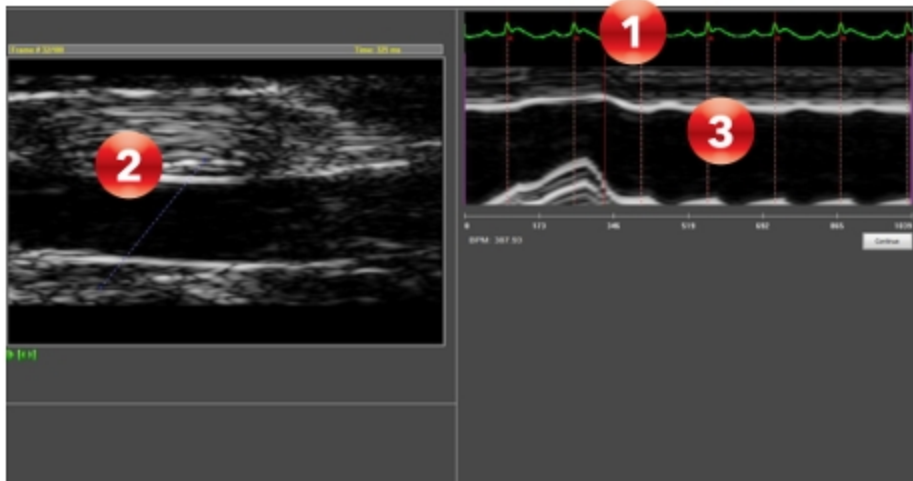
Initially R-Waves will automatically be placed on the displayed ECG trace (see **1** below), within the physiological data area.

R-Waves can be added by right clicking within the physiological data area. R-Waves can be deleted by right clicking on the existing R-Wave.

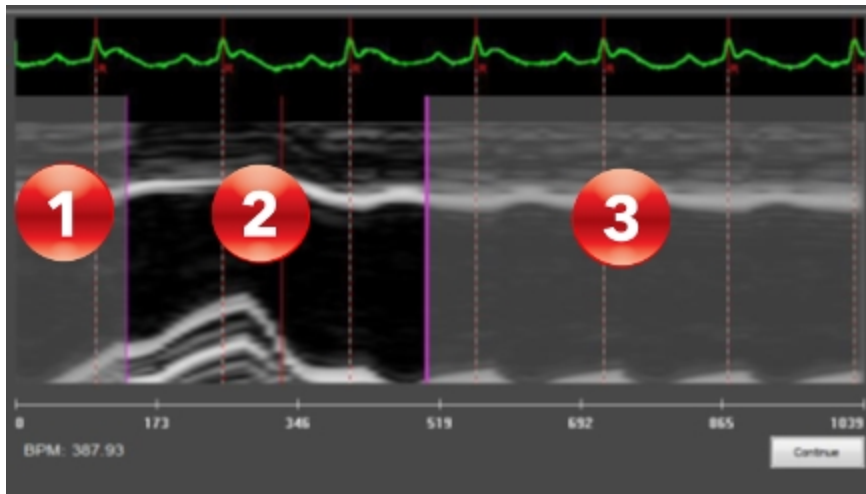
**Note:** There must be a minimum of two R-Wave indicators within the physiological data area.

By drawing a line onto the image (see **2** below), it is possible to create an AM-Mode image to be used as a background reference (see **3** below). The User can toggle the display of this data in the analysis graphs by clicking **Toggle AM-Mode Image** in the tool panel.

The AM-Mode overlay on the image can be modified after placing by selecting and dragging the beginning or end points. It can also be deleted by clicking the image **Erase AM-Mode Line** context menu option.



Start and stop time intervals can be defined by moving the purple sliders on the time scale (see **1** and **2** below). The shaded areas displayed (see **3** below) are excluded from ROI analysis, and the non-shaded areas are included in ROI analysis.



A minimum one cardiac cycle is required to make analysis possible. If less than one cardiac cycle is selected, a yellow warning message is placed near one of the time cursors, and the user will not be able to proceed with the analysis (see below).

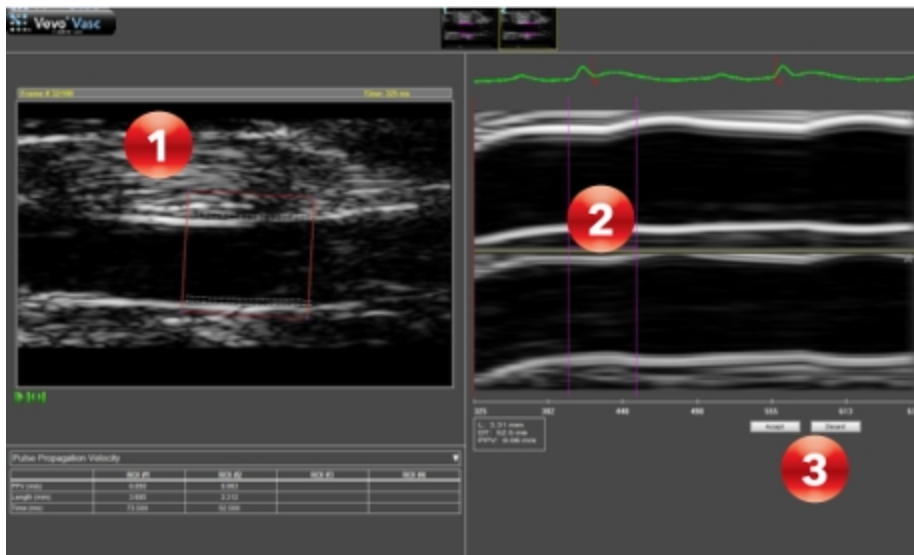


### Pulse Propagation Velocity measurement

Pulse Propagation Velocity (PPV) for longitudinal ROIs can be measured by clicking **Pulse Propagation Velocity** on the tool panel.

A floating window panel appears. Draw a longitudinal rectangle that covers the traced ROI. Then click **Accept** or **Discard**.

The PPV Definition Workspace opens. On the image, the red longitudinal rectangle is displayed (see **1** below).



**Note:** Only one ROI can be shown at a time and it can be selected by toggling on the thumbnails.

Once the ROI is selected, all lines of the rectangle can be adjusted by selecting a line then dragging to a new position. The user can also rotate the rectangle to align the ROI box with the vessel being analyzed, and to get the most appropriate AM-Mode image. Vertical lines of data from the rectangle will be displayed and identified as the **Left** (top image) and **Right** (bottom image) on the ROI (see **2** above).

As you adjust the lines of the rectangle, the vertical lines of data that are displayed on the AM-Mode image are adjusted automatically by detecting the edge of the ROI.

After setting the PPV times within the displayed AM-Mode images, click to **Accept** or **Discard** the results (see **3** above).

Once completed, for each traced ROI, the PPV parameters are displayed within the Results Table.

For each ROI, the user can read:

- Pulse Propagation Velocity evaluated in m/s.
- ROI length used for PPV evaluation in mm.
- Time duration used for PPV evaluation in ms.

### Deleting a Vevo Vasc analysis

A specific image's Vevo Vasc analysis can be deleted from the Study Browser.

In the Study Browser, select an image which has already been processed with Vevo Vasc—the image will be identified by '(Vevo Vasc)' within the Mode column.

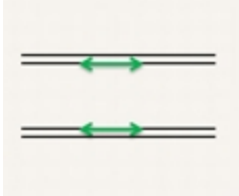
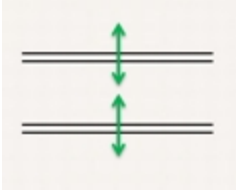
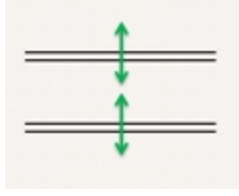

Right-click to display the context menu, then select the **Delete Vevo Vasc Analysis** option.

The Vevo Vasc analysis associated with the selected image will be deleted.

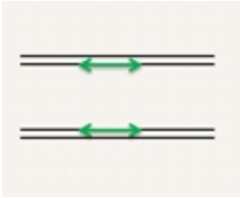
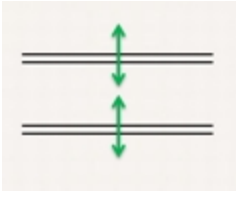


# Appendix 1

## Parameters

### Velocity

Longitudinal	 <p>A diagram showing two horizontal parallel lines representing a vessel lumen. Two green double-headed arrows are positioned between the lines, one in the upper half and one in the lower half, pointing horizontally in opposite directions to represent tangential flow.</p>	 <p>A diagram showing two horizontal parallel lines representing a vessel lumen. Two green double-headed arrows are positioned between the lines, one in the upper half and one in the lower half, pointing vertically in opposite directions to represent radial flow.</p>
Transverse (Cross-sectional)	 <p>A diagram showing two horizontal parallel lines representing a vessel lumen. Two green double-headed arrows are positioned between the lines, one in the upper half and one in the lower half, pointing vertically in opposite directions to represent radial flow.</p>	 <p>A diagram showing two concentric circles representing a vessel cross-section. A green double-headed arrow is positioned between the circles, pointing horizontally in opposite directions to represent rotational flow.</p>

## Displacement

Longitudinal	 <p>Tangential Displacement</p>	 <p>Radial Displacement</p>
Transverse (Cross-sectional)	 <p>Radial Displacement</p>	 <p>Rotation</p>

## Strain

Longitudinal Strain is the lengthening or shortening (if negative) of the vessel wall along its length.



In formulas,

$$\text{Strain} = (L(t) - LO)/LO$$

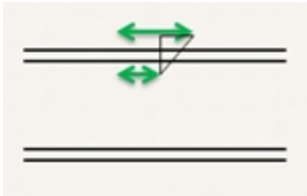
where:

**LO** is the length at the R-wave

This corresponds to circumferential strain in cardiac (LV) strain analysis (REF: 2011 Kim et al.)

## Shear

Shear graph is evaluated as the time plot of the arctan of shear strain normalized to ROI thickness. So a 100% shear is intended as a "thickness equivalent" relative movement of the borders.



Is the angular deformation between external and internal borders. The difference between the two displacements (starting from zero at the R) divided by the thickness.

$$Sh = \frac{1}{h(t)} \int_R^t \Delta V dt$$

where:

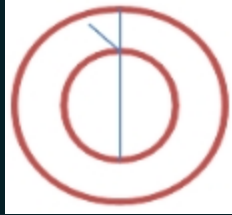
**h** is the thickness

**ΔV** is the difference in tangential (longitudinal) velocity between external and internal borders.



(REF: 2006 Cinthio et al.)

**Note:** For Transverse (Cross-sectional View), Shear is the same as above, where tangential displacements are rotations.



## Elasticity

Elasticity is calculated according to the following formula:

$$E = 0.1333 \times (P_{sys} - P_{dia}) \times \frac{T_{dia}}{T_{dia} - T_{sys}}$$

where:

$T$  is the thickness at systole or diastole

Frames corresponding to systole and diastole are calculated automatically

$P_{sys}$  and  $P_{dia}$  are systolic and diastolic pressure which can be manually entered into Vevo Vasc.

## Distensibility

Distensibility graph is evaluated as a time plot of:

$$D(t) = 7.5 \times \left[ \frac{\left( \frac{Area(t) - Area(dia)}{Area(dia)} \right)}{Pressure(sys) - Pressure(dia)} \right]$$

Distensibility parameter is evaluated as:

$$d = 7.5 \times \left[ \frac{\left( \frac{Area(sys) - Area(dia)}{Area(dia)} \right)}{Pressure(sys) - Pressure(dia)} \right]$$

**Note:** The actual blood pressure must be entered via the Blood Pressure



Modification button on the Tool Panel for a correct evaluation of the distensibility parameter in the results table.

## Appendix 2

### Results table

#### Longitudinal ROIs

Parameter	Measurement	Units
Pulse Propagation Velocity	PPV	m/s
	Length	mm
	Time	ms
Intima Media Thickness	IMT Meas Near	µm
	Std Dev Meas Near	µm
	IMT Meas Far	µm

### Longitudinal ROIs

Parameter	Measurement	Units
	Std Dev Meas Far	μm
Diameter/Area	Mean Diameter	mm
	Mean Area	mm <sup>2</sup>
	Max Area	mm <sup>2</sup>
	Min Diameter	mm
	Min Area	mm <sup>2</sup>
	Dia Perc Spread	%/100
	Area Perc Spread	%/100
Distensibility/Elasticity	Thickness Near	μm
	Thickness Far	μm
	Distensibility	MPa <sup>-1</sup>
	Elast Near	kPa
	Elast Far	kPa
Wall	Thickness Near	μm
	Std Dev Meas Near	μm
	Thickness Far	μm

### Longitudinal ROIs

Parameter	Measurement	Units
	Std Dev Meas Far	μm

### Transverse ROIs

Parameter	Measurement	Units
Diameter/Area	Mean Diameter	mm
	Mean Area	mm <sup>2</sup>
	Max Diameter	mm
	Max Area	mm <sup>2</sup>
	Min Diameter	mm
	Min Area	mm <sup>2</sup>
	Dia Perc Spread	%/100
	Area Perc Spread	%/100
Distensibility/Elasticity	Thickness S1	mm
	Thickness S2	mm
	Thickness S3	mm
	Thickness S4	mm
	Distensibility	MPa <sup>-1</sup>

### Transverse ROIs

Parameter	Measurement	Units
	Elasticity	kPa
	Elast S1	kPa
	Elast S2	kPa
	Elast S3	kPa
	Elast S4	kPa

## Appendix

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This section includes a range of reference content.

["Measurement Package Protocols"](#) on the facing page

["Troubleshooting"](#) on page 834

["Customer Support"](#) on page 857

["Vevo Brain Neuroanatomical Atlas installation"](#) on page 859

## Measurement Package Protocols

This appendix details the measurement and calculation definitions for each measurement package.

"Abdominal Measurement Package" on the next page

"Cardiac Measurement Package" on page 702

"Embryology Measurement Package" on page 768

"Ophthalmology Measurement Package" on page 772

"Vascular measurement Package" on page 776

## Abdominal Measurement Package

This section provides the measurements and calculations information for the Protocols in the Abdominal Measurement Package.

"Liver" on the facing page

"Spleen" on page 660

"Gallbladder" on page 663

"Kidney" on page 664

"Adrenal Glands" on page 670

"Pancreas" on page 676

"Female Reproductive" on page 678

"Mammary Glands" on page 686

"Male Reproductive" on page 688



Liver

Liver Protocol Measurement Definitions

Label	Description	Units	Generic Type	Mode
Liver Sag	Sagittal length	mm	Linear	EKV B-Mode Color Power Linear Nonlinear
Liver Trans	Transverse length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Hepatic Vel	Hepatic vein velocity	mm/s	Velocity	PW Doppler Mode
Hepatic Diam	Hepatic vein diameter	mm	Linear	EKV

Liver Protocol Measurement Definitions

Label	Description	Units	Generic Type	Mode
				B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Hepatic Diam	Hepatic vein diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RHV Vel	Right hepatic vein velocity	mm/s	Velocity	PW Doppler Mode
RHV Diam	Right hepatic vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RHV Diam	Right hepatic vein diameter	mm	Depth	M-Mode

Liver Protocol Measurement Definitions

Label	Description	Units	Generic Type	Mode
				AM-Mode EKV AM-Mode
LHV Vel	Left hepatic vein velocity	mm/s	Velocity	PW Doppler Mode
LHV Diam	Left hepatic vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LHV Diam	Left hepatic vein diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
CHA Vel	Common hepatic artery velocity	mm/s	Velocity	PW Doppler Mode
CHA PS Vel	Common hepatic artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode

### Liver Protocol Measurement Definitions

Label	Description	Units	Generic Type	Mode
CHA LD Vel	Common hepatic artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
CHA VTI	Common hepatic artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Common hepatic peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Common hepatic mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Common hepatic peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Common hepatic mean gradient	mmHg	VTI	PW Doppler Mode
CHA Diam	Common hepatic artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode

Liver Protocol Measurement Definitions

Label	Description	Units	Generic Type	Mode
CHA Diam	Common hepatic artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RHA Vel	Right hepatic artery velocity	mm/s	Velocity	PW Doppler Mode
RHA PS Vel	Right hepatic artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RHA LD Vel	Right hepatic artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
RHA VTI	Right hepatic artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right hepatic peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right hepatic mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right hepatic peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right hepatic mean gradient	mmHg	VTI	PW Doppler Mode
RHA Diam	Right hepatic artery diameter	mm	Linear	EKV

Liver Protocol Measurement Definitions

Label	Description	Units	Generic Type	Mode
				B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RHA Diam	Right hepatic artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LHA Vel	Left hepatic artery velocity	mm/s	Velocity	PW Doppler Mode
LHA PS Vel	Left hepatic artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LHA LD Vel	Left hepatic artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
LHA VTI	Left hepatic artery velocity time integral	mm	VTI	PW Doppler Mode

**Liver Protocol Measurement Definitions**

<b>Label</b>	<b>Description</b>	<b>Units</b>	<b>Generic Type</b>	<b>Mode</b>
Peak Vel	Left hepatic peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left hepatic mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left hepatic peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left hepatic mean gradient	mmHg	VTI	PW Doppler Mode
LHA Diam	Left hepatic artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LHA Diam	Left hepatic artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
MPV Vel	Main portal vein velocity	mm/s	Velocity	PW Doppler Mode

Liver Protocol Measurement Definitions

Label	Description	Units	Generic Type	Mode
MPV Diam	Main portal vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
MPV Diam	Main portal vein diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RPV Vel	Right portal vein velocity	mm/s	Velocity	PW Doppler Mode
RPV Diam	Right portal vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode



Liver Protocol Measurement Definitions

Label	Description	Units	Generic Type	Mode
RPV Diam	Right portal vein diameter	mm	Linear	M-Mode AM-Mode EKV AM-Mode
LPV Vel	Left portal vein velocity	mm/s	Velocity	PW Doppler Mode
LPV Diam	Left portal vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LPV Diam	Left portal vein diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
Gast Vel	Gastroduodenal artery velocity	mm/s	Velocity	PW Doppler Mode
Gast PS Vel	Gastroduodenal artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode

