VisualSonics
Vevo® 2100 Imaging System

Operator Manual
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**Acquiring PW Doppler Mode and PW Tissue Doppler Mode images**

- Typical PW Doppler Mode image acquisition session
- PW Doppler Mode window workspace
- Control panel controls for PW Doppler Mode
- PW Doppler Mode acquisition settings
- Setting the PW Doppler Mode sample volume
- Setting the PW Doppler Mode sample volume in a distance blockout zone
- Exporting PW Doppler Mode cine loop audio

**Acquiring PW Tissue Doppler Mode images**

- Typical PW Tissue Doppler Mode image acquisition session
- Analyzing PW Tissue Doppler Mode images

**Analyzing PW Doppler Mode and PW Tissue Doppler Mode images**

- Adding generic PW Doppler Mode measurements
- Applying automatic traces to the frequency waveform
- Adding protocol measurements

### 3D-Mode imaging and analysis

**How 3D-Mode works**

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Section 1

Getting started

This section introduces you to the Vevo 2100 Imaging System.

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Chapter 1

Introduction

Thank you for using the Vevo® Imaging System, the high-resolution in vivo micro imaging system from VisualSonics®.

The Vevo 2100 Imaging System supports the following ultrasound imaging modes:

- B-Mode imaging
- M-Mode imaging
- PW (Pulsed Wave) Doppler Mode imaging
- Color Doppler Mode imaging
- 3D-Mode imaging
- Power Doppler imaging
- Contrast Mode imaging

The system provides an array of measurement tools in addition to the following custom measurement packages:

- Cardiac measurement package
- Abdominal measurement package
- Vascular measurement package
- Embryology measurement package
- Ophthalmology application package

This operator manual provides detailed procedures and descriptions for operators who use the system to acquire and analyze ultrasound image data.

WARNING: Do not use the Vevo 2100 Imaging System for human applications.

In this chapter

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Operator Manual conventions

This documentation uses the following typeface conventions:
Bold

- Selections you make when you are using the software
- Subheadings
- Names of power switches and rear panel connectors
- Labels (such as Tip:)
- Column headings in a table
- Keywords and parameters in text

Control Block

- Control panel keys, dials, toggles, sliders.

Italic

- Cross references
- Menu paths
- Citations (titles of books, diskettes, and CDs)
- Terms defined in text
- Variables and values that you must provide

Monospace

- Examples and software code examples
- File names, programming keywords and other elements that are difficult to distinguish from surrounding text
- Message text and prompts addressed to you
- Text that you must type
Chapter 2

System description

The Vevo 2100 Imaging System enables in vivo visualization, assessment, and measurement of anatomical structures and hemodynamic function in longitudinal imaging studies for small animal phenotyping.

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Cart description

The cart houses the Vevo 2100 Imaging System. This section describes the key cart components.
Chapter 2: System description

Front view of the Vevo 2100 Imaging System

- 24" LCD monitor
- Speakers (x2)
- Transducer
- Transducer and gel holder
- Replaceable air filter
- Lockable castor (x4)
- Replaceable air filter
- Transducer ports (1 active, 2 passive)
- Control panel
- DVD drive
- Grab bar
- Air vent (x2)
Chapter 2: System description

Rear view of the Vevo 2100 Imaging System

- ECG/Physio 10-pin locking connector
- 3D motor connector
- 3-way monitor positioning arm
- Main power switch
- Power cable
- BNC connectors (for future use)
- Lockable castor (x4)
- Air filter
- 24" LCD monitor
- Firewire connector
- USB connector (x3)
- Parallel port
- DVI connector
- Computer power switch
- DVD drive
- S-Video connector
MicroScan™ transducer

The MicroScan™ array transducer (the transducer) is the device you use to acquire real-time visualization of the hemodynamic or anatomical target. The unit is designed as a hand-held probe for rapid screening procedures. You can attach it to the Vevo Imaging Station.

The components of the integrated transducer system are displayed in the following illustration.

Related information

- For information on connecting the transducer to the Vevo Imaging Station, see Working with the Vevo Imaging Station
- Options and accessories (see page 422)

Transducer array description

The 256-element array transducer delivers a usable frame rate of more than 300 frames per second depending on the transducer you use and the field of view that you have set for your image acquisition.
Chapter 2: System description

The features of the transducer are displayed in the following illustration.