### Liver Protocol Measurement Definitions

Label	Description	Units	Generic Type	Mode
Gast LD Vel	Gastroduodenal artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
Gast VTI	Gastroduodenal artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Gastroduodenal peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Gastroduodenal mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Gastroduodenal peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Gastroduodenal mean gradient	mmHg	VTI	PW Doppler Mode
Gast Diam	Gastroduodenal artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode

Liver Protocol Measurement Definitions

Label	Description	Units	Generic Type	Mode
Gast Diam	Gastroduodenal artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode

Liver Protocol Calculation Definitions

Label	Description	Formula
CHA RI	Common Hepatic Artery Resistive Index	$\frac{CHA\ PSV - CHA\ LDV}{CHA\ PSV}$
CHA PI	Common Hepatic Artery Pulsatility Index	$\frac{CHA\ PSV - CHA\ LDV}{CHA\ VTI\ Mean\ Vel}$
LHA RI	Left Hepatic Artery Resistive Index	$\frac{LHA\ PSV - LHA\ LDV}{LHA\ PSV}$
LHA PI	Left Hepatic Artery Pulsatility Index	$\frac{LHA\ PSV - LHA\ LDV}{LHA\ VTI\ Mean\ Vel}$
RHA RI	Right Hepatic Artery Resistive Index	$\frac{RHA\ PSV - RHA\ LDV}{RHA\ PSV}$

### Liver Protocol Calculation Definitions

Label	Description	Formula
RHA PI	Right Hepatic Artery Pulsatility Index	$\frac{RHA\ PSV - RHA\ LDV}{RHA\ VTI\ Mean\ Vel}$
Gast RI	Gastroduodenal Artery Resistive Index	$\frac{Gast\ PSV - Gast\ LDV}{Gast\ PSV}$
Gast PI	Gastroduodenal Artery Pulsatility Index	$\frac{Gast\ PSV - Gast\ LDV}{Gast\ VTI\ Mean\ Vel}$

### Spleen

#### Spleen Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Spleen Sag	Sagittal length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Spleen Trans	Transverse length	mm	Linear	EKV

### Spleen Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Splenic Artery Vel	Splenic artery velocity	mm/s	Velocity	PW Doppler Mode
Splenic PS Vel	Splenic artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
Splenic LD Vel	Splenic artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
Splenic VTI	Splenic artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Splenic peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Splenic mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Splenic peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Splenic mean gradient	mmHg	VTI	PW Doppler Mode

### Spleen Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Splenic Artery Diam	Splenic artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Splenic Artery Diam	Splenic artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode

### Spleen Protocol Calculation Definitions

Label	Description	Formula
SA RI	Splenic artery resistive index	$\frac{SA\ PSV - SA\ LDV}{SA\ PSV}$
SA PI	Splenic artery pulsatility index	$\frac{SA\ PSV - SA\ LDV}{SA\ VTI\ Mean\ Vel}$

## Gallbladder

Gallbladder Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
GB Sag	Gallbladder sagittal length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
GB Trans	Gallbladder transverse length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
GB Wall Thickness	Gallbladder wall thickness	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode

### Gallbladder Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Linear Contrast Mode Nonlinear Contrast Mode
CBD	Common bile duct diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode

### Kidney

#### Kidney Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
R Kidney Sag	Right Kidney sagittal length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast



### Kidney Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Mode
R Kidney Trans	Right Kidney transverse length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RRA PSV	Right Renal Artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RRA LDV	Right Renal Artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
RRA VTI	Right Renal artery mean systolic velocity	mm	VTI	PW Doppler Mode
Peak Vel	Right Renal peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right Renal mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right Renal peak gradient	mmHg	VTI	PW Doppler Mode

### Kidney Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Mean Grad	Right Renal mean gradient	mmHg	VTI	PW Doppler Mode
RRA Diam	Right Kidney Renal Artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RRA Diam	Right Kidney Renal Artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RRV PSV	Right Kidney Renal Vein peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RRV DV	Right Kidney Renal Vein diastolic velocity	mm/s	Velocity	PW Doppler Mode
RRV Diam	Right Kidney Renal Vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode

### Kidney Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RRV Diam	Right Kidney Renal Vein diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
L Kidney Sag	Left Kidney sagittal length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
L Kidney Trans	Left Kidney transverse length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode

### Kidney Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Linear Contrast Mode Nonlinear Contrast Mode
LRA PSV	Left Kidney Renal Artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LRA LDV	Left Kidney Renal Artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
LRA VTI	Left Kidney Renal artery mean systolic velocity	mm	VTI	PW Doppler Mode
Peak Vel	Left Renal peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left Renal mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left Renal peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left Renal mean gradient	mmHg	VTI	PW Doppler Mode
LRA Diam	Left Kidney Renal Artery diameter	mm	Linear	EKV B-Mode

### Kidney Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LRA Diam	Left Kidney Renal Artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LRV Diam	Left Kidney Renal Vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LRV Diam	Left Kidney Renal Vein diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode

### Kidney Protocol Calculation Definitions

Label	Description	Formula
RRA RI	Right Renal artery resistive index	$\frac{RRA\ PSV - RRA\ LDV}{RRA\ PSV}$
RRA PI	Right Renal artery pulsatility index	$\frac{RRA\ PSV - RRA\ LDV}{RRA\ VTI\ Mean\ Vel}$
LRA RI	Left Renal artery resistive index	$\frac{LRA\ PSV - LRA\ LDV}{LRA\ PSV}$
LRA PI	Left Renal artery pulsatility index	$\frac{LRA\ PSV - LRA\ LDV}{LRA\ VTI\ Mean\ Vel}$

### Adrenal Glands

#### Adrenal Glands Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
RAG Sag	Right adrenal glands sagittal length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode

### Adrenal Glands Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Nonlinear Contrast Mode
RAG Trans	Right adrenal glands transverse length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RAA Vel	Right adrenal artery velocity	mm/s	Velocity	PW Doppler Mode
RAA PS Vel	Right adrenal artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RAA LD Vel	Right adrenal artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
RAA VTI	Right adrenal artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right adrenal peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right adrenal mean velocity	mm/s	VTI	PW Doppler Mode

### Adrenal Glands Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Peak Grad	Right adrenal peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right adrenal mean gradient	mmHg	VTI	PW Doppler Mode
RAA Diam	Right adrenal artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RAA Diam	Right adrenal artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RAV Vel	Right adrenal artery velocity	mm/s	Velocity	PW Doppler Mode
RAV Diam	Right adrenal artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode



### Adrenal Glands Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Linear Contrast Mode Nonlinear Contrast Mode
RAV Diam	Right adrenal artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
Lag Sag	Left adrenal glands sagittal length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Lag Trans	Left adrenal glands transverse length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode

### Adrenal Glands Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LAA Vel	Left adrenal artery velocity	mm/s	Velocity	PW Doppler Mode
LAA PS Vel	Left adrenal artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LAA LD Vel	Left adrenal artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
LAA VTI	Left adrenal artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left adrenal peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left adrenal mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left adrenal peak gradient	mmhg	VTI	PW Doppler Mode
Mean Grad	Left adrenal mean gradient	mmhg	VTI	PW Doppler Mode
LAA Diam	Left adrenal artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode

### Adrenal Glands Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LAA Diam	Left adrenal artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LAV Vel	Left adrenal vein velocity	mm/s	Velocity	PW Doppler Mode
LAV Diam	Left adrenal vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LAV Diam	Left adrenal vein diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode

### Adrenal Glands Protocol Calculation Definitions

Label	Description	Formula
RAA RI	Right Adrenal Artery resistive index	$\frac{RAA\ PSV - RAA\ LDV}{RAA\ PSV}$
RAA PI	Right Adrenal Artery pulsatility index	$\frac{RAA\ PSV - RAA\ LDV}{RAA\ VTI\ Mean\ Vel}$
LAA RI	Left Adrenal Artery resistive index	$\frac{LAA\ PSV - LAA\ LDV}{LAA\ PSV}$
LAA PI	Left Adrenal Artery pulsatility index	$\frac{LAA\ PSV - LAA\ LDV}{LAA\ VTI\ Mean\ Vel}$

### Pancreas

#### Pancreas Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Pancreas Sag	Pancreas sagittal length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode

Pancreas Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Nonlinear Contrast Mode
Pancreas Trans	Pancreas transverse length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Duct	Pancreatic duct diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode

Female Reproductive

Female Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Uterus Sag	Uterus sagittal length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Uterus Trans	Uterus transverse length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
UA Vel	Uterine artery velocity	mm/s	Velocity	PW Doppler Mode
UA PS Vel	Uterine artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode

### Female Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
UA LD Vel	Uterine artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
UA VTI	Uterine artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Uterine artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Uterine artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Uterine artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Uterine artery mean gradient	mmHg	VTI	PW Doppler Mode
UA Diam	Uterine artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
UA Diam	Uterine artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode

### Female Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
UV Vel	Uterine vein velocity	mm/s	Velocity	PW Doppler Mode
UV Diam	Uterine vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
UV Diam	Uterine vein diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
ROv Sag	Right ovary sagittal	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
ROv Trans	Right ovary transverse	mm	Linear	EKV



### Female Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
ROv Art Vel	Right ovarian artery velocity	mm/s	Velocity	PW Doppler Mode
ROv PS Vel	Right ovarian artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
ROv LD Vel	Right ovarian artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
ROv VTI	Right ovarian artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right ovarian artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right ovarian mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right ovarian peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right ovarian mean gradient	mmHg	VTI	PW Doppler Mode

### Female Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
ROv Art Diam	Right ovarian artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
ROv Art Diam	Right ovarian artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
ROv Vein Vel	Right ovarian vein velocity	mm/s	Velocity	PW Doppler Mode
ROv Vein Diam	Right ovarian vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
ROv Vein Diam	Right ovarian vein diameter	mm	Depth	M-Mode

Female Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				AM-Mode EKV AM-Mode
LOv Sag	Left ovary sagittal	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LOv Trans	Left ovary transverse	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LOv Art Vel	Left ovarian artery velocity	mm/s	Velocity	PW Doppler Mode
LOv PS Vel	Left ovarian artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode

### Female Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LOv LD Vel	Left ovarian artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
LOv VTI	Left ovarian artery mean systolic velocity	mm	VTI	PW Doppler Mode
Peak Vel	Right ovarian peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right ovarian mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right ovarian peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right ovarian mean gradient	mmHg	VTI	PW Doppler Mode
LOv Art Diam	Left ovarian artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LOv Art Diam	Left ovarian artery diameter	mm	Depth	M-Mode AM-Mode

### Female Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				EKV AM-Mode
LOv Vein Vel	Left ovarian vein velocity	mm/s	Velocity	PW Doppler Mode
LOv Vein Diam	Left ovarian vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LOv Vein Diam	Left ovarian vein diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode

### Female Reproductive Protocol Calculation Definitions

Label	Description	Formula
UA RI	Uterine artery resistive index	$\frac{UA\ PSV - UA\ LDV}{UA\ PSV}$

### Female Reproductive Protocol Calculation Definitions

Label	Description	Formula
UA PI	Uterine artery pulsatility index	$\frac{UA\ PSV - UA\ LDV}{UA\ VTI\ Mean\ Vel}$
ROv RI	Right ovarian artery resistive index	$\frac{ROv\ PSV - ROv\ LDV}{ROv\ PSV}$
ROv PI	Right ovarian artery pulsatility index	$\frac{ROv\ PSV - ROv\ LDV}{ROv\ VTI\ Mean\ Vel}$
LOv RI	Left ovarian artery resistive index	$\frac{LOv\ PSV - LOv\ LDV}{LOv\ PSV}$
LOv PI	Left ovarian artery pulsatility index	$\frac{LOv\ PSV - LOv\ LDV}{LOv\ VTI\ Mean\ Vel}$

### Mammary Glands

#### Mammary Glands Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Cervical Diam	Mammary glands	mm	Linear	EKV B-Mode

### Mammary Glands Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Thoracic Diam	Thoracic diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Abdominal Diam	Abdominal diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Inguinal Diam	Inguinal diameter	mm	Linear	EKV B-Mode

### Mammary Glands Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Papilla Mammae Diam	Papilla mammae diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode

### Male Reproductive

#### Male Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Prostate Sag	Prostate sagittal	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode



Male Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Linear Contrast Mode Nonlinear Contrast Mode
Prostate Trans	Prostate transverse	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RVG Sag	Right vesicular glands sagittal	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RVG Trans	Right vesicular glands transverse	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode

### Male Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Linear Contrast Mode Nonlinear Contrast Mode
RVA Vel	Right vesicular artery velocity	mm/s	Velocity	PW Doppler Mode
RVA PS Vel	Right vesicular artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RVA LD Vel	Right vesicular artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
RVA VTI	Right vesicular artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right vesicular peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right vesicular mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right vesicular peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right vesicular mean gradient	mmHg	VTI	PW Doppler Mode
RVA Diam	Right vesicular artery diameter	mm	Linear	EKV

### Male Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RVA Diam	Right vesicular artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RVV Vel	Right vesicular vein velocity	mm/s	Velocity	PW Doppler Mode
RVV Diam	Right vesicular vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RVV Diam	Right vesicular vein diameter	mm	Depth	M-Mode AM-Mode

### Male Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				EKV AM-Mode
LVG Sag	Left vesicular glands sagittal	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LVG Trans	Left vesicular glands transverse	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LVA Vel	Left vesicular artery velocity	mm/s	Velocity	PW Doppler Mode
LVA PS Vel	Left vesicular artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LVA LD Vel	Left vesicular artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode

### Male Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LVA VTI	Left vesicular artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left vesicular peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left vesicular mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left vesicular peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left vesicular mean gradient	mmHg	VTI	PW Doppler Mode
LVA Diam	Left vesicular artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LVA Diam	Left vesicular artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode

### Male Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LW Vel	Left vesicular vein velocity	mm/s	Velocity	PW Doppler Mode
LW Diam	Left vesicular vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LW Diam	Left vesicular vein diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
R Test Sag	Right testicle sagittal	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
R Test Trans	Right testicle transverse	mm	Linear	EKV

### Male Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RTA Vel	Right testicular artery velocity	mm/s	Velocity	PW Doppler Mode
RTA PS Vel	Right testicular artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RTA LD Vel	Right testicular artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
RTA VTI	Right testicular artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right testicular peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right testicular mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right testicular peak gradient	mmHg	VTI	PW Doppler Mode

### Male Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Mean Grad	Right testicular mean gradient	mmHg	VTI	PW Doppler Mode
RTA Diam	Right testicular artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RTA Diam	Right testicular artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RTV Vel	Right testicular vein velocity	mm/s	Velocity	PW Doppler Mode
RTV Diam	Right testicular vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode



### Male Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
RTV Diam	Right testicular vein diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
L Test Sag	Left testicle sagittal	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
L Test Trans	Left testicle transverse	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LTA Vel	Left testicular artery velocity	mm/s	Velocity	PW Doppler Mode
LTA PS Vel	Left testicular artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode

### Male Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LTA LD Vel	Left testicular artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
LTA VTI	Left testicular artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left testicular peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left testicular mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left testicular peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left testicular mean gradient	mmHg	VTI	PW Doppler Mode
LTA Diam	Left testicular artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LTA Diam	Left testicular artery diameter	mm	Depth	M-Mode AM-Mode

### Male Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				EKV AM-Mode
LTV Vel	Left testicular vein velocity	mm/s	Velocity	PW Doppler Mode
LTV Diam	Left testicular vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LTV Diam	Left testicular vein diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
Epid Head	Epididymis head length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode

### Male Reproductive Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Epid Head	Epididymis head depth	mm	Depth	M-Mode AM-Mode EKV AM-Mode
Epid Tail	Epididymis tail length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Epid Tail	Epididymis tail depth	mm	Depth	M-Mode AM-Mode EKV AM-Mode

### Male Reproductive Protocol Calculation Definitions

Label	Description	Formula
RVA RI	Right vesicular artery resistive index	$\frac{RVA\ PSV - RVA\ LDV}{RVA\ PSV}$

Label	Description	Formula
RVA PI	Right vesicular artery pulsatility index	$\frac{RVA\ PSV - RVA\ LDV}{RVA\ VTI\ Mean\ Vel}$
LVA RI	Left vesicular artery resistive index	$\frac{LVA\ PSV - LVA\ LDV}{LVA\ PSV}$
LVA PI	Left vesicular artery pulsatility index	$\frac{LVA\ PSV - LVA\ LDV}{LVA\ VTI\ Mean\ Vel}$
RTA RI	Right testicular artery resistive index	$\frac{RTA\ PSV - RTA\ LDV}{RTA\ PSV}$
RTA PI	Right testicular artery pulsatility index	$\frac{RTA\ PSV - RTA\ LDV}{RTA\ VTI\ Mean\ Vel}$
LTA RI	Left testicular artery resistive index	$\frac{LTA\ PSV - LTA\ LDV}{LTA\ PSV}$
LTA PI	Left testicular artery pulsatility index	$\frac{LTA\ PSV - LTA\ LDV}{LTA\ VTI\ Mean\ Vel}$

## Cardiac Measurement Package

This section provides the measurements and calculations information for the Protocols in the Cardiac Measurement Package.

"PSLAX" on the facing page

"SAX" on page 724

"Anatomical M-Mode" on page 742

"Simpson's" on page 745

"ARCH" on page 749

"AoV Flow" on page 750

"MV Flow" on page 755

"RV and PV Function" on page 760

"TV Flow" on page 765

PSLAX

PSLAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
LV Trace	PSLAX LV trace - long axis area	mm <sup>2</sup>	BLVArea	EKV B-Mode	
A	LV trace area	mm <sup>2</sup>	BLVArea	EKV B-Mode	
A;s	Systolic area	mm <sup>2</sup>	BLVArea	EKV B-Mode	
A;d	Diastolic area	mm <sup>2</sup>	BLVArea	EKV B-Mode	
V;s	Systolic volume	μL	BLVArea	EKV B-Mode	
V;d	Diastolic volume	μL	BLVArea	EKV B-Mode	
SV	Stroke volume	μL	BLVArea	EKV	

### PSLAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				B-Mode	
EF	Ejection fraction	%	BLVArea	EKV B-Mode	
FS	Fractional shortening	%	BLVArea	EKV B-Mode	
CO	Cardiac output	mL/min	BLVArea	EKV B-Mode	
V	LV trace - long axis volume	μL	BLVArea	EKV B-Mode	
HR	Heart rate	BPM	BLVArea	EKV B-Mode	
RVID;d	Right ventricular internal diameter (diastole)	mm	Depth	M-Mode	IVS;d
IVS;d	Interventricular septum (diastole)	mm	Depth	M-Mode	LVID;d



PSLAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
IVS;d	Interventricular septum (diastole)	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	LVID;d
LVAW;d	Left ventricular anterior wall (diastole)	mm	Depth	M-Mode	LVID;d
LVID;d	Left ventricular internal diameter (diastole)	mm	Depth	M-Mode	LVPW;d
LVID;d	Left ventricular internal diameter (diastole)	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler	LVPW;d

PSLAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				Mode Linear Contrast Mode Nonlinear Contrast Mode	
LVEnd;d	Left ventricular endocardial length (diastole)	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	
LVPW;d	Left ventricular posterior wall (diastole)	mm	Depth	M-Mode	
LVPW;d	Left ventricular posterior wall (diastole)	mm	Length	EKV B-Mode	

PSLAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	
IVS;s	Inter ventricular septum (systole)	mm	Depth	M-Mode	LVID;s
IVS;s	Inter ventricular septum (systole)	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	LVID;s

PSLAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
LVAW;s	Left ventricular anterior wall (systole)	mm	Depth	M-Mode	LVID;s
LVID;s	Left ventricular internal diameter (systole)	mm	Depth	M-Mode	LVPW;s
LVID;s	Left ventricular internal diameter (systole)	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	LVPW;s
LVEEnL;s	Left ventricular endocardial length (systole)	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode	

PSLAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				Linear Contrast Mode Nonlinear Contrast Mode	
LVPW;s	Left ventricular posterior wall (systole)	mm	Depth	M-Mode	
LVPW;s	Left ventricular posterior wall (systole)	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	
LVET	Left ventricular ejection time (systole)	ms	Time	M-Mode	

PSLAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
LA	Left atrium	mm	Depth	M-Mode	
LA	Left atrium	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	
Ao Root	Aortic root	mm	Depth	M-Mode	
Ao Sinus	Aortic sinus	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast	

PSLAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				Mode Nonlinear Contrast Mode	
LVEEnL;d	Left Ventricular Endocardial Length (diastole)	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	
LVEEnL;s	Left Ventricular Endocardial Length (systole)	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast	

PSLAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				Mode Nonlinear Contrast Mode	
LV Trace	Two or four-wall trace of the LV systolic diameter			M-Mode AM-Mode EKV AM-Mode	
D;d	Diastolic diameter	mm	MLVArea	M-Mode AM-Mode EKV AM-Mode	
D;s	Systolic diameter	mm	MLVArea	M-Mode AM-Mode EKV AM-Mode	
V;s	Systolic volume	μL	MLVArea	M-Mode AM-Mode EKV AM-Mode	
V;d	Diastolic volume	μL	MLVArea	M-Mode AM-Mode	



### PSLAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				EKV AM-Mode	
SV	Stroke volume	μL	MLVArea	M-Mode AM-Mode EKV AM-Mode	
EF	Ejection fraction	%	MLVArea	M-Mode AM-Mode EKV AM-Mode	
FS	Fractional shortening	%	MLVArea	M-Mode AM-Mode EKV AM-Mode	
CO	Cardiac output	mL/min	MLVArea	M-Mode AM-Mode EKV AM-Mode	
LV Mass	LV Mass uncorrected <b>Note:</b> Available only for four walls.	mg	MLVArea	M-Mode AM-Mode EKV AM-Mode	

### PSLAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
LV Mass Cor	LV Mass corrected <div style="background-color: #002060; color: yellow; padding: 2px; border-radius: 5px; display: inline-block;"> <b>Note:</b> Available only for four walls.                 </div>	mg		M-Mode AM-Mode EKV AM-Mode	
HR	Heart Rate	BPM	MLVArea	M-Mode AM-Mode EKV AM-Mode	
ENDOmajr;d	Endocardial major in diastole	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	
ENDOmajr;s	Endocardial major in systole	mm	Length	EKV B-Mode	

PSLAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	
EPI:majr;d	Epicardial major in diastole	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	
EPI:majr;s	Epicardial major in systole	mm	Length	EKV B-Mode	

PSLAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	

PSLAX Protocol Calculation Definitions

Label	Description	Units	Formula
LV Vol;d	Left ventricle volume diastole (M-Mode)	μL	$\left( \frac{7.0}{2.4 + LVID;d} \right) \times LVID;d^3$
LV Vol;d	Left ventricle volume diastole (B-Mode)	μL	$\left( \frac{7.0}{2.4 + LVID;d} \right) \times LVID;d^3$
LV Vol;s	Left ventricle volume systole (M-Mode)	μL	$\left( \frac{7.0}{2.4 + LVID;s} \right) \times LVID;s^3$

PSLAX Protocol Calculation Definitions

Label	Description	Units	Formula
LV Vol;s	Left ventricle volume systole (B-Mode)	μL	$\left(\frac{7.0}{2.4 + LVID;s}\right) \times LVID;s^3$
EF	LV ejection fraction (M-Mode)	%	$100 \times \left(\frac{LV\ Vol;d - LV\ Vol;s}{LV\ Vol;d}\right)$
EF	LV ejection fraction (B-Mode)	%	$100 \times \left(\frac{LV\ Vol;d - LV\ Vol;s}{LV\ Vol;d}\right)$
FS	LV fractional shortening (M-Mode)	%	$100 \times \left(\frac{LVID;d - LVID;s}{LVID;d}\right)$
FS; diameter	LV fractional shortening (B-Mode)	%	$100 \times \left(\frac{LVID;d - LVID;s}{LVID;d}\right)$
FS; length	LV fractional shortening length (B-Mode)	%	$100 \times \left(\frac{LVEnL;d - LVEnL;s}{LVEnL;d}\right)$
LV Mass	LV mass uncorrected (M-Mode)	mg	$1.053 \times [(LVID;d + LVPW;d + IVS;d)^3 - LVID;d^3]$
LV Mass	LV mass uncorrected (B-Mode)	mg	$1.053 \times [(LVID;d + LVPW;d + IVS;d)^3 - LVID;d^3]$

PSLAX Protocol Calculation Definitions

Label	Description	Units	Formula
LV Mass (Corrected)	LV mass corrected (M-Mode)	mg	<i>LV Mass M-Mode</i> × 0.8
LV Mass (Corrected)	LV mass corrected (B-Mode)	mg	<i>LV Mass M-Mode</i> × 0.8
V;s (LV Trace)	Systolic volume parameter of PSLAX LV trace (B-Mode)	μL	The Average Systolic Volume in B-Mode (for long axis LV Trace) shall be based on the rotational volume of the LV trace at systole around the long axis line of the spline.  <b>Note:</b> Actual formula is not testable.
V;d (LV Trace)	Diastolic volume parameter of PSLAX LV trace (B-Mode)	μL	The Average Diastolic Volume in B-Mode (for long axis LV Trace) shall be based on the rotational volume of the LV trace at diastole around the long axis line of the spline.  <b>Note:</b> Actual formula is not testable.
SV (LV Trace)	Stroke volume parameter of PSLAX LV trace (B-Mode)	μL	<i>Diastolic Volume</i> – <i>Systolic Volume</i>

PSLAX Protocol Calculation Definitions

Label	Description	Units	Formula
EF (LV Trace)	Ejection fraction volume parameter of PSLAX LV trace (B-Mode)	%	$100 \times \left( \frac{\textit{Stroke Volume}}{\textit{Diastolic Volume}} \right)$
FS (LV Trace)	Fractional shortening volume parameter of PSLAX LV trace (B-Mode)	%	$100 \times \left( \frac{\textit{Average LVID;d} - \textit{Average LVID;s}}{\textit{Average LVID;d}} \right)$  where:  <i>LVID</i> is a long axis line length that extends from the base to the farthest extent of the spline
CO (LV Trace)	Cardiac output volume parameter of PSLAX LV trace (B-Mode)	mL/min	$\textit{Stroke Volume} \times \left( \frac{\textit{Heart Rate at the first frame drawn}}{1000} \right)$
Area;d (LV Trace)	Diastolic area parameter of PSLAX LV trace (B-Mode)	mm <sup>2</sup>	Average of all the Diastolic Areas
Area;s (LV Trace)	Systolic area parameter of PSLAX LV trace (B-Mode)	mm <sup>2</sup>	Average of all the Systolic Areas

PSLAX Protocol Calculation Definitions

Label	Description	Units	Formula
Endocardial FS	Fractional shortening (B-Mode)	%	$100 \times \left( \frac{END_{major;d} - END_{major;s}}{END_{major;d}} \right)$ <p><b>Note:</b> Each of the above measurements are from B-Mode.</p>
V;s (LV Trace)	Systolic volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	μL	$\frac{7.0}{(2.4 + ASD) \times ASD^3}$ <p>where: <i>ASD</i> is <i>Average Systolic Diameter</i></p> <p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
V;d (LV Trace)	Diastolic volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	μL	$\frac{7.0}{(2.4 + ASD) \times ASD^3}$ <p>where: <i>ASD</i> is <i>Average Systolic Diameter</i></p>



PSLAX Protocol Calculation Definitions

Label	Description	Units	Formula
			<p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
SV (LV Trace)	Stroke volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	μL	<p><i>Diastolic Volume</i> – <i>Systolic Volume</i></p> <p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
EF (LV Trace)	Ejection fraction volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	%	$100 \times \left( \frac{\text{Stroke Volume}}{\text{Diastolic Volume}} \right)$ <p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
FS (LV Trace)	Fractional shortening volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	%	$100 \times \left( \frac{\text{Average } D;d - \text{Average } D;s}{\text{Average } D;d} \right)$ <p>where:</p> <p><i>D;d</i> is <i>Diameter (diastole)</i> and <i>D;s</i> is <i>Diameter (systole)</i></p>

PSLAX Protocol Calculation Definitions

Label	Description	Units	Formula
			<p><b>Note:</b> Each of the above input values are from the appropriate mode</p>
CO (LV Trace)	Cardiac output volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	mL/min	$\textit{Stroke Volume} \times \left( \frac{\textit{Heart Rate at the first frame drawn}}{1000} \right)$ <p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
LV Mass (LV Trace)	LV Mass Uncorrected parameter of LV Mass LV trace  <p><b>Note:</b> Available only with 4 wall trace (M-Mode and AM-Mode).</p>	mg	$1.053 \times [(\textit{AdD at outer wall})^3 - (\textit{AdD at inner wall})^3]$ <p>where:</p> <p><i>AdD</i> is <i>Average diastolic Diameter</i></p> <p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
LV Mass Corr (LV Trace)	LV Mass Corrected parameter of LV Mass LV trace	mg	$0.8 \times \textit{LV Mass LV Trace}$ <p>That is, uncorrected <i>LV Mass</i> x 0.8.</p>

PSLAX Protocol Calculation Definitions

Label	Description	Units	Formula
	<p><b>Note:</b> Available only with 4 wall trace (M-Mode and AM-Mode).</p>		<p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
Diameter;d (LV Trace)	Diastolic Area parameter of LV Mass LV trace (M-Mode and AM-Mode)	mm	<p>Average of all the Diastolic Diameters</p> <p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
Diameter;s (LV Trace)	Systolic Area parameter of LV Mass LV trace (M-Mode and AM-Mode)	mm	<p>Average of all the Systolic Diameters</p> <p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>

SAX

SAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
LV Trace	SAX LV trace - short axis area	mm <sup>2</sup>	BLVArea	EKV B-Mode	
A	LV trace area	mm <sup>2</sup>	BLVArea	EKV B-Mode	
A;s	Systolic area	mm <sup>2</sup>	BLVArea	EKV B-Mode	
A;d	Diastolic area	mm <sup>2</sup>	BLVArea	EKV B-Mode	
FAC	Fractional area change	%	BLVArea	EKV B-Mode	
HR	Heart Rate	BPM	BLVArea	EKV B-Mode	

### SAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
IVS;d	Inter ventricular septum (diastole)	mm	Depth	M-Mode	LVID;d
IVS;d	Inter ventricular septum (diastole)	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	LVID;d
LVAW;d	Left ventricular anterior wall (diastole)	mm	Depth	M-Mode	
LVID;d	Left ventricular internal diameter (diastole)	mm	Depth	M-Mode	LVPW;d
LVID;d	Left ventricular internal diameter (diastole)	mm	Length	EKV B-Mode Color Doppler	LVPW;d

SAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	
LVPW;d	Left ventricular posterior wall (diastole)	mm	Depth	M-Mode	
LVPW;d	Left ventricular posterior wall (diastole)	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	

### SAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
IVS;s	Interventricular septum	mm	Depth	M-Mode	LVID;s
IVS;s	Interventricular septum	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	LVID;s
LVAW;s	Left ventricular anterior wall (systole)	mm	Depth	M-Mode	
LVID;s	Left ventricular internal diameter (systole)	mm	Depth	M-Mode	LVPW;s
LVID;s	Left ventricular internal diameter (systole)	mm	Length	EKV B-Mode Color Doppler	LVPW;s

SAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	
LVPW;s	Left ventricular posterior wall (systole)	mm	Depth	M-Mode	
LVPW;s	Left ventricular posterior wall (systole)	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	



### SAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
LV Trace	Two or Four wall trace of the LV systolic and diastolic diameter		MLVarea	M-Mode AM-Mode EKV AM-Mode	
D;d	Diastolic diameter	mm	MLVArea	M-Mode AM-Mode EKV AM-Mode	
D;s	Systolic diameter	mm	MLVArea	M-Mode AM-Mode EKV AM-Mode	
V;s	Systolic volume	μL	MLVArea	M-Mode AM-Mode EKV AM-Mode	
V;d	Diastolic volume	μL	MLVArea	M-Mode AM-Mode EKV AM-Mode	
SV	Stroke volume	μL	MLVArea	M-Mode	

### SAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				AM-Mode EKV AM-Mode	
EF	Ejection fraction	%	MLVArea	M-Mode AM-Mode EKV AM-Mode	
FS	Fractional shortening	%	MLVArea	M-Mode AM-Mode EKV AM-Mode	
CO	Cardiac output	mL/min	MLVArea	M-Mode AM-Mode EKV AM-Mode	
LV Mass	LV Mass Uncorrected	mg	MLVArea	M-Mode AM-Mode EKV AM-Mode	
LV Mass Cor	LV Mass corrected	mg	MLVArea	M-Mode AM-Mode	

SAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				EKV AM-Mode	
ENDOarea;d	Endocardial area in diastole	mm <sup>2</sup>	Area	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	
ENDOarea;s	Endocardial area in systole	mm <sup>2</sup>	Area	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode	

SAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				Nonlinear Contrast Mode	
EPIarea;d	Epicardial area in diastole	mm <sup>2</sup>	Area	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode	
EPIarea;s	Epicardial area in systole	mm <sup>2</sup>	Area	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast	

### SAX Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
				Mode Nonlinear Contrast Mode	

### SAX Protocol Calculation Definitions

Label	Description	Units	Formula
LV Vol;d	Left ventricle volume diastole (M-Mode)	μL	$\left( \frac{7.0}{2.4 + LVID;d} \right) \times LVID;d^3$
LV Vol;d	Left ventricle volume diastole (B-Mode)	μL	$\left( \frac{7.0}{2.4 + LVID;d} \right) \times LVID;d^3$  <b>Note:</b> Only if legacy calculations is checked.
LV Vol;s	Left ventricle volume systole (M-Mode)	μL	$\left( \frac{7.0}{2.4 + LVID;s} \right) \times LVID;s^3$
LV Vol;s	Left ventricle volume systole (B-Mode)	μL	$\left( \frac{7.0}{2.4 + LVID;s} \right) \times LVID;s^3$

SAX Protocol Calculation Definitions

Label	Description	Units	Formula
			<b>Note:</b> Only if legacy calculations is checked.
EF	LV ejection fraction (M-Mode)	%	$100 \times \left( \frac{LV\ Vol;d - LV\ Vol;s}{LV\ Vol;d} \right)$
EF	LV ejection fraction (B-Mode)	%	$100 \times \left( \frac{LV\ Vol;d - LV\ Vol;s}{LV\ Vol;d} \right)$ <b>Note:</b> Only if legacy calculations is checked.
FS	LV fractional shortening (M-Mode)	%	$100 \times \left( \frac{LVID;d - LVID;s}{LVID;d} \right)$
FS	LV fractional shortening (B-Mode)	%	$100 \times \left( \frac{LVID;d - LVID;s}{LVID;d} \right)$ <b>Note:</b> Only if legacy calculations is checked.
LV Mass	LV mass uncorrected (M-Mode)	mg	$1.053 \times [(LVID;d + LVPW;d + IVS;d)^3 - LVID;d^3]$

SAX Protocol Calculation Definitions

Label	Description	Units	Formula
LV Mass	LV mass uncorrected (B-Mode)	mg	$1.053 \times [(LVID;d + LVPW;d + IVS;d)^3 - LVID;d^3]$ <p><b>Note:</b> Only if legacy calculations is checked.</p>
LV Mass (Corrected)	LV mass corrected (M-Mode)	mg	$LV\ Mass\ M-Mode \times 0.8$
LV Mass (Corrected)	LV mass corrected (B-Mode)	mg	$LV\ Mass\ M-Mode \times 0.8$ <p><b>Note:</b> Only if legacy calculations is checked.</p>
LV Mass AW	LV Mass AW Uncorrected (M-Mode)	mg	$1.053 \times [(LVID;d + LVPW;d + LVAW;d)^3 - LVID;d^3]$
LV Mass AW (Corrected)	LV Mass AW corrected (M-Mode)	mg	$LV\ Mass\ AW\ M-Mode \times 0.8$
Area;d (LV Trace)	Diastolic Area parameter of SAX LV trace (B-Mode)	mm <sup>2</sup>	Average of all the Diastolic Areas

SAX Protocol Calculation Definitions

Label	Description	Units	Formula
Area;s (LV Trace)	Systolic Area parameter of SAX LV trace (B-Mode)	mm <sup>2</sup>	Average of all the Systolic Areas
FAC (LV Trace)	Fractional area change parameter of SAX LV trace (B-Mode)	%	$100 \times \left( \frac{LV\ Trace\ Area;d - LV\ Trace\ Area;s}{LV\ Trace\ Area;d} \right)$
Endocardial Volume;d	Endocardial volume in diastole (B-Mode)	μL	$\frac{5}{6} \times ENDmajor;d \times ENDarea;d$  <b>Note:</b> The 'ENDmajor;d' measurement has to be made in the PSLAX protocol.
Endocardial Volume;s	Endocardial volume in systole (B-Mode)	μL	$\frac{5}{6} \times ENDmajor;s \times ENDarea;s$  <b>Note:</b> The 'ENDmajor;s' measurement has to be made in the PSLAX protocol.
Endocardial SV	Stroke volume (B-Mode)	μL	$Endocardial\ Volume;d - Endocardial\ Volume;s$



SAX Protocol Calculation Definitions

Label	Description	Units	Formula
Endocardial EF	Percent ejection fraction (B-Mode)	%	$100 \times \left( \frac{\text{Endocardial SV}}{\text{Endocardial Vol;d}} \right)$
Endocardial FAC	Percent fractional area change (B-Mode)	%	$100 \times \left( \frac{\text{ENDarea;d} - \text{ENDarea;s}}{\text{ENDarea;d}} \right)$
Endocardial Area Change	Area change (B-Mode)	mm <sup>2</sup>	$\text{ENDarea;d} - \text{ENDarea;s}$
Endocardial CO	Cardiac output (B-Mode)	mL/min	$\frac{\text{Endocardial SV} \times \text{Heart Rate}}{1000}$  <b>Note:</b> Heart Rate is additional parameter for ENDmajor;d measurement.
Endocardial FS	Fractional shortening (B-Mode)	%	$100 \times \left( \frac{\text{ENDmajor;d} - \text{ENDmajor;s}}{\text{ENDmajor;d}} \right)$  <b>Note:</b> Each of the above measurements are made in PSLAX protocol in B-Mode.