![Transducer Illustration]

**Transducer options**
VisualSonics offers five transducers with center frequencies ranging from 12.5MHz to 45MHz to serve applications ranging from rabbit to mouse.

<table>
<thead>
<tr>
<th>Transducer</th>
<th>Collar color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS-200</td>
<td>Orange</td>
<td>Rabbit, general and abdominal imaging</td>
</tr>
<tr>
<td>MS-250</td>
<td>Yellow</td>
<td>Rat cardiology and abdominal imaging</td>
</tr>
<tr>
<td>MS-400</td>
<td>Red</td>
<td>Optimized for mouse cardiovascular imaging with frame rates greater than 300 frames per second</td>
</tr>
<tr>
<td>MS-550D</td>
<td>Blue</td>
<td>Mouse cancer and abdominal imaging</td>
</tr>
<tr>
<td>MS-550S</td>
<td>Gray</td>
<td>Optimized for mouse embryology imaging and injection</td>
</tr>
</tbody>
</table>

**IMPORTANT:** Only transducers manufactured by VisualSonics may be used.
Front panel

The front panel of the Vevo 2100 Imaging System features three transducer ports and a transducer cable holder, as shown in the following illustration.

Related information

- Connecting and disconnecting the transducer  (page 106)

Rear panel

The rear panel provides the connectors and power controls as detailed in the following illustration.
## Chapter 2: System description

### Rear panel connector Description

<table>
<thead>
<tr>
<th>Connector</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main power switch</td>
<td>After the power cable is connected, push the switch up to power the Vevo 2100 Imaging System.</td>
</tr>
<tr>
<td>AC in</td>
<td>Connect the power cable here.</td>
</tr>
<tr>
<td>ECG/Physio 10-pin locking connector</td>
<td>Connect your animal handling platform (optional VisualSonics accessory) cable here.</td>
</tr>
<tr>
<td>3D motor connector</td>
<td>Connect your 3D motor stage (optional VisualSonics accessory) cable here.</td>
</tr>
<tr>
<td>TX Trigger, Trig In, Trig Out</td>
<td>Connect BNC cables here. For future use.</td>
</tr>
<tr>
<td>Ethernet connector</td>
<td>Connect your network data cable here.</td>
</tr>
<tr>
<td>FireWire connector</td>
<td>Connect your Firewire equipped data storage device here.</td>
</tr>
<tr>
<td>S-Video connector</td>
<td>Connect your S-Video equipped external video recording device here.</td>
</tr>
<tr>
<td>USB connectors</td>
<td>Connect your USB equipped data storage device here.</td>
</tr>
<tr>
<td>DVI connector</td>
<td>Connect an additional monitor (optional VisualSonics accessory) in the open DVI port.</td>
</tr>
</tbody>
</table>

**WARNING:** Do not modify the attachment plug or use an adapter. This could cause an electrical hazard. If you need to use a different plug, contact a Technical Support Representative at 1-866-416-4636 (North America, toll-free), +800 0751 2020 (Europe, toll-free) or by email at support@visualsonics.com.

**CAUTION:** Before connecting the system ensure the voltage is correct. Ensure the power cable is undamaged before plugging the system directly into the wall outlet. Use of an extension cord or a power bar is discouraged.

The voltage is specified on the power connection plate on the rear panel of the system.

With the exception of the Ethernet network cable, cables being connected to the rear panel of the Vevo 2100 Imaging System must be 3 m (9'10") in length, or shorter.
Control panel

The control panel provides all image acquisition controls as well as the primary study management controls.

The control panel also provides variable backlighting under the keys and controls.

To adjust the backlighting level under the control panel:

Press and hold FN while you tap either the Up arrow key (↑ or ↓) to increase the brightness or the Down arrow key (↑ or ↓) to decrease the brightness between the Off setting and through a series of seven brightness levels.
Chapter 2: System description

Grab bars
Use the front and back grab bars when you are moving the system. Don't use them to lift the system. They are not designed to bear the weight of the system.

Transducer and gel holder
Use the transducer or gel holders located on the left and right sides of the cart to store your transducers and gel bottles. Store both items facing up.

Castors
Castors allow the Vevo 2100 Imaging System to be moved easily. The four castors can be locked using a lever located above each castor. The castors are locked when their levers are down.