SAX Protocol Calculation Definitions

Label	Description	Units	Formula
a;d	Average LV epicardial radius in diastole (B-Mode)	mm	$\sqrt{\frac{EPIarea;d}{\pi}}$
b;d	Average LV endocardial radius in diastole (B-Mode)	mm	$\sqrt{\frac{ENDarea;d}{\pi}}$
T;d	Average wall thickness (B-Mode)	mm	$a - b$
LV Mass;d	LV Mass (B-Mode)	mg	$1.05 \times \left[ \left( \frac{5}{6} \times EPIarea;d \times (EPImajor;d + T;d) \right) - \left( \frac{5}{6} \times ENDarea;d \times ENDmajor;d \right) \right]$
V;s (LV Trace)	Systolic volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	μL	$\frac{7.0}{(2.4 + ASD) \times (ASD)^3}$ where: <i>ASD</i> is <i>Average Systolic Diameter</i>

SAX Protocol Calculation Definitions

Label	Description	Units	Formula
			<p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
V;d (LV Trace)	Diastolic volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	μL	$\frac{7.0}{(2.4 + ADD) \times (ADD)^3}$ <p>where:</p> <p><i>ADD</i> is <i>Average Diastolic Diameter</i></p> <p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
SV (LV Trace)	Stroke volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	μL	<p><i>Diastolic Volume</i> – <i>Systolic Volume</i></p> <p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
EF (LV Trace)	Ejection fraction volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	%	$100 \times \left( \frac{\textit{Stroke Volume}}{\textit{Diastolic Volume}} \right)$

SAX Protocol Calculation Definitions

Label	Description	Units	Formula
			<p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
FS (LV Trace)	Fractional shortening volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	%	$100 \times \left( \frac{\text{Average } D;d - \text{Average } D;s}{\text{Average } D;d} \right)$ <p>where:</p> <p><i>D;d</i> is <i>Diameter (diastole)</i> and <i>D;s</i> is <i>Diameter (systole)</i></p> <p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
CO (LV Trace)	Cardiac output volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	mL/min	$\frac{\text{Stroke Volume} \times \text{Heart Rate at the first point drawn}}{1000}$ <p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
LV Mass (LV Trace)	LV Mass Uncorrected parameter of LV Mass LV trace	mg	$1.053 \times [(\text{ADD at outer wall})^3 - (\text{ADD at inner wall})^3]$ <p>where:</p>

SAX Protocol Calculation Definitions

Label	Description	Units	Formula
	<p><b>Note:</b> Available only with a 4 wall trace (M-Mode and AM-Mode).</p>		<p><i>ADD</i> is <i>Average Diastolic Diameter</i></p> <p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
LV Mass Corr (LV Trace)	<p>LV Mass Corrected parameter of LV Mass LV trace</p> <p><b>Note:</b> Available only with a 4 wall trace (M-Mode and AM-Mode).</p>	mg	<p><math>0.8 \times \text{LV Mass LV Trace}</math></p> <p>That is, uncorrected <i>LV Mass</i> <math>\times 0.8</math></p> <p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
Diameter;d (LV Trace)	<p>Diastolic Area parameter of LV Mass LV trace (M-Mode and AM-Mode)</p>	mm	<p>Average of all the Diastolic Diameters</p> <p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>
Diameter;s (LV Trace)	<p>Systolic Area parameter of LV Mass LV trace (M-Mode)</p>	mm	<p>Average of all the Systolic Diameters</p>

### SAX Protocol Calculation Definitions

Label	Description	Units	Formula
	and AM-Mode)		<p><b>Note:</b> Each of the above input values are from the appropriate mode.</p>

### Anatomical M-Mode

#### Anatomical M-Mode Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
IVS;d	Inter ventricular septum (diastole)	mm	Depth	AM-Mode EKV AM-Mode	LVID;d
LVAW;d	Left ventricular anterior wall (diastole)	mm	Depth	AM-Mode EKV AM-Mode	LVID;d
LVID;d	Left ventricular internal diameter (diastole)	mm	Depth	AM-Mode EKV AM-Mode	LW;d
LW;d	Left ventricular lateral wall (diastole)	mm	Depth	AM-Mode EKV AM-Mode	

### Anatomical M-Mode Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode	Chain
IVS;s	Inter ventricular septum (systole)	mm	Depth	AM-Mode EKV AM-Mode	LVID;s
LVAW;s	Left ventricular anterior wall (systole)	mm	Depth	AM-Mode EKV AM-Mode	LVID;s
LVID;s	Left ventricular internal diameter (systole)	mm	Depth	AM-Mode EKV AM-Mode	LW;s
LW;s	Left ventricular lateral wall (systole)	mm	Depth	AM-Mode EKV AM-Mode	

### Anatomical M-Mode Protocol Calculation Definitions

Label	Description	Units	Formula
LV Vol;d	Left ventricle volume diastole (AM-Mode)	μL	$\left( \frac{7.0}{2.4 + LVID;d} \right) \times LVID;d^3$
LV Vol;s	Left ventricle volume systole (AM-Mode)	μL	$\left( \frac{7.0}{2.4 + LVID;s} \right) \times LVID;s^3$

Anatomical M-Mode Protocol Calculation Definitions

Label	Description	Units	Formula
LV EF	LV ejection fraction (AM-Mode)	%	$100 \times \left( \frac{LV\ Vol;d - LV\ Vol;s}{LV\ Vol;d} \right)$
LV FS	LV Fractional Shortening (AM-Mode)	%	$100 \times \left( \frac{LVID;d - LVID;s}{LVID;d} \right)$
LV Mass	LV Mass Uncorrected (AM-Mode)	mg	$1.053 \times [(LVID;d + LW;d + IVS;d)^3 - LVID;d^3]$
LV Mass Corr.	LV Mass corrected (AM-Mode)	mg	<i>AM-Mode LV Mass</i> × 0.8
LV Mass AW	LV Mass AW Uncorrected (AM-Mode)	mg	$1.053 \times [(LVID;d + LW;d + LVAW;d)^3 - LVID;d^3]$
LV Mass AW Corr.	LV Mass AW corrected (AM-Mode)	mg	<i>LV Mass AW AM-Mode</i> × 0.8



## Simpson's

Simpson's Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
SimpAreaDist;d	Simpson's area distal, diastole	mm <sup>2</sup>	Area	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
SimpArea Mid;d	Simpson's area mid, diastole	mm <sup>2</sup>	Area	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
SimpAreaProx;d	Simpson's area proximal, diastole	mm <sup>2</sup>	Area	EKV B-Mode Color Doppler Mode Power Doppler Mode

### Simpson's Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Linear Contrast Mode Nonlinear Contrast Mode
SimpLength;d	Simpson's length, diastole	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
SimpAreaDist;s	Simpson's area distal, systole	mm <sup>2</sup>	Area	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
SimpAreaMid;s	Simpson's area mid, systole	mm <sup>2</sup>	Area	EKV B-Mode Color Doppler Mode Power Doppler Mode

### Simpson's Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Linear Contrast Mode Nonlinear Contrast Mode
SimpAreaProx;s	Simpson's area proximal, systole	mm <sup>2</sup>	Area	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
SimpLength;s	Simpson's length, systole	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode

Simpson's Protocol Calculation Definitions

Label	Description	Units	Formula
Simp Volume;d	Simpson's volume calculation in diastole	μL	$(\mathit{Simp\ Area\ Dist;d} + \mathit{Simp\ Area\ Mid;d} + \mathit{Simp\ Area\ Prox;d}) \times \frac{h}{3}$ <p>Where:</p> $h = \mathit{Simpson\ Length\ in\ diastole}$
Simp Volume;s	Simpson's volume calculation in systole	μL	$(\mathit{Simp\ Area\ Dist;s} + \mathit{Simp\ Area\ Mid;s} + \mathit{Simp\ Area\ Prox;s}) \times \frac{h}{3}$ <p>Where:</p> $h = \mathit{Simpson\ Length\ in\ systole}$
Simp SV	Stroke Volume	μL	$\mathit{Simp\ Volume;d} - \mathit{Simp\ Volume;s}$ <p>Simp Volume;d - Simp Volume;s</p>
Simp FAC	Fraction area change	%	$100 \times \left( \frac{\mathit{Simp\ Area\ Mid;d} - \mathit{Simp\ Area\ Mid;s}}{\mathit{Simp\ Area\ Mid;d}} \right)$
Simp EF	Ejection fraction	%	$100 \times \left( \frac{\mathit{Simp\ SV}}{\mathit{Simp\ Volume;d}} \right)$

### Simpson's Protocol Calculation Definitions

Label	Description	Units	Formula
Simp FS	Fractional shortening	%	$100 \times \left( \frac{\text{Simp Length;d} - \text{Simp Length;s}}{\text{Simp Length;d}} \right)$
Simp CO	Cardiac output	mL/min	$\frac{\text{Simp SV} \times \text{Heart Rate}}{1000}$

### ARCH

#### ARCH Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Asc Ao	Ascending aorta length	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Trans Arch	Transverse aortic arch diameter	mm	Length	EKV B-Mode Color Doppler Mode

### ARCH Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Desc Ao	Descending aorta diameter	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode

### AoV Flow

#### AoV Flow Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LVOT	Left ventricular outflow tract length	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode

### AoV Flow Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Nonlinear Contrast Mode
AoV diam	Ascending Aorta diameter	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LVOT VTI	LVOT velocity time integral	mm	VTI	PW Doppler Mode
Mean Vel	LVOT mean velocity	mm/s	VTI	PW Doppler Mode
Mean Grad	LVOT mean pressure gradient	mmHg	VTI	PW Doppler Mode
Peak Vel	LVOT peak velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	LVOT peak pressure gradient	mmHg	VTI	PW Doppler Mode
Cycles	LVOT cycles	(none)	VTI	PW Doppler Mode

### AoV Flow Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
AV Peak Vel	Aortic valve peak velocity	mm/s	Vertical Velocity	PW Doppler Mode
AoV VTI	Aorta velocity time integral	mm	VTI	PW Doppler Mode
Mean Vel	Aorta mean velocity	mm/s	VTI	PW Doppler Mode
Mean Grad	Aorta mean pressure gradient	mmHg	VTI	PW Doppler Mode
Peak Vel	Aorta peak velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Aorta peak pressure gradient	mmHg	VTI	PW Doppler Mode
Cycles	Aorta cycles	(none)	VTI	PW Doppler Mode
Desc Ao Vel	Descending Aorta peak velocity	mm/s	Vertical Velocity	PW Doppler Mode
AI PHT	Aortic insufficiency deceleration	mm/s <sup>2</sup>	Acceleration	PW Doppler Mode
T	Aortic insufficiency half time	ms	Time	PW Doppler Mode
Desc Ao Vp	Descending Aorta Velocity time integral, proximal	mm	VTI	PW Doppler Mode



### AoV Flow Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Mean Vel	Descending Aorta mean velocity, proximal	mm/s	VTI	PW Doppler Mode
Mean Grad	Descending Aorta mean pressure gradient, proximal	mmHg	VTI	PW Doppler Mode
Peak Vel	Descending Aorta peak velocity, proximal	mm/s	VTI	PW Doppler Mode
Peak Grad	Descending Aorta peak pressure gradient, proximal	mmHg	VTI	PW Doppler Mode
Cycles	Descending Aorta cycles, proximal	(none)	VTI	PW Doppler Mode
Desc Ao Vd	Descending Aorta Velocity time integral, distal	mm	VTI	PW Doppler Mode
Mean Vel	Descending Aorta mean velocity, distal	mm/s	VTI	PW Doppler Mode
Mean Grad	Descending Aorta mean pressure gradient, distal	mmHg	VTI	PW Doppler Mode
Peak Vel	Descending Aorta peak velocity, distal	mm/s	VTI	PW Doppler Mode
Peak Grad	Descending Aorta peak pressure gradient,	mmHg	VTI	PW Doppler Mode

### AoV Flow Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
	distal			
Cycles	Descending Aorta cycles, distal	(none)	VTI	PW Doppler Mode
AAT	Aortic acceleration time	ms	Time	PW Doppler Mode
AET	Aortic ejection time	ms	Time	PW Doppler Mode

**Note:** Input frame mode measurements are from B-Mode only.

### AoV Flow Protocol Calculation Definitions

Label	Description	Units	Formula
AV Peak Press	Aortic valve peak pressure gradient	mmHg	$4 \times \left( \frac{AV \text{ Peak Vel}}{1000} \right)^2$
LVOT SV	Stroke volume	$\mu\text{L}$	$0.785 \times LVOT^2 \times LVOT VTI$
LVOT CO	Cardiac output	mL/min	$\frac{LVOT SV \times \text{Heart Rate from LVOT}}{1000}$

### AoV Flow Protocol Calculation Definitions

Label	Description	Units	Formula
AVA	Aortic valve area	mm <sup>2</sup>	$\frac{\left(\frac{LVOT}{2}\right)^2 \times \pi \times LVOT VTI Peak Vel}{AV Peak Vel}$
AoV SV	Stroke volume	μL	$0.785 \times AoV Diameter^2 \times AoV VTI$
AoV CO	Cardiac output	mL/min	$\frac{AoV SV \times Heart Rate from AoV diameter}{1000}$
AAT/AET	Aortic acceleration time to ejection time ratio		$\frac{AAT}{AET}$

### MV Flow

#### MV Flow Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
MV VTI	Mitral valve velocity time integral	mm	VTI	PW Doppler Mode
Mean Vel	Mitral valve mean velocity	mm/s	VTI	PW Doppler Mode
Mean Grad	Mitral valve mean pressure gradient	mmHg	VTI	PW Doppler Mode

### MV Flow Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Peak Vel	Mitral valve peak velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Mitral valve peak pressure gradient	mmHg	VTI	PW Doppler Mode
Cycles	Mitral valve cycles	(none)	VTI	PW Doppler Mode
MV E	Mitral valve E velocity	mm/s	Vertical Velocity	PW Doppler Mode
MV A	Mitral valve A velocity	mm/s	Vertical Velocity	PW Doppler Mode
MV PHT	Mitral valve pressure half time	mm/s <sup>2</sup>	Acceleration	PW Doppler Mode
T	Mitral valve pressure half time	ms	Time	PW Doppler Mode
MV Decel	E wave deceleration time	mm/s <sup>2</sup>		PW Doppler Mode
T	E wave deceleration time	ms	Time	PW Doppler Mode
IVRT	Isovolumic relaxation time	ms	Time	PW Doppler Mode PW Tissue Doppler Mode
IVCT	Isovolumic contraction time	ms	Time	PW Doppler Mode

### MV Flow Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				PW Tissue Doppler Mode
MV ET	Mitral valve ejection time	ms	Time	PW Doppler Mode
NFT	Non-filling time	ms	Time	PW Doppler Mode
AET	Aortic ejection Time	ms	Time	PW Doppler Mode
E'	Velocity at E'	mm/s	Velocity	PW Tissue Doppler Mode
A'	Velocity at A	mm/s	Velocity	PW Tissue Doppler Mode
ET	Ejection Time	ms	Time	PW Tissue Doppler Mode
MV LW E'	Mitral Valve Velocity at E'	mm/s	Velocity	PW Tissue Doppler Mode
MV LW A'	Mitral Valve Velocity at A'	mm/s	Velocity	PW Tissue Doppler Mode
MV IVS E'	Mitral Valve IVS Velocity at E'	mm/s	Velocity	PW Tissue Doppler Mode
MV IVS A'	Mitral Valve IVS Velocity at A'	mm/s	Velocity	PW Tissue Doppler Mode
S WAVE	Sound wave	mm/s	Velocity	PW Tissue Doppler Mode

### MV Flow Protocol Calculation Definitions

Label	Description	Units	Formula
MV E/A	Mitral valve E to A ratio (PW Doppler Mode)		$\frac{MV E}{MV A}$
MV Area	MV area (PW Doppler Mode)	mm <sup>2</sup>	$\frac{220}{MV PHT \text{ in time}}$
LV MPI NFT	Left ventricle Myocardial performance index (PW Doppler Mode)		$\frac{NFT - AET}{AET}$  <b>Note:</b> The input values are from PW Doppler Mode
LV MPI IV	Left ventricle Myocardial performance index (PW Doppler Mode)		$\frac{IVRT + IVCT}{AET}$
E'/A'	Ratio of E' velocity to A' velocity (PW Tissue Doppler Mode)		$\frac{E'}{A'}$
A'/E'	Ratio of A' velocity to E' velocity (PW Tissue Doppler Mode)		$\frac{A'}{E'}$

### MV Flow Protocol Calculation Definitions

Label	Description	Units	Formula
MV E/E'	Ratio of MV E velocity to E' velocity (PW Tissue Doppler Mode)		$\frac{MV E'}{E'}$ <div style="background-color: #1a3d4d; color: white; padding: 5px; border-radius: 5px; margin-top: 10px;"> <p><b>Note:</b> MV E is from PW Doppler Mode; E' is from PW Tissue Doppler Mode</p> </div>
MV LW E'/A'	Ratio of E' velocity to A' velocity (PW Tissue Doppler Mode)		$\frac{MV LW E'}{MV LW A'}$
MV LW A'/E'	Ratio of A' velocity to E' velocity (PW Tissue Doppler Mode)		$\frac{MV LW A'}{MV LW E'}$
MV IVS E'/A'	Ratio of E' velocity to A' velocity (PW Tissue Doppler Mode)		$\frac{MV IVS E'}{MV IVS A'}$
MV IVS A'/E'	Ratio of A' velocity to E' velocity (PW Tissue Doppler Mode)		$\frac{MV IVS A'}{MV IVS E'}$
MV PHT (simplified)	MV PHT (simplified) (PW Doppler Mode)	ms	$0.29 \times MV Decel\ in\ time$
MV Area (simplified)	MV Area (simplified) (PW Doppler Mode)	mm <sup>2</sup>	$\frac{759}{MV Decel\ in\ time}$

RV and PV Function

RV and PV Function Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
RVOT	Right ventricular outflow tract length	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RVOT VTI				PW Doppler Mode
VTI	RVOT VTI	mm	VTI	PW Doppler Mode
Mean Vel	RVOT mean velocity	mm/s	VTI	PW Doppler Mode



### RV and PV Function Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Mean Grad	RVOT mean pressure gradient	mmHg	VTI	PW Doppler Mode
Peak Vel	RVOT peak velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	RVOT peak pressure gradient	mmHg	VTI	PW Doppler Mode
Cycles	RVOT cycles		VTI	PW Doppler Mode
PV VTI				PW Doppler Mode
VTI	Pulmonary Valve Velocity time integral	mm	VTI	PW Doppler Mode
Mean Vel	Pulmonary Valve mean velocity	mm/s	VTI	PW Doppler Mode
Mean Grad	Pulmonary Valve mean pressure gradient	mmHg	VTI	PW Doppler Mode
Peak Vel	Pulmonary Valve peak velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Pulmonary Valve peak pressure gradient	mmHg	VTI	PW Doppler Mode
Cycles	Pulmonary Valve cycles		VTI	PW Doppler Mode

### RV and PV Function Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
PVdiam	Pulmonary Valve Diameter <div style="background-color: #002060; color: white; padding: 5px; border-radius: 5px; margin-top: 10px;"> <b>Note:</b> Calculations based on PVdiam values using are only available in B-Mode.                     </div>	mm	Length	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
PA VTI				PW Doppler Mode
VTI	Pulmonary Artery velocity time integral	mm	VTI	PW Doppler Mode
Mean Vel	Pulmonary Artery mean velocity	mm/s	VTI	PW Doppler Mode
Mean Grad	Pulmonary Artery mean pressure gradient	mmHg	VTI	PW Doppler Mode
Peak Vel	Pulmonary Artery peak velocity	mm/s	VTI	PW Doppler Mode

### RV and PV Function Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Peak Grad	Pulmonary Artery peak pressure gradient	mmHg	VTI	PW Doppler Mode
Cycles	Pulmonary Artery cycles		VTI	PW Doppler Mode
PV Peak Vel	Pulmonary Valve peak velocity	mm/s	Velocity	PW Doppler Mode
PR Peak Vel	Pulmonary Regurgitation peak velocity	mm/s	Velocity	PW Doppler Mode
PAT	Pulmonary Acceleration Time	ms	Time	PW Doppler Mode
PET	Pulmonary Ejection Time	ms	Time	PW Doppler Mode
IVCT;r	Isovolumic contraction time (right ventricle)	ms	Time	PW Doppler Mode
IVRT;r	Isovolumic relaxation time (right ventricle)	ms	Time	PW Doppler Mode
NFT;r	Non-filling time (right ventricle)	ms	Time	PW Doppler Mode

**Note:** Input frame mode measurements are from B-Mode only.

RV and PV Function Protocol Calculation Definitions

Label	Description	Units	Formula
PV SV	Pulmonary valve stroke volume	μL	$0.785 \times PVdiam^2 \times PV VTI$
PV CO	Pulmonary valve cardiac output	mL/min	$\frac{PV SV \times Heart Rate from PV diameter}{1000}$
PVA	Pulmonary Valve Area	mm <sup>2</sup>	$\frac{\left(\frac{RVOT}{2}\right)^2 \times \pi \times RVOT VTI Peak Vel}{PV VTI Peak Vel}$
RVOT SV	Right ventricle Stroke volume	μL	$0.785 \times RVOT^2 \times RVOT VTI$
RVOT CO	Right ventricle Cardiac Output	mL/min	$\frac{RVOT SV \times Heart Rate from RVOT}{1000}$
PV Peak Pressure	Pulmonary valve peak gradient	mmHg	$4 \times \left(\frac{PV Peak Vel}{1000}\right)^2$
RV MPI NFT	Right ventricle Myocardial performance index		$\frac{NFT;r - PET}{PET}$
RV MPI IV	Right ventricle Myocardial performance index		$\frac{IVRT;r + IVCT;r}{PET}$

### RV and PV Function Protocol Calculation Definitions

Label	Description	Units	Formula
PAT/PET	Pulmonary acceleration time to ejection time ratio		$\frac{PAT}{PET}$
MPAP (common)	Mean pulmonary artery pressure	mmHg	$79 - (0.45 \times PAT)$
MPAP (PAT < 120 ms)	Mean pulmonary artery pressure	mmHg	$90 - (0.62 \times PAT)$

### TV Flow

#### TV Flow Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
TV VTI	Tricuspid Velocity time integral	mm	VTI	PW Doppler Mode
Mean Vel	Tricuspid mean velocity	mm/s	VTI	PW Doppler Mode
Mean Grad	Tricuspid mean pressure gradient	mmHg	VTI	PW Doppler Mode
Peak Vel	Tricuspid peak velocity	mm/s	VTI	PW Doppler Mode

### TV Flow Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Peak Grad	Tricuspid peak pressure gradient	mmHg	VTI	PW Doppler Mode
Cycles	Tricuspid cycles	(none)	VTI	PW Doppler Mode
TV E	Tricuspid valve E wave velocity	mm/s	Vertical Velocity	PW Doppler Mode
TV A	Tricuspid valve A wave velocity	mm/s	Vertical Velocity	PW Doppler Mode
TR Peak Vel	Tricuspid regurgitation peak velocity	mm/s	Vertical Velocity	PW Doppler Mode
TV LW E'	Tricuspid Valve Velocity at E'	mm/s	Velocity	PW Tissue Doppler Mode
TV LW A'	Tricuspid Valve Velocity at A'	mm/s	Velocity	PW Tissue Doppler Mode

### TV Flow Protocol Calculation Definitions

Label	Description	Units	Formula
TV Peak Press	Tricuspid Valve Peak Pressure Gradient	mmHg	$4 \times \left( \frac{TV\ VTI, Tricuspid\ Peak\ Vel}{1000} \right)^2$

TV Flow Protocol Calculation Definitions

Label	Description	Units	Formula
TV E/A	Ratio of tricuspid valve E to A	N/A	$\frac{TV\ E}{TV\ A}$
TV LW E'/A'	Ratio of Velocity on Tricuspid Valve Lateral Wall	N/A	$\frac{TV\ LW\ E'}{TV\ LW\ A'}$
TV LW A'/E'	Ratio of Velocity on Tricuspid Valve Lateral Wall	N/A	$\frac{TV\ LW\ A'}{TV\ LW\ E'}$

## Embryology Measurement Package

This section provides the measurements and calculations information for the Protocols in the Embryology Measurement Package.

"Uterine Horn" below

"Placenta" on page 771

### Uterine Horn

Uterine Horn Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
UA Vel	Umbilical artery velocity	mm/s	Velocity	PW Doppler Mode
UA Diam	Umbilical artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
UA Diam	Umbilical artery diameter	mm	Depth	M-Mode



### Uterine Horn Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				AM-Mode EKV AM-Mode
UV Vel	Umbilical vein velocity	mm/s	Velocity	PW Doppler
UV Diam	Umbilical vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
UV Diam	Umbilical vein diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
VA Vel	Vitelline artery velocity	mm/s	Velocity	PW Doppler
VA Diam	Vitelline artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode

### Uterine Horn Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
VA Diam	Vitelline artery diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
W Vel	Vitelline vein velocity	mm/s	Velocity	PW Doppler
W Diam	Vitelline vein diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
W Diam	Vitelline vein diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode

## Placenta

Placenta Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Placenta Sag	Sagittal length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Placenta Trans	Transverse length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode

## Ophthalmology Measurement Package

This section provides the measurements and calculations information for the Protocols in the Ophthalmology Measurement Package.

"Ophthalmology" below

### Ophthalmology

Ophthalmology Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Lens Length	Lens length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Lens Area	Lens area	mm <sup>2</sup>	Polygon	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode

### Ophthalmology Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Nonlinear Contrast Mode
Lens Curvature	Lens curvature	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Lens Radius	Lens radius	mm	Radius	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Anterior Chamber Area	Anterior chamber area	mm <sup>2</sup>	Polygon	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode

### Ophthalmology Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Nonlinear Contrast Mode
Cornea Length	Cornea length	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Choroid Thickness	Choroid thickness	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Sclera Thickness	Sclera thickness	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode

### Ophthalmology Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Nonlinear Contrast Mode
Retina Thickness	Retina thickness	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
Retinal Artery Velocity	Retinal artery velocity	mm/s	Velocity	PW Doppler Mode
Retinal Vein Velocity	Retinal vein velocity	mm/s	Velocity	PW Doppler Mode

## Vascular measurement Package

This section provides the measurements and calculations information for the protocols in the Vascular measurement package.

"Abdominal Aorta and Inferior Vena Cava" on the facing page

"Mesenteric Arteries" on page 779

"Carotid Arteries" on page 784

"Innominate and Subclavian Arteries" on page 796

"Iliac Arteries" on page 803

"Femoral Arteries" on page 815

"Saphenous Arteries" on page 819

"Renal Arteries" on page 824

"Other Artery" on page 828

"Umbilical Arteries" on page 830



## Abdominal Aorta and Inferior Vena Cava

Abdominal Aorta and Inferior Vena Cava Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
AA PSV	Abdominal Aorta peak systolic velocity	mm/s	Velocity	PW Doppler Mode
AA EDV	Abdominal Aorta end diastolic velocity	mm/s	Velocity	PW Doppler Mode
AA Vel	Abdominal Aorta velocity	mm/s	Velocity	PW Doppler Mode
AA Diam	Abdominal Aorta diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
AA Diam	Abdominal Aorta diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode
AA VTI	Abdominal Aorta velocity time integral	mm	VTI	PW Doppler Mode

### Abdominal Aorta and Inferior Vena Cava Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Peak Vel	Abdominal Aorta peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Abdominal Aorta mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Abdominal Aorta peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Abdominal Aorta mean gradient	mmHg	VTI	PW Doppler Mode
IVC Vel	Inferior Vena Cava peak velocity	mm/s	Velocity	PW Doppler Mode
IVC Diam	Inferior Vena Cava diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
IVC Diam	Inferior Vena Cava diameter	mm	Depth	M-Mode AM-Mode EKV AM-Mode

### Abdominal Aorta and Inferior Vena Cava Protocol Calculation Definitions

Label	Description	Formula
AA RI	Abdominal Aorta Resistive Index	$\frac{AA\ PSV - AA\ EDV}{AA\ PSV}$
AA PI	Abdominal Aorta Pulsatility Index	$\frac{AA\ PSV - AA\ EDV}{AA\ VTI\ Mean\ Vel}$

### Mesenteric Arteries

#### Mesenteric Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
SMA PSV	Superior mesenteric artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
SMA EDV	Superior mesenteric artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
SMA Diam;s	Superior mesenteric artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode

### Mesenteric Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Nonlinear Contrast Mode
SMA Diam;d	Superior mesenteric artery diameter	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
SMA Diam;s	Superior mesenteric artery diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
SMA Diam;d	Superior mesenteric artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
SMA VTI	Superior mesenteric artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Superior mesenteric artery peak velocity	mm/s	VTI	PW Doppler Mode

### Mesenteric Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Mean Vel	Superior mesenteric artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Superior mesenteric artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Superior mesenteric artery mean gradient	mmHg	VTI	PW Doppler Mode
IMA PSV	Inferior mesenteric artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
IMA EDV	Inferior mesenteric artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
IMA Diam;s	Inferior mesenteric artery diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode

### Mesenteric Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
IMA Diam;d	Inferior mesenteric artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
IMA Diam;s	Inferior mesenteric artery diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
IMA Diam;d	Inferior mesenteric artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
IMA VTI	Inferior mesenteric artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Inferior mesenteric artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Inferior mesenteric artery mean	mm/s	VTI	PW Doppler Mode

### Mesenteric Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
	velocity			
Peak Grad	Inferior mesenteric artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Inferior mesenteric artery mean gradient	mmHg	VTI	PW Doppler Mode

### Mesenteric Arteries Protocol Calculation Definitions

Label	Description	Units	Formula
SMA RI	Superior mesenteric artery resistive index	none	$\frac{SMA\ PSV - SMA\ EDV}{SMA\ PSV}$
SMA PI	Superior mesenteric artery pulsatility index	none	$\frac{SMA\ PSV - SMA\ EDV}{SMA\ VTI\ Mean\ Vel}$
IMA RI	Inferior mesenteric artery resistive index	none	$\frac{IMA\ PSV - IMA\ EDV}{IMA\ PSV}$
IMA PI	Inferior mesenteric artery pulsatility index	none	$\frac{IMA\ PSV - IMA\ EDV}{IMA\ VTI\ Mean\ Vel}$

## Carotid Arteries

Carotid Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LCCA PSV	Left common carotid peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LCCA EDV	Left common carotid end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LCCA Diam;s	Left common carotid diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LCCA Diam;d	Left common carotid diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode



### Carotid Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Nonlinear Contrast Mode
LCCA Diam;s	Left common carotid diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LCCA Diam;d	Left common carotid diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LCCA VTI	Left common carotid velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left common carotid peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left common carotid mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left common carotid peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left common carotid mean gradient	mmHg	VTI	PW Doppler Mode
RCCA PSV	Right common carotid peak systolic	mm/s	Velocity	PW Doppler Mode

### Carotid Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
	velocity			
RCCA EDV	Right common carotid end diastolic velocity	mm/s	Velocity	PW Doppler Mode
RCCA Diam;s	Right common carotid diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RCCA Diam;d	Right common carotid diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RCCA Diam;s	Right common carotid diameter, systole	mm	Depth	M-Mode AM-Mode

### Carotid Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				EKV AM-Mode
RCCA Diam;d	Right common carotid diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RCCA VTI	Right common carotid velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right common carotid peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right common carotid mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right common carotid peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right common carotid mean gradient	mmHg	VTI	PW Doppler Mode
LICA PSV	Left internal carotid peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LICA EDV	Left internal carotid end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LICA Diam;s	Left internal carotid diameter, systole	mm	Linear	EKV

Carotid Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LICA Diam;d	Left internal carotid diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LICA Diam;s	Left internal carotid diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LICA Diam;d	Left internal carotid diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode

### Carotid Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LICA VTI	Left internal carotid velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left internal carotid peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left internal carotid mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left internal carotid peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left internal carotid mean gradient	mmHg	VTI	PW Doppler Mode
LECA PSV	Left external carotid peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LECA EDV	Left external carotid end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LECA Diam;s	Left external carotid diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LECA Diam;d	Left external carotid diameter, diastole	mm	Linear	EKV

### Carotid Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LECA Diam;s	Left external carotid diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LECA Diam;d	Left external carotid diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LECA VTI	Left external carotid velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left external carotid peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left external carotid mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left external carotid peak gradient	mmHg	VTI	PW Doppler Mode

### Carotid Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Mean Grad	Left external carotid mean gradient	mmHg	VTI	PW Doppler Mode
RICA PSV	Right internal carotid peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RICA EDV	Right internal carotid end diastolic velocity	mm/s	Velocity	PW Doppler Mode
RICA Diam;s	Right internal carotid diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RICA Diam;d	Right internal carotid diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode

### Carotid Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
RICA Diam;s	Right internal carotid diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RICA Diam;d	Right internal carotid diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RICA VTI	Right internal carotid velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right internal carotid peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right internal carotid mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right internal carotid peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right internal carotid mean gradient	mmHg	VTI	PW Doppler Mode
RECA PSV	Right external carotid peak systolic velocity	mm/s	Velocity	PW Doppler Mode



### Carotid Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
RECA EDV	Right external carotid end diastolic velocity	mm/s	Velocity	PW Doppler Mode
RECA Diam;s	Right external carotid diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RECA Diam;d	Right external carotid diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RECA Diam;s	Right external carotid diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode

### Carotid Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
RECA Diam;d	Right external carotid diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RECA VTI	Right external carotid velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right external carotid peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right external carotid mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right external carotid peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right external carotid mean gradient	mmHg	VTI	PW Doppler Mode

### Carotid Arteries Protocol Calculation Definitions

Label	Description	Units	Formula
LCCA RI	Left common carotid resistive index	none	$\frac{LCCA PSV - LCCA EDV}{LCCA PSV}$