WARNING: Ensure that the Castors are locked whenever the Vevo 2100 system is not being transported* together with the warning symbol.
Air filters

The Vevo 2100 Imaging System includes three air filters as described in the following illustration.

![Air filters illustration]

**WARNING:** Do not obstruct or block the filter inlets; overheating of the electronics could occur.

**Related information**

- *Cleaning your air filters* (page 440)

Vents

The cart includes six air vents. Two are located toward the rear of the left and right panels of the control panel module. Two more are located in the rear panel, and two more are located at the bottom center of the front and rear of the cart.

**WARNING:** Do not obstruct or block these vents; overheating of the electronics could occur.

Internal data storage devices

The Vevo 2100 Imaging System includes a DVD+-RW drive and two hard drives. One hard drive contains the Microsoft® Windows® Vista operating system and the Vevo software and the other hard drive is used for study storage.

The DVD drive is located on the left side of the Vevo 2100 Imaging System.
Use it to read or write data to and from CDs and DVDs. The system also provides USB, Firewire and S-Video connectors on the rear panel so you can export image data to a wide range of external devices.

**Note:** The S-Video connection may not be active on your cart, depending on the configuration. Some internal configuration may be required. Contact VisualSonics for more information.

### Related information
- **Rear panel** (page 21)

### Network connection
The computer unit includes a 100 Mbps Ethernet network connection.

### Related information
- **Rear panel** (page 21)

### Display monitor
The LCD monitor features an all-way adjustable mounting arm so you can position the monitor exactly where you want it.
Speakers

Integrated speakers provide an audio representation of the blood flow acquired in PW Doppler Mode to complement the image on the PW Doppler spectral display.

Isolation transformer

The isolation transformer that powers the Vevo 2100 Imaging System is located inside the Vevo 2100 Imaging System. The isolation transformer protects you and the equipment from electrical shock and power surges.

The Vevo 2100 Imaging System is designed to operate according to the electrical specifications of the region to which the system has been shipped. The nameplate on the back of the system indicates the electrical requirements.

The Vevo 2100 Imaging System uses a combination power switch/circuit breaker for protection in case of electrical overload. If the circuit breaker is tripped, the switch is toggled to a position that is in between the ON and OFF position.

WARNING: If the switch is positioned between the ON and OFF position it is tripped. Unplug the machine immediately and contact a Technical Support Representative at 1-866-416-4636 (North America, toll-free), +800 0751 2020 (Europe, toll-free) or by email at support@visualsonics.com.

Plug

Your Vevo 2100 Imaging System is equipped with the appropriate plug for a wall outlet. See Power plug to ensure that the plug is ideally suited for the configuration of a wall outlet.

For optimal system performance, use a dedicated, interference-free grounded/earthed wall outlet.

The power cable is securely connected to the Vevo 2100 Imaging System with a cable retainer. If you need to remove the power cable from the cart, loosen the screw at the top of the cable retainer.

WARNING: Do not modify the attachment plug or use an adapter. This could cause an electrical hazard. If you need to use a different plug, contact a Technical Support Representative at 1-866-416-4636 (North America, toll-free), +800 0751 2020 (Europe, toll-free) or by email at support@visualsonics.com.
CAUTION: Before connecting the system ensure the voltage is correct. Ensure the power cable is undamaged before plugging the system directly into the wall outlet. Use of an extension cord or a power bar is discouraged.

The voltage is specified on the power connection plate on the rear panel of the system.

Related information
- Rear panel (page 21)

Vevo 2100 Workstation Software description

VisualSonics offers an optional Vevo 2100 Workstation Software package which includes all the software tools and features that you will find on the Vevo 2100 Imaging System excluding the image acquisition tools features.