### Carotid Arteries Protocol Calculation Definitions

Label	Description	Units	Formula
LCCA PI	Left common carotid pulsatility index	none	$\frac{LCCA\ PSV - LCCA\ EDV}{LCCA\ VTI\ Mean\ Vel}$
RCCA RI	Right common carotid resistive index	none	$\frac{RCCA\ PSV - RCCA\ EDV}{RCCA\ PSV}$
RCCA PI	Right common carotid pulsatility index	none	$\frac{RCCA\ PSV - RCCA\ EDV}{RCCA\ VTI\ Mean\ Vel}$
LICA RI	Left internal carotid resistive index	none	$\frac{LICA\ PSV - LICA\ EDV}{LICA\ PSV}$
LICA PI	Left internal carotid pulsatility index	none	$\frac{LICA\ PSV - LICA\ EDV}{LICA\ VTI\ Mean\ Vel}$
LECA RI	Left external carotid resistive index	none	$\frac{LECA\ PSV - LECA\ EDV}{LECA\ PSV}$
LECA PI	Left external carotid pulsatility index	none	$\frac{LECA\ PSV - LECA\ EDV}{LECA\ VTI\ Mean\ Vel}$
RICA RI	Right internal carotid resistive index	none	$\frac{RICA\ PSV - RICA\ EDV}{RICA\ PSV}$

### Carotid Arteries Protocol Calculation Definitions

Label	Description	Units	Formula
RICA PI	Right internal carotid pulsatility index	none	$\frac{RICA\ PSV - RICA\ EDV}{RICA\ VTI\ Mean\ Vel}$
RECA RI	Right external carotid resistive index	none	$\frac{RECA\ PSV - RECA\ EDV}{RECA\ PSV}$
RECA PI	Right external carotid pulsatility index	none	$\frac{RECA\ PSV - RECA\ EDV}{RECA\ VTI\ Mean\ Vel}$

### Innominant and Subclavian Arteries

#### Innominant and Subclavian Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
IA PSV	Innominant artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
IA EDV	Innominant artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
IA Diam;s	Innominant artery diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode

### Innominant and Subclavian Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Linear Contrast Mode Nonlinear Contrast Mode
IA Diam;d	Innominant artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
IA Diam;s	Innominant artery diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
IA Diam;d	Innominant artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
IA VTI	Innominant artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Innominant artery peak velocity	mm/s	VTI	PW Doppler Mode

### Innominant and Subclavian Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Mean Vel	Innominant artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Innominant artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Innominant artery mean gradient	mmHg	VTI	PW Doppler Mode
LSA PSV	Left Subclavian artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LSA EDV	Left Subclavian artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LSA Diam;s	Left Subclavian artery diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LSA Diam;d	Left Subclavian artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode

### Innominant and Subclavian Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LSA Diam;s	Left Subclavian artery diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LSA Diam;d	Left Subclavian artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LSA VTI	Left Subclavian artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left Subclavian artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left Subclavian artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left Subclavian artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left Subclavian artery mean gradient	mmHg	VTI	PW Doppler Mode

### Innominate and Subclavian Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
RSA PSV	Right Subclavian artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RSA EDV	Right Subclavian artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
RSA Diam;s	Right Subclavian artery diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RSA Diam;d	Right Subclavian artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RSA Diam;s	Right Subclavian artery diameter, systole	mm	Depth	M-Mode AM-Mode



### Innominant and Subclavian Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				EKV AM-Mode
RSA Diam;d	Right Subclavian artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RSA VTI	Right Subclavian artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right Subclavian artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right Subclavian artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right Subclavian artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Mean gradient	mmHg	VTI	PW Doppler Mode

Innominant and Subclavian Arteries Protocol Calculation Definitions

Label	Description	Units	Formula
IA RI	Innominant artery resistive index	none	$\frac{IA\ PSV - IA\ EDV}{IA\ PSV}$
IA PI	Innominant artery pulsatility index	none	$\frac{IA\ PSV - IA\ EDV}{IA\ VTI\ Mean\ Vel}$
LSA RI	Left subclavian artery resistive index	none	$\frac{LSA\ PSV - LSA\ EDV}{LSA\ PSV}$
LSA PI	Left subclavian artery pulsatility index	none	$\frac{LSA\ PSV - LSA\ EDV}{LSA\ VTI\ Mean\ Vel}$ <p>where:</p> <p><i>LSA</i> is <i>Left Subclavian Artery</i></p>
RSA RI	Right subclavian artery resistive index	none	$\frac{RSA\ PSV - RSA\ EDV}{RSA\ PSV}$
RSA PI	Right subclavian artery pulsatility index	none	$\frac{RSA\ PSV - RSA\ EDV}{RSA\ VTI\ Mean\ Vel}$

Iliac Arteries

Iliac Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
CLI PSV	Common left iliac artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
CLI EDV	Common left iliac artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
CLI Diam;s	Common left iliac artery diameter, systole r	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
CLI Diam;d	Common left iliac artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode

### Iliac Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Nonlinear Contrast Mode
CLI Diam;s	Common left iliac artery diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
CLI Diam;d	Common left iliac artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
CLI VTI	Common left iliac artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Common left iliac artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Common left iliac artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Common left iliac artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Common left iliac artery mean gradient	mmHg	VTI	PW Doppler Mode
CRI PSV	Common right iliac artery peak systolic	mm/s	Velocity	PW Doppler Mode

Iliac Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
	velocity			
CRI EDV	Common right iliac artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
CRI Diam;s	Common right iliac artery diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
CRI Diam;d	Common right iliac artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
CRI Diam;s	Common right iliac artery diameter, systole	mm	Depth	M-Mode AM-Mode

### Iliac Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				EKV AM-Mode
CRI Diam;d	Common right iliac artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
CRI VTI	Common right iliac artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Common right iliac artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Common right iliac artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Common right iliac artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Common right iliac artery mean gradient	mmHg	VTI	PW Doppler Mode
LII PSV	Left internal iliac artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LII EDV	Left internal iliac artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LII Diam;s	Left internal iliac artery diameter, systole	mm	Linear	EKV

Iliac Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LII Diam;d	Left internal iliac artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LII Diam;s	Left internal iliac artery diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LII Diam;d	Left internal iliac artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode

### Iliac Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LII VTI	Left internal iliac artery velocity time Integral	mm	VTI	PW Doppler Mode
Peak Vel	Left internal iliac artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left internal iliac artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left internal iliac artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left internal iliac artery mean gradient	mmHg	VTI	PW Doppler Mode
LEI PSV	Left external iliac artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LEI EDV	Left external iliac artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LEI Diam;s	Left external iliac artery diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode



### Iliac Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LEI Diam;d	Left external iliac artery Diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LEI Diam;s	Left external iliac artery Diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LEI Diam;d	Left external iliac artery Diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LEI VTI	Left external iliac artery Velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left external iliac artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left external iliac artery mean velocity	mm/s	VTI	PW Doppler Mode

### Iliac Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Peak Grad	Left external iliac artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left external iliac artery mean gradient	mmHg	VTI	PW Doppler Mode
RII PSV	Right internal iliac artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RII EDV	Right internal iliac artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
RII Diam;s	Right internal iliac artery diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RII Diam;d	Right internal iliac artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode

### Iliac Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Nonlinear Contrast Mode
RII Diam;s	Right internal iliac artery diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RII Diam;d	Right internal iliac artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RII VTI	Right internal iliac artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right internal iliac artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right internal iliac artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right internal iliac artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right internal iliac artery mean gradient	mmHg	VTI	PW Doppler Mode
REI PSV	Right external iliac artery peak systolic	mm/s	Velocity	PW Doppler Mode

### Iliac Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
	velocity			
REI EDV	Right external iliac artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
REI Diam;s	Right external iliac artery diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
REI Diam;d	Right external iliac artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
REI Diam;s	Right external iliac artery diameter, systole	mm	Depth	M-Mode AM-Mode

### Iliac Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				EKV AM-Mode
REI Diam;d	Right external iliac artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
REI VTI	Right external iliac artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right external iliac artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right external iliac artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right external iliac artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right external iliac artery mean gradient	mmHg	VTI	PW Doppler Mode

Iliac Arteries Protocol Calculation Definitions

Label	Description	Units	Formula
CLI RI	Common left iliac artery resistive index	none	$\frac{CLI\ PSV - CLI\ EDV}{CLI\ PSV}$
CLI PI	Common left iliac artery pulsatility index	none	$\frac{CLI\ PSV - CLI\ EDV}{CLI\ VTI\ Mean\ Vel}$
CRI RI	Common right iliac artery resistive index	none	$\frac{CRI\ PSV - CRI\ EDV}{CRI\ PSV}$
CRI PI	Common right iliac artery pulsatility index	none	$\frac{CRI\ PSV - CRI\ EDV}{CRI\ VTI\ Mean\ Vel}$
LII RI	Left internal iliac artery resistive index	none	$\frac{LII\ PSV - LII\ EDV}{LII\ PSV}$
LII PI	Left internal iliac artery pulsatility index	none	$\frac{LII\ PSV - LII\ EDV}{LII\ VTI\ Mean\ Vel}$
LEI RI	Left external iliac artery resistive index	none	$\frac{LEI\ PSV - LEI\ EDV}{LEI\ PSV}$
LEI PI	Left external iliac artery pulsatility index	none	$\frac{LEI\ PSV - LEI\ EDV}{LEI\ VTI\ Mean\ Vel}$

### Iliac Arteries Protocol Calculation Definitions

Label	Description	Units	Formula
RII RI	Right internal iliac artery resistive index	none	$\frac{RII\ PSV - RII\ EDV}{RII\ PSV}$
RII PI	Right internal iliac artery pulsatility index	none	$\frac{RII\ PSV - RII\ EDV}{RII\ VTI\ Mean\ Vel}$
REI RI	Right external iliac artery resistive index	none	$\frac{REI\ PSV - REI\ EDV}{REI\ PSV}$
REI PI	Right external iliac artery pulsatility index	none	$\frac{REI\ PSV - REI\ EDV}{REI\ VTI\ Mean\ Vel}$

### Femoral Arteries

#### Femoral Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LFA PSV	Left femoral artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LFA EDV	Left femoral artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LFA Diam;s	Left femoral artery diameter, systole	mm	Linear	EKV B-Mode

### Femoral Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LFA Diam;d	Left femoral artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LFA Diam;s	Left femoral artery diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LFA Diam;d	Left femoral artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LFA VTI	Left femoral artery velocity time integral	mm	VTI	PW Doppler Mode



### Femoral Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Peak Vel	Left femoral artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left femoral artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left femoral artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left femoral artery mean gradient	mmHg	VTI	PW Doppler Mode
RFA PSV	Right femoral artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RFA EDV	Right femoral artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
RFA Diam;s	Right femoral artery diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RFA Diam;d	Right femoral artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode

### Femoral Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RFA Diam;s	Right femoral artery diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RFA Diam;d	Right femoral artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RFA VTI	Right femoral artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right femoral artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right femoral artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right femoral artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right femoral artery mean gradient	mmHg	VTI	PW Doppler Mode

### Femoral Arteries Protocol Calculation Definitions

Label	Description	Units	Formula
LFA RI	Left femoral artery resistive index	none	$\frac{LFA\ PSV - LFA\ EDV}{LFA\ PSV}$
LFA PI	Left femoral artery pulsatility index	none	$\frac{LFA\ PSV - LFA\ EDV}{LFA\ VTI\ Mean\ Vel}$
RFA RI	Right femoral artery resistive index	none	$\frac{RFA\ PSV - RFA\ EDV}{RFA\ PSV}$
RFA PI	Right femoral artery pulsatility index	none	$\frac{RFA\ PSV - RFA\ EDV}{RFA\ VTI\ Mean\ Vel}$

### Saphenous Arteries

#### Saphenous Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LSaA PSV	Left saphenous artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LSaA EDV	Left saphenous artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode

### Saphenous Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LSaA Diam;s	Left saphenous artery diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LSaA Diam;d	Left saphenous artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LSaA Diam;s	Left saphenous artery diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LSaA Diam;d	Left saphenous artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode

### Saphenous Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LSaA VTI	Left saphenous artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left saphenous artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left saphenous artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left saphenous artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left saphenous artery mean gradient	mmHg	VTI	PW Doppler Mode
RSaA PSV	Right saphenous artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RSaA EDV	Right saphenous artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
RSaA Diam;s	Right saphenous artery diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode

### Saphenous Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Nonlinear Contrast Mode
RSaA Diam;d	Right saphenous artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RSaA Diam;s	Right saphenous artery diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RSaA Diam;d	Right saphenous artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RSaA VTI	Right saphenous artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right saphenous artery peak velocity	mm/s	VTI	PW Doppler Mode

### Saphenous Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Mean Vel	Right saphenous artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right saphenous artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right saphenous artery mean gradient	mmHg	VTI	PW Doppler Mode

### Saphenous Arteries Protocol Calculation Definitions

Label	Description	Units	Formula
LSaA RI	Left saphenous artery resistive index	none	$\frac{LSaA\ PSV - LSaA\ EDV}{LSaA\ PSV}$
LSaA PI	Left saphenous artery pulsatility index	none	$\frac{LSaA\ PSV - LSaA\ EDV}{LSaA\ VTI\ Mean\ Vel}$
RSaA RI	Right saphenous artery resistive index	none	$\frac{RSaA\ PSV - RSaA\ EDV}{RSaA\ PSV}$
RSaA PI	Right saphenous artery pulsatility index	none	$\frac{RSaA\ PSV - RSaA\ EDV}{RSaA\ VTI\ Mean\ Vel}$

## Renal Arteries

Renal Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LRA PSV	Left renal artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LRA EDV	Left renal artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LRA Diam;s	Left renal artery diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
LRA Diam;d	Left renal artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode



### Renal Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
LRA Diam;s	Left renal artery diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LRA Diam;d	Left renal artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
LRA VTI	Left renal artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left renal artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left renal artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left renal artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left renal artery mean gradient	mmHg	VTI	PW Doppler Mode
RRA PSV	Right renal artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RRA EDV	Right renal artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode

### Renal Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
RRA Diam;s	Right renal artery diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RRA Diam;d	Right renal artery diameter, diastole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
RRA Diam;s	Right renal artery diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
RRA Diam;d	Right renal artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode

### Renal Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
RRA VTI	Right renal artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right renal artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right renal artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right renal artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right renal artery mean gradient	mmHg	VTI	PW Doppler Mode

### Renal Arteries Protocol Calculation Definitions

Label	Description	Units	Formula
LRA RI	Left renal artery resistive index	none	$\frac{LRA\ PSV - LRA\ EDV}{LRA\ PSV}$
LRA PI	Left renal artery pulsatility index	none	$\frac{LRA\ PSV - LRA\ EDV}{LRA\ VTI\ Mean\ Vel}$
RRA RI	Right renal artery resistive index	none	$\frac{RRA\ PSV - RRA\ EDV}{RRA\ PSV}$

### Renal Arteries Protocol Calculation Definitions

Label	Description	Units	Formula
RRA PI	Right renal artery pulsatility index	none	$\frac{RRA\ PSV - RRA\ EDV}{RRA\ VTI\ Mean\ Vel}$

### Other Artery

#### Other Artery Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
OA PSV	Other artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
OA EDV	Other artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
OA Diam;s	Other artery diameter, systole	mm	Linear	EKV B-Mode Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
OA Diam;d	Other artery diameter, diastole	mm	Linear	EKV B-Mode

### Other Artery Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
				Color Doppler Mode Power Doppler Mode Linear Contrast Mode Nonlinear Contrast Mode
OA Diam;s	Other artery diameter, systole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
OA Diam;d	Other artery diameter, diastole	mm	Depth	M-Mode AM-Mode EKV AM-Mode
OA VTI	Other artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Other artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Other artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Other artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Other artery mean gradient	mmHg	VTI	PW Doppler Mode

### Other Artery Protocol Calculation Definitions

Label	Description	Formula
OA RI	Other artery resistive index	$\frac{OA\ PSV - OA\ EDV}{OA\ PSV}$
OA PI	Other artery pulsatility index	$\frac{OA\ PSV - OA\ EDV}{OA\ VTI\ Mean\ Vel}$

### Umbilical Arteries

#### Umbilical Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
UT PSV	Uterine artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
UT EDV	Uterine artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
UT VTI	Uterine artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Uterine artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Uterine artery mean velocity	mm/s	VTI	PW Doppler Mode

### Umbilical Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
Peak Grad	Uterine artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Uterine artery mean gradient	mmHg	VTI	PW Doppler Mode
UM PSV	Umbilical artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
UM EDV	Umbilical artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
UM VTI	Umbilical artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Umbilical artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Umbilical artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Umbilical artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Umbilical artery mean gradient	mmHg	VTI	PW Doppler Mode
VIT PSV	Vitelline artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
VIT EDV	Vitelline artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode

### Umbilical Arteries Protocol Measurement Definitions

Label	Description	Units	Generic type	Mode
VIT VTI	Vitelline artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Vitelline artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Vitelline artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Vitelline artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Vitelline artery mean gradient	mmHg	VTI	PW Doppler Mode

### Umbilical Arteries Protocol Calculation Definitions

Label	Description	Formula
UT RI	Uterine artery resistive index	$\frac{UT\ PSV - UT\ EDV}{UT\ PSV}$
UT PI	Uterine Artery Pulsatility index	$\frac{UT\ PSV - UT\ EDV}{UT\ VTI\ Mean\ Vel}$
UM RI	Umbilical artery resistive index	$\frac{UM\ PSV - UM\ EDV}{UM\ PSV}$



Umbilical Arteries Protocol Calculation Definitions

Label	Description	Formula
UM PI	Umbilical Artery Pulsatility index	$\frac{UM\ PSV - UM\ EDV}{UM\ VTI\ Mean\ Vel}$
VIT RI	Vitelline artery resistive index	$\frac{VIT\ PSV - VIT\ EDV}{VIT\ PSV}$
VIT PI	Vitelline Artery Pulsatility index	$\frac{VIT\ PSV - VIT\ EDV}{VIT\ VTI\ Mean\ Vel}$

## Troubleshooting

If a problem is encountered when using Vevo LAB, try the solutions described in this appendix.

If none of the solutions solve the problem, contact a VisualSonics Technical Support Representative, see "[Technical Support](#)" on page 857.

### General

Summary	PowerPoint 2003 and 2007, on Windows 7 workstations, will not play files exported in AVI format.
Description	Images exported to AVI format from any available mode on the Vevo Imaging System cannot be played within PowerPoint 2003 or 2007 on computers running Windows 7 OS. This is a PowerPoint 2003/2007 limitation.
Workaround	Cine loops that are to be used for PowerPoint presentations should be exported in the Animated GIF format.

Summary	Vevo LAB does not respond when attempting to open a report for a large number of studies (50+).
Description	In the Study Browser, select a large number of studies (50+) then select <b>Report</b> . The application does not respond, and you need to close the application to stop or cancel the process.
Workaround	

## M-Mode/AM-Mode

Summary	A generic message is displayed for all AM-Mode reconstruction limitations.
Description	<p>Regeneration of AM-Mode cine loops is not allowed if the original B-Mode cine loop was acquired under any of the following conditions:</p> <ul style="list-style-type: none"><li>• Zoom feature ON</li><li>• Respiration Gating ON</li><li>• ECG trigger ON</li><li>• frame rate less than 20 fps</li><li>• contains less than 50 frames</li></ul> <p>Also, AM-Mode image regeneration will not be allowed:</p> <ul style="list-style-type: none"><li>• from 3D-Mode or RF B-Mode 3D data</li></ul> <p>The same generic message is displayed for all of the above conditions: "AM-Mode image cannot be generated from this image. Refer to Operator's Manual".</p>
Workaround	

Summary	Regenerated AM-Mode data is not saved until the Cine Store is activated.
Description	A regenerated AM-Mode cine loop, from a B-Mode cine loop, is not saved automatically. The operator should click <b>Cine Store</b> or <b>Image Label</b> to save the cine loop.

Workaround	
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## Contrast Modes

Summary	Image Sequence burst position is off by one frame.
Description	In Contrast Mode (Linear or Nonlinear), set the sequence destroy position at A% and the Contrast Mode cine loop length at B frames. When scanning in Contrast Mode, press the <b>Image Sequence</b> key. The burst happens at frame C, representing A% based on the length of the cine loop. After scanning has stopped, the burst marker may appear shifted by 1 frame to right of the expected position (frame C + 1).
Workaround	

Summary	Hide/Show frames function does not work when accessed from the report in the Nonlinear Contrast Mode Region analysis window.
Description	When opening a Nonlinear Contrast Region graph from the Nonlinear Contrast Region Analysis window by clicking <b>Report</b> , the Hide/Show frames functionality will not be available. To use this function in the Nonlinear Contrast Region Analysis window, open the graph directly from the image by right-clicking on the measurement and clicking <b>Region Graph</b> .
Workaround	

## Workflow

Summary	PW Doppler Mode audio and image data not in sync when exported to AVI format.
Description	The size of PW Doppler Mode image files, exported to the uncompressed AVI format, is large and the playback might not be correct. In some cases the PW Doppler Mode image data is not in sync with audio data.
Workaround	

Summary	No access to desktop when the Vevo Strain application is running on Vevo LAB.
Description	<p>Users might not be able to access the desktop while the Vevo Strain application is running, depending on their computer configuration.</p> <p>To speed up processing it is recommended that users run no other applications on their computer when using the Vevo Strain application. Applications like Vevo Strain on Vevo LAB need significant resources in order to speed up data computing within the application.</p> <p><b>Note:</b> The amount of resources required is also dependent on the size of the cine loop opened in the Vevo Strain application.</p>
Workaround	

Summary	Limitations loading csv data files in various Excel versions.
Description	In Excel 2007 the worksheet size limit is 16,387 columns by 1,048,576 rows while earlier versions are limited to 256 columns by 65,536 rows.
Workaround	

Summary	Missing copy or overwrite confirmation when importing a study to the Vevo LAB.
Description	If the user selectively copies an image from a series (with a defined Study/Series owner) from a Vevo Imaging System to Vevo LAB, and then later selects to copy a collection of images from the same Study/Series, as the same Series/Study owner, there is no message to prompt that the image previously copied will be overwritten by the image in the second import.
Workaround	

Summary	Incorrect statement in the Copy To report.
Description	When repeating Copy To of a study to some location, selecting "Skip" it actually overwrites the study.xml file. This means that the Study Notes section will be overwritten and the name of the study.  To avoid overwriting of the Study Notes, keep separate notes for each series.
Workaround	

Summary	When adding a new user and after selecting Copy Settings from another user, selection cannot be canceled.
Description	In User Management Mode, when adding a new user by copying the settings from an existing user, there is no way to deselect the user, and not copy the settings once selected. Cancel the addition of the new user to allow deselection.
Workaround	

Summary	All open studies must be closed before Lock All can be enabled.
Description	In User Management Mode, when an Administrator attempts to enable Lock All on a system where one or more open series exists, a message is displayed noting that all open series must be closed prior to enabling Lock All.
Workaround	<p>One method of closing all series (including those users who are not logged in) is to return to standard mode, which will automatically close all series. The user can then set the Lock state to Lock All, and return to User Management Mode.</p> <p>It is recommended that Lock All should be adopted from the start if this is the desired method of organization, i.e. before different users start leaving open series when they log out of the system.</p>

## 3D Mode

Summary	Pasted rotational volume has different values.
Description	<p>Loaded a processed Linear Contrast 3D Mode loop into 3D. Place rotational and parallel volume measurements on the image. Copy and pasted the volumes to another instance of the same image loaded into 3D. The value of pasted rotational volume is slightly different (&lt;1%) than the original. No difference was seen in the pasted Parallel volume values.</p> <p><b>Note:</b> This is also observed in Power 3D Mode.</p>
Workaround	

Summary	Occasionally have a closed end in a 3D Mode parallel volume measurement
Description	It has been noticed that occasionally a parallel volume measurement will extend across the open end of a parallel volume.
Workaround	

Summary	3D Mode recording is slow.
Description	3D Mode export (*.tif, *.bmp, *.avi) is much slower when exporting to USB memory card or external hard drive. It is recommended to export 3D Mode images to a local hard drive when performing export on a workstation computer.
Workaround	



Summary	Not able to add measurements or annotations during 3D Mode recording.
Description	During regular 3D Mode recording users are not able to add annotations or measurements. All measurements and annotations should be added prior to the 3D Mode recording.
Workaround	

Summary	Insert contour for 3D Mode volume does nothing.
Description	Attempting to insert a contour if the plane is too close to an existing contour will be ignored.
Workaround	

Summary	Playback of exported Animated GIF (AGIF) is very slow.
Description	<p>The actual playback of exported AGIF is extremely slow. Surface View Rotation recordings play as expected in PowerPoint, Windows Picture and Fax Viewer, and Internet Explorer.</p> <p>Manual recordings play much slower in PowerPoint, Windows Picture and Fax Viewer, and Internet Explorer.</p>
Workaround	

Summary	During 3D Mode AGIF playback in Internet Explorer 8, a faint wireframe "residue" is visible.
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Description	There is a faint wireframe "residue" visible during the playback of either the manual 3D Mode recording or the Surface View Rotation of 3D Mode recording when they are exported as AGIF format and played back in Internet Explorer 8. The "residue" is not visible in PowerPoint or other viewers.
Workaround	

Summary	In Linear Contrast 3D Mode, the reference is always the whole cine loop.
Description	Open a Linear Contrast 3D Mode cine loop, make a sub-range and click <b>Create Reference</b> . Select the <b>Process</b> button. The application ignores the selected sub-range and uses the entire cine loop as the reference.
Workaround	

Summary	Difference in rotational volume values reported dependent on Vevo LAB application size.
Description	<p>On Vevo LAB, with the application size maximized, load a 3D-Mode image. Place a rotational volume measurement within the image and observe the Volume calculated. Reduce the size of the application to the minimum size, and observe the Volume calculated. A slight difference in the rotational volume values has been observed.</p> <p><b>Note:</b> This is not seen in parallel volume measurements.</p> <p>For example:</p>

Mode	Maximized application		Minimized application		+/-
	Volume	%	Volume	%	
Nonlinear Contrast 3D Mode	363.543	93.670	364.072	93.670	-0.037
Linear Contrast 3D Mode	148.152	4.501	148.188	4.501	-0.002
Power Doppler 3D Mode	5.826	17.998	5.717	17.998	+1.8
PA-Mode 3D	895.646	41.362	899.8	41.362	-0.464

Workaround	
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## Measurements, calculations, and annotations

Summary	M-Mode measurement option is cut-off on Vevo LAB.
Description	<p>With all the options available for the M-Mode LV Trace measurements and the Show Values and Labels option enabled, the bottom parameter (LV Mass) in the list is cut off.</p> <p><b>Note:</b> This is dependent on Vevo LAB screen resolution.</p>
Workaround	

Summary	Incorrect frame numbers listed when exporting PA Region values
Description	Acquire a PA-Mode loop and hide a region of frames that begins at frame 1. Place a PA-Region measurement on the image, then select "Export Region Values" from the context menu. When the exported .csv is reviewed, the first frame will

	<p>be listed is "1" rather than the frame number for the first unhidden frame.</p> <p><b>Note:</b> The data is correct for the loop displayed. The only issue is that the loop frame numbers exported have been reset to begin at 1.</p> <p><b>Note:</b> If these values are exported from the PA-Region graph, the data will be exported with the correct frame number defined.</p>
Workaround	

Summary	Failed to open a graph from Vevo 2100 system V1.0.0 study.
Description	<p>If a study is exported to the network and the drive path is too long, the saved graphs file names will be truncated by Windows. This prevents them from being read properly by the Vevo 2100 application. If this study is moved to the workstation via "Copy To" / "Copy From" the files will fail to copy.</p> <p>The problem will occur when the file name, plus the destination path, has 256 characters (including "/", space, "C:", etc.) or more.</p> <p>Examples:</p> <p>This path is too long:</p> <p>\\CompanyFileServer\ProjectOmega\Initial Project Studies\Thursday September 27 -2009\Morning Studies\Good Studies\System Vevo2100 094\infarct mouse</p>

	<p>model using 230 mg of dihydrogen oxide as suitable internal laxative\20039492934</p> <p>This path is acceptable:</p> <p>\\CompanyFileServer\ProjectOmega\Studies\infarct model 1\20039492934</p>
Workaround	Map the drive, which will reduce the destination path/file name length.

Summary	Report does not list the correct modes for RF-Mode images on workstation running on Windows 7.
Description	Load a RF M-Mode loop, place a measurement, and click the Report button. The measurement appears in the Report as an M-Mode measurement rather than the expected RF-Mode. If the image is resaved (even without modifying the measurement), when the report is opened again, it will be correctly identified as a RF Mode measurement.
Workaround	

Summary	Endocardial FS calculated value displayed in PSLAX and in SAX.
Description	Place every SAX B-Mode measurement plus the 4 required from PSLAX (ENDOmajr and EPImajr) for both diastolic and systolic on an image. Within the Report calculations, the Endocardial FS appears under both the PSLAX and SAX.
Workaround	

Summary	Can place both an AM-Mode LV trace and an M-Mode trace within the same PV graph.
Description	Place an LV Trace measurement in an M-Mode loop and an AM-Mode loop. From the Report window, select both measurements and click "PV Loop". Both measurements are displayed on the displayed PV Loop graph.
Workaround	

Summary	Measurements made in Vevo 2100 software V1.0.0 now display 2 decimal places of precision.
Description	For a Vevo 2100 V1.0.0 study with measurements made in a V1.0.0 custom package that had number precision different than the default (i.e. 1), load the image or display the Report. The measurement will display 2 decimal places of precision rather than the number precision original defined in the V1.0.0 study. The only exception is if the Vevo 2100 V1.0.0 measurement package had 3 decimal places of precision.  <b>Note:</b> Exported *.csv file contains all decimal places.
Workaround	

Summary	Measurement precision is different in the Mode and Report windows.
Description	After importing a user-defined Vevo 2100 software V1.0.X measurement package with number precision different than the default and then placing a measurement, the original measurement precision will be displayed. Click "Report"

	<p>within the Mode. The Report window displays the measurement with this number precision.</p> <p><b>Note:</b> If a new measurement is created with software V1.2.0 or higher, the 2 decimal places are displayed in the Analysis Browser as described in the previous note.</p>
Workaround	

Summary	Cardiac Region measurement displayed during playback of cine loop with hidden frames.
Description	Within a Linear Contrast Mode cine loop, during playback a cardiac region measurement is displayed even when passing through hidden frames.
Workaround	

Summary	Inconsistent PA-Mode "Avr" parameter value.
Description	The value for the "PA Avr" is a frame reading. The value exported in the Report will be based on the reading from the frame saved as the thumbnail of the image.
Workaround	

Summary	Ability to Save / Delete graphs in a 'Locked All' study.
Description	Locked a study in 'Lock All' mode. Have the ability to make a contrast region graph, PV Curve or histogram, and save it. When the Report window is opened, the saved graphs are

	displayed. Also have the ability to delete any saved graph from the Report window.
Workaround	

Summary	Early Vevo 2100 (V1.1.X / V1.2.X) Cardiac package measurements and calculations in later Vevo LAB version.
Description	<p>All measurements in the Cardiac packages were made in V1.1.X, and a csv report was exported. After upgrading to V1.6.X, a report is exported.</p> <p>When these two reports were compared the following was found: 1) all measurement values are the same, 2) the duplicate measurements in various protocols done within V1.1.X no longer occurs - the measurement is only found within the protocol where it was made, 3a) there have been a number of calculations dropped from earlier versions (defined in applicable Release Notes), 3b) some protocols show new calculations which have been added in later Vevo 2100 versions (defined in applicable Release Notes), 3c) some formula changes (defined in applicable Release Notes, eg. decimal point placement).</p> <p><b>Note:</b> Measurement calculations are completed at run time using the current calculation formulas.</p>
Workaround	

## Export

Summary	An exported Uncompressed AVI does not play in Media
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	Player on Windows 7.
Description	Exported cine loops in Uncompressed AVI format are unable to play in Windows Media Player (WMP) on Windows 7.
Workaround	

## EKV Mode

Summary	EKV process bar may proceed many times during the processing or reprocessing of EKV data.
Description	During EKV acquisition or reprocessing of a large file, the EKV process bar runs through its length a number of times. This continuous process bar method is used as the system is unable at the beginning of processing to determine exactly how long processing will take. This method gives the user an indication that processing is proceeding normally.
Workaround	

## PA-Mode

Summary	Frames alternate between normal and artificially oxygenated for Oxy-Hemo 3D when using persistence.
Description	In Oxy-Hemo 3D with persistence set to any even numbered value, the frames displayed alternate between one normal frame and one frame which appears artificially oxygenated.
Workaround	Set the persistence to 3, and no odd artificially oxygenated frames are acquired or displayed.

Summary	Current wavelength indicator jumps around erratically.
Description	<p>When reviewing Multi-wavelength/NanoStepper mode data with a fast playback rate, within the mode settings panel the indicator showing the current wavelength seems to jump erratically.</p> <p><b>Note:</b> When the loop is reviewed manually or at a slow playback rate, you can see the wavelengths values, and the indicator no longer jumps erratically.</p>
Workaround	

## Usage Log

Summary	Current Usage Log entry is not always displayed immediately in the Usage Log table.
Description	<p>This may occur on a workstation where the user is not logged in to the OS as an Administrator. Within the Preferences &gt; User tab, enable User Management Mode (UMM), then before exiting Preferences, enable the Usage Log. The current usage log entry may not be displayed.</p> <p>Refresh the screen by going to a different Prefs tab and then back to the User tab. The current usage log entry should be displayed.</p>
Workaround	

Summary	Current Usage Log entry is not always correctly located within the Usage Log table.
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Description	When Usage Log is enabled, within the Preferences > User tab, sort the Usage Log table by Session Time. If this screen is left open, the location of the current usage log entry will not change or be updated, even if the displayed Session Time implies that it should be located elsewhere in the table. If the Preferences screen is closed and then reopened, the current usage log entry should be displayed in the correct location for that moment in time.
Workaround	

Summary	25 hour Usage Log entry possible within the Usage Log table.
Description	A session time maximum could be 25 hours, rather than the expected 24 hours if the day in question is the day when Daylight Saving time begins.
Workaround	

## Vevo Vasc software

Summary	Long narrow ROI box creates oddly displayed floating window
Description	In Vevo Vasc, place a long narrow Long-IMT Auto box on the image. The floating window displayed may appear with a cut off <b>Discard</b> button, and the top of the ROI box may not be displayed. Re-draw a taller ROI box.
Workaround	

Summary	Window with traces for new ROI too large to fit floating
---------	--

	window.
Description	In Vevo Vasc, zoom into the image displayed. Place one or more Longitudinal ROIs on the image. Now create another Longitudinal ROI which is tall and narrow. After drawing the red ROI rectangle, the ROI with the traces will show on the top of the Vevo Vasc application, but will be too large to fit. The expected buttons (and close X) will not be displayed/available. Need to close the application via the task manager.
Workaround	

## Vevo CQ software

Summary	In the Quantification screen - selecting fast playback of current loop switches playback rate to slower playback rate. Fast playback can appear jumpy.
Description	<p>After processing a Nonlinear Contrast Mode image with a frame rate of 150 fps, the data is displayed on the Quantification screen. Click the fast play &gt;&gt; button. Instead of playing at 8X, it goes to 1X. The playback at 4x and even at 2X is jumpy.</p> <p>Vevo CQ is a real-time player which plays clips at the true frame rate. When playing at 2X, 4X, or 8X, Vevo CQ will multiply the frame rate by 2, 4, or 8, respectively. In some cases if it is not possible to allow for fast playback mode (e.g. 4X or 8X), the playback rate will change to the next sequential one. For Example: 2X (OK) → 4X (OK) → 8X (not OK, not enough images) → Vevo CQ updates play mode to next sequential rate (i.e. 1X) → 1X. The playback modes behavior is 1X → 2X → 4X → 8X.</p>

Workaround	
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Summary	Only one Vevo CQ screen can be saved to the Vevo 2100 report.
Description	If repeated analysis is done on the same cine loop, when saving results to the Vevo report will overwrite the previous image.
Workaround	

Summary	Exclusion is not consistent before and after quantification.
Description	<p>Open a Nonlinear Contrast Mode image in Vevo CQ application. Place a region of interest (ROI). Before quantification, there are two ways to exclude frames:</p> <ol style="list-style-type: none"> <li>1 Click the minus red button, drag the frame maker, and the area that the marker passes will become red.</li> <li>2 By dragging the marker in between the green and red area, either expanding the green or the red area.</li> </ol> <p>After exclusion and application of quantification, functionality changes. Click the minus red button and where the marker currently stays a single frame becomes red. If you drag the marker, there is no effect (i.e. red stays red and green stays green).</p>
Workaround	

Summary	In Nonlinear Contrast Mode without burst, the "R" button is
---------	---

	not always working.
Description	Open a Nonlinear Contrast Mode image without a burst in Vevo CQ application. Select "Targeted". Drag the green section to become red for the whole section. Click the "R" button. The whole bar stays red, although the marker jumps back to its original position.
Workaround	

Summary	Some text is cut off on higher resolution monitors.
Description	When a Nonlinear Contrast Image is displayed within Vevo CQ, text in the image appears to be cut off. Vevo CQ supports a pixel density of 96 dpi (or pixels per inch) only.
Workaround	

Summary	German / French settings still use decimals internally.
Description	Vevo CQ still uses decimals internally, instead of "," when German or French locale settings are selected. This is also true for exported .csv files.
Workaround	

Summary	Initial opening of Vevo CQ on Windows 8 system requires more time than expected.
Description	The initial time Vevo CQ opens on a Windows 8 workstation, the splash screen is displayed for a longer than expected time

	(it seems like 2-3 minutes). If the application is closed and another image opened within Vevo CQ, the image loads within a reasonable time.
Workaround	

## Vevo Strain software

Summary	Unable to load large loops into Vevo Strain application.
Description	When loading large loops (from 750 to 1000 frames) into the Vevo Strain application, the application appears to be loading normally. Once processing is completed, the Vevo LAB application returns.
Workaround	

Summary	ECG signal inaccurately displays for very long cine loops.
Description	With very large B-Mode cine loops loaded into the Vevo Strain application, the ECG will appear as noise due to limited space within the display area.
Workaround	

Summary	"Place Points Further Apart" error message displayed.
Description	Load a B-Mode image into the Vevo Strain application and place a trace on the image as normal. When attempting to start the analysis, a "Place Points Further Apart" error message is displayed.