Vevo 2100 Workstation Software running on a laptop

Related information
- Workstation analysis (optional) (page 157)
Available configurations

VisualSonics offers several configurations of the Vevo 2100 Imaging System, as described in the following table.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Configuration</td>
<td>Vevo 2100 Imaging System&lt;br&gt;Vevo software, including:&lt;br&gt;• Analytic software package for B-Mode (2D) image capture and analysis&lt;br&gt;• Cine loop image capture, display, and review&lt;br&gt;• Software analytics for Advanced Measurements and Annotations&lt;br&gt;• Physiological Data on-screen trace</td>
</tr>
<tr>
<td>Flow Analysis Option</td>
<td>PW Doppler Mode (for rapid flow applications) and Power Doppler (for slow blood flow applications)</td>
</tr>
<tr>
<td>3D Analysis Option</td>
<td>3D acquisition and visualization</td>
</tr>
<tr>
<td>Cardiac Analysis Option</td>
<td>M-Mode&lt;br&gt;Tissue Doppler Imaging (TDI) for assessing diastolic dysfunction&lt;br&gt;Automated LV Analysis for semi-automated analysis and quantification of LV function&lt;br&gt;Integrated Blood Pressure with Pressure-Volume Analysis&lt;br&gt;Advanced Cardiovascular Measurements Capability</td>
</tr>
<tr>
<td>Molecular Imaging Option</td>
<td>Contrast Mode acquisition and analysis</td>
</tr>
</tbody>
</table>

Related information

- For a complete list of accessories and optional components, see Accessories (page 422)
Chapter 3

Quick Start Tutorial

This chapter is a high-level procedure for acquiring and analyzing an image and then exporting your analysis.

You will find this quick start tutorial useful:

- If you are familiar with how ultrasound systems work and you want to jump in and give it a try
- If you haven't used the system in a while and want a refresher tutorial

Before you begin

- Ensure that you have connected a transducer to the transducer port on the front of the cart.
- If you are imaging an animal, ensure that the animal is properly prepared on the animal platform and ensure that the animal is connected to the physiological data monitoring system.

**WARNING**: Before using the VEVO 2100 any operator must read and observe the Safety Warnings and Precautions in Safety (page 429).

To acquire and analyze a B-Mode image and export your analysis:

1. On the back of the cart, turn on the **Main Power**.
2. On the left side of the cart press the **Computer Standby** toggle.
   
   The computer operating system starts and then the Vevo 2100 Imaging System software starts and displays the **VisualSonics Vevo® 2100** dialog.
3. In the **Application** box select the type of imaging application: General Imaging or Cardiology.
   
   The system initializes the transducer and opens the **Study Browser** window.
4. Press **B-Mode**.
   
   The **B-Mode** imaging window appears and the system begins acquiring B-Mode data.
5. Refine your image using the various control panel controls such as the **Image Depth** toggle control, the **2D Gain** dial and the **Invert** button.
6. Press **Scan/Freeze** to stop the data acquisition.
7. Press **Cine Store** to save the sequence of images in the system buffer. In the background:
The system creates a date-stamped new study for you as well as the first image series set, **Series 1**.

The system stores a date-stamped cine loop of the B-Mode data you are acquiring.

8. Press **Scan/Freeze** again to resume the data acquisition.

9. Continue freezing and storing as required.

10. Press **Study Management**.

The **Study Browser** window appears and displays the new date-stamped study, new date-stamped study series and the new time-stamped images. You can now analyze the image data.

11. In the **Name** column, double-click the **Series 1** row.

   The review panel displays thumbnails of the images you stored.

12. Double-click the first thumbnail.

   The B-Mode window appears and plays the cine loop you stored.

13. Using the **Cine Loop Review** dial:

   a. Turn the dial counter-clockwise to slow the loop down until you reach your desired playback rate

   b. Press down on the dial to toggle the cine loop to stop.

   c. Turn the dial one way or the other to control the movement of the cine loop frame by frame.

14. Press **Measure**.

   The measurement tools appear near the top of the left panel.

15. In the measurement packages list box:

   d. Click the appropriate measurement package for your study. For example, click **Embryology Package**.

      The system displays the list of available measurement protocols.

   e. Click the appropriate protocol. For example, click **Placenta**.

      Under the protocol label, the system displays the list of predefined protocol measurements.

   f. Click the appropriate measurement. For example, click **Placenta Sag**.

      The list box becomes a preview panel and the system highlights the icon for the measurement tool that the system uses for the protocol measurement. For the Placenta Sag measurement, the system uses the **Linear** tool.

16. In the image area, place and complete your measurement.
When you have completed your measurement, the system applies a label or index number to your measurement based on the preferences you set in the Measurement tab of the Preferences window.

The system also displays the value in the **Measured Values** list.

17. Press **Study Management**.

The **Study Browser** appears. The thumbnail of the image you have been adding measurements