	<p><b>Note:</b> This occurs regularly on longer (975+ frames) loops and intermittently with smaller loops (&lt;975 frames).</p>
Workaround	

Summary	German/French settings still use decimals internally.
Description	Vevo Strain still uses decimals internally, instead of “,” when German or French locale settings are selected. This is also true for exported *.csv files.
Workaround	



## Customer Support

### Scientific Support

General information, product details, application support, operator instructions or training:

Phone	+1.416.484.5000 +31 20 808 2913 (Europe)
Toll-free	+1.866.416.4636 +800 0751 2020 (Europe)
Email	<a href="http://www.visualsonics.com/support/scientific-support">www.visualsonics.com/support/scientific-support</a>
Email (training)	<a href="http://www.visualsonics.com/support/contact-sales/training-request">www.visualsonics.com/support/contact-sales/training-request</a>

### Technical Support

Performing maintenance procedures not described in the user manual may void the product warranty.

The Technical Support Representative can help you troubleshoot the situation by phone or by email.

Phone	+1.416.484.5000
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Toll-free	+1.888.416.4636
Email	<a href="http://www.visualsonics.com/support/technical-support">www.visualsonics.com/support/technical-support</a>
Website	<a href="http://www.visualsonics.com">www.visualsonics.com</a>
Europe service center	FUJIFILM SonoSite - Amsterdam Joop Geesinkweg 140 1114 AB Amsterdam The Netherlands Tel (Main): +31 20 808 2913 Tel (Toll-free): +800 0751 2020

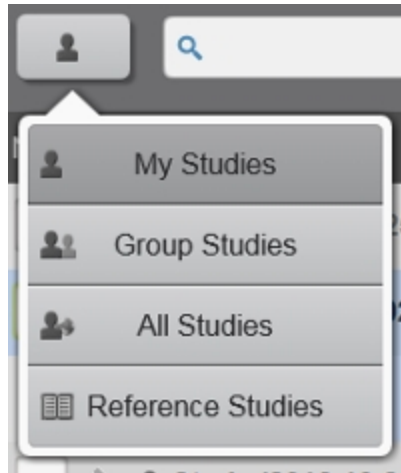
## Vevo Brain Neuroanatomical Atlas installation

When you purchase the Vevo Brain Stereotactic Frame, a Vevo Brain Neuroanatomical Atlas is also included. The Neuroanatomical Atlas is a study that will help you when imaging the brain. You can install the Neuroanatomical Atlas on your system and Vevo LAB and once installed, will be found in the Study Browser.

**Note:** The Neuroanatomical Atlas cannot be deleted or edited.

The Vevo Brain Stereotactic Frame works with the Vevo Mouse Handling Table II; the frame attaches to the platform to secure an animal's head from movement while imaging the brain.

- 1 Insert the USB containing the Atlas installer files, in to one of your PC's USB ports.
- 2 Go to Preferences.
- 3 Go to Maintenance.
- 4 Click **Upgrade**. The Upgrade window will be displayed.
- 5 Go to and click to select the file named *Vevo Reference Studies 3.0.0.XXXXX*.
- 6 Click **Upgrade**.
- 7 Once the installation is complete, go to the Study Browser.
  - a. If UMM (User Management Mode) is enabled, click the privacy settings button, then click to select **Reference Studies**. Go to the Study Browser and search for the study *Adult Mouse Brain Atlas*; double click on the image *Adult CD-1 Mouse brain atlas* to load it into review.



- b. If UMM is not enabled, search for the study *Adult Mouse Brain Atlas*; double click on the image *Adult CD-1 Mouse brain atlas* to load it into review.

8 Enable Split Screen by clicking **Split Screen**. The study will be loaded to the left side of the screen.

9 Click on the right (blank) side of the screen.

10 Click the Study Browser icon and select another image to load into review. You can now compare your image to the Vevo Brain Neuroanatomical Atlas.

## Glossary

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3

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### 3D Mode

3D Mode provides a three-dimensional view of an area of interest from frame-based imaging modes, excluding PA-Mode (Spectro) and EKV Mode. The system acquires the 3D data by first creating a rapid series of B-Mode slices, and then combining these slices into a whole image. You can then view the structures you are interested in by using the analysis and measurement tools.

4

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### 4D-Mode

4D-Mode is a three dimensional EKV Mode (ECG-based Kilohertz Visualization) image of one complete cardiac cycle synthesized from B-Mode image data acquired at a high frame rate. The software acquires EKV acquisitions at different 3D motor positions. Each EKV acquisition is a complete heart cycle. Thus we end up with complete heart cycles for each motor position creating a 4D-Mode clip of the entire heart cycle.

A

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### AM-Mode (Anatomical M-Mode)

AM-Mode, or Anatomical M-Mode, is a modification to standard M-Mode typically used in echocardiography. AM-Mode is a tool you can use to steer the sample volume to any angle, rather than positioning the sample volume in a strict vertical position.

## Annotation

A text label that you can add to any ultrasound image.

## AVI

Audio Video Interleave (AVI) is a standard file format developed by Microsoft that includes both live video and sound.

## B

---

### B-Mode

B-Mode is the imaging mode you will work with most often because it is the most effective mode for locating anatomical structures. If you have seen a conventional ultrasound image then you are already familiar with B-Mode. You also use B-Mode in other imaging modes as the background orientation image over which the active mode data is applied and use B-Mode as a real-time orientation window in other imaging mode windows so you can visually guide the transducer to the right location to acquire the most useful data in your active imaging mode.

### BMP

BMP is a Bitmap file extension of a static image file format. Each bit of the saved BMP file represents a piece or pixel of the image.

## C

---

### Caliper

An user-defined point for a measurement.

### Cine loop

A multiple frame animation of your image frames.

## Color Doppler Mode

Color Doppler Mode uses PW Doppler Mode ultrasound to produce an image of a blood vessel. In addition, the Doppler sounds are converted into colors that are overlaid on the image of the blood vessel to represent the speed and direction of blood flow through the vessel. This mode is useful for blood flow applications such as distinguishing non-vascular tissue structures from vascular tissue structures or identifying vascular structures that can be more difficult to identify in other ultrasound mode image data

## CSV

Comma Separated Value (CSV) is a file format used to represent database fields. Each entry of the file represents one field and is separated from the next field by a comma.

## D

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## DICOM

Digital Imaging and Communications in Medicine (DICOM) is a comprehensive set of standards for handling, storing and transmitting information in medical imaging. It includes a file format definition and a network communication protocol.

## Dongle

A hardware device that serves as copy protection for the software by rendering the software inoperable when the device is not plugged into a USB port.

## Doppler angle

The angle between the ultrasound pulse and the direction of blood flow. This angle is also known as the incident angle to flow or the angle of insonation.

## E

---

### ECG

Electrocardiogram is a electronic representation of a physiological measurement of the electrical potentials of heart tissue. The output is a trace of the heart rhythm.

### ECG trigger

A feature you can use when you want to add measurements at a specific time during the heart cycle. ECG triggering acquires one single frame of image data during each cardiac cycle, at precisely the same time point after the R wave peak. To use this feature, your subject must be connected to the Advanced Physiological Monitoring Unit.

### EKV Mode

EKV Mode (ECG-based Kilohertz Visualization) is an image reconstruction technique that produces a one-heart-cycle cine loop synthesized from B-Mode image data acquired at a very high frame rate. The process works by acquiring data over multiple heart cycles, extracting data at specific time points in these cycles, then producing a representative one-heart-cycle cine loop. To analyze an EKV Mode image, you can use the same analysis tools you use to analyze a B-Mode image.

## F

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### Focal length

The distance from the active surface of the transducer to the middle of the focal zone.



## Focal zone

The portion of a focused ultrasound beam which is the region of optimal resolution. The structure of interest is optimally focused when it is imaged within this region.

## Frame rate

The number of acquisition image updates per second. A higher acquisition frame rate is desirable when watching a moving structure such as the heart, or when moving the transducer.

H

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## HemoMeaZure

A measuring tool that measures and quantifies hemoglobin content and quantification in PA-Mode images. Available only in Oxy-Hemo sub-mode.

L

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## Linear Contrast Mode

Linear Contrast Mode imaging provides tools to detect and quantify vascular structures and dynamics at the molecular level in two dimensions or three dimensions. This mode is useful in cancer, vascular and cardiology research for real-time in vivo applications such as targeted molecular imaging for visualizing and quantifying the expression of intravascular molecular markers (for example: angiogenesis and inflammation) and tumor perfusion and relative quantification of vascular volume and structure; Assessment of myocardial perfusion and area of infarction

## M-Mode

M-Mode is used primarily to measure the movement and dimensions of cardiac structures such as chambers and walls. M-Mode works fundamentally differently than B-Mode. Where B-Mode is a frame-based image that uses multiple scanning beams to create its image, M-Mode is a time-based image that uses just one beam. During an image acquisition session, when the user has guided the transducer beam to the depth that displays a proper cross-section of the heart, the user can then set M-Mode to lay its single beam across that cross-section. This way, the movement of the heart structures move up and down that single line. Then, after you save an image over a period of time, you can open the image and take measurements along that line over time. These movements over time are the wave-like image cycles that are visible in the M-Mode image.

## MIP (Max)

Maximum Intensity Persistence highlights the denser portions of the volume by bringing them forward in the image and making them brighter. This more clearly displays a small bright object in the middle of a dark ultrasound image.

## MIP (Min)

Minimum Intensity Persistence highlights the less dense portions of the volume by bringing them forward in the image and making them darker. This more clearly displays a small dark object in the middle of a bright ultrasound image.

## Multi-wavelength sub-mode

One of four available sub-modes in PA-Mode (Single, Oxy-Hemo, Multi-wavelength, Spectro). Use PA-Mode (Multi-wavelength) when

you want to scan with multiple custom wavelengths, components or both and have the ability to multiplex and unmix your data.

## Multiplexer Control

Multiplexer control is a set of tools you can use to assign color and other visual properties to each wavelength image series in a PA-Mode (NanoStepper) or PA-Mode (Spectro) acquisition. You can then view these layers as individual or combined views of the data.

N

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## NanoStepper sub-mode

One of four available sub-modes in PA-Mode (Single, Oxy-Hemo, NanoStepper, Spectro). NanoStepper is a multi-wavelength PA-Mode image acquisition sub-mode that acquires photoacoustic images at up to five custom wavelengths.

## Nonlinear Contrast Mode

Nonlinear Contrast Mode is a high-frequency imaging mode that produces improved sensitivity in microbubble detection and quantification. This mode suppresses the tissue signal while increasing the detection of the contrast agents. During acquisition the system modulates the amplitude of the ultrasound pulses, enabling a nonlinear response to microbubbles. To acquire images in this mode you must use one of the following transducers on a Vevo 2100 Imaging System: MS-200, MS-201, MS-250, MS-250S or LZ250. And the following transducers on a Vevo 3100 Imaging System: MX201, MX250 or MX250S.

## O

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### Oxy-Hemo sub-mode

One of four available sub-modes in PA-Mode (Single, Oxy-Hemo, Multi-wavelength/NanoStepper, Spectro). Oxy-Hemo sub-mode acquires PA-Mode image data at two wavelengths. In the Mode Settings preferences tab you can select one of two default wavelength values (734 nm or 750 nm) for Wavelength 1. Wavelength 2 is always 850 nm. The blue overlay displays deoxygenated blood. The red overlay displays oxygenated blood.

### OxyZated

A measuring tool that calculates and quantifies oxygen saturation in PA-Mode images. Available only in Oxy-Hemo sub-mode.

## P

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### PA-Mode

A method for obtaining optical contrast from biological tissues and detecting it with ultrasound. By illuminating tissue, a thermoelastic expansion occurs and this expansion creates an ultrasound wave which can be detected with an ultrasound transducer.

### Perfusion

The delivery and circulation of contrast agent through the blood vessels.

### Power Doppler Mode

Power Doppler Mode provides tools to visualize and measure flow dynamics. This imaging mode displays the energy from the returning Doppler signal and assigns a color range to the energy generated by moving blood flow. This is useful for applications such as detecting

vascularity in and around orthotopic and subcutaneous tumors and producing a measure of relative quantification.

## Pressure-volume loop

A graphical method of identifying and evaluating LV pressure-volume relationship changes related to dynamic levels of cardiac stress.

## PW Angle

Adjusts the angle correction (1-degree increments on Vevo LAB) between the vertical line of the ultrasound pulse from the face of the transducer and the direction of vascular flow in the sample volume in a PW Doppler Mode image acquisition session. The dashed yellow line indicates the direction of flow.

## PW Doppler Mode

PW Doppler Mode (Pulsed Wave Doppler) is an ultrasound mode you can use to measure the velocity and direction of flow. The Vevo software presents the detected PW Doppler signal as both a spectral image in the display window as well as an audio output through the available speakers on your PC.

R

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## RF-Mode

Digital RF-Mode provides data in RF, Raw and IQ format for further analysis. Digital RF-Mode allows users to digitize and view the RF data from the high-frequency ultrasound signal, which can be acquired in both frame-based and time-based imaging modes. The data can be envelope detected and log compressed to be exported in a range of file formats. Envelope format is a useful way of storing raw data that correlates exactly to what is seen in the B-Mode image and is readily available for image processing applications.

## Sample volume

The region of interest being imaged during PW Doppler Mode, PW Tissue Doppler Mode, M-Mode or AM-mode acquisition. Sample volume size is defined by the length of the pulse and the width of the ultrasound beam.

## Scout window

A small B-Mode window that renders the region of interest for acquisition in M-Mode, AM-Mode, EKV AM-Mode, PW Doppler Mode, PW Tissue Doppler Mode.

## Session

A period of time that a user spends adding information (acquiring data or making measurements and/or annotations on acquired data) to a study.

## Single sub-mode

One of four available sub-modes in PA-Mode (Single, Oxy-Hemo, Multi-wavelength/NanoStepper, Spectro). PA-Mode (Single) is a single-wavelength PA-Mode image acquisition sub-mode that acquires photoacoustic data at one wavelength.

## Spectro sub-mode

One of four available sub-modes in PA-Mode (Single, Oxy-Hemo, Multi-wavelength/NanoStepper, Spectro). Spectro is a multiple-wavelength PA-Mode image acquisition sub-mode that acquires a flexible range of two-dimensional images at defined steps between a range of wavelengths.

## Standard mode

When the Vevo LAB is installed, standard mode is the default user access mode. Each user maintains full administrative rights until someone assigns administrative rights either to themselves or to someone else.

## Study sharing level

When User Management Mode is enabled, a user can apply one of the three sharing levels to their own study to control who accesses it. Keep Private - provides study access to you and administrators. Share with Group - provides study access to you, to all users in your group and to Administrators. Share with Everyone - provides study access to all users and Administrators.

---

## T

### TIFF

Tagged Image File Format (TIFF) is a standard still image file format that includes tagged fields with the image that can be read by the opening application.

---

## U

### Usage log

Usage Log is a user management mode feature that tracks users who access a Vevo Imaging System or Vevo LAB. The log consists of individual session entries and is available on the Vevo Imaging System as well as the Vevo LAB software.

### User

A specified user of the system with whom study sessions may be associated.

## User group

A user group is a User Management Mode label that an Administrator applies to one or more users. When a user in a group creates a study and assigns the study sharing level "Share with Group" to that study, every user in the group can see the study.

## User Management Mode

User Management Mode is an administration option that activates advanced user account controls, user groups, user-assignable study sharing levels and Usage Log availability.

V

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## Vevo Color

Vevo Color is a tool that applies color to add visual definition to an area of interest on an image.

## Vevo LAB

Vevo LAB software includes all the software tools and features that are on the Vevo Imaging System, excluding the image acquisition tools features.

W

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## WAV

WAV is the file extension for a Waveform file format developed by Microsoft that includes sound. This file format is used exclusively in Windows.



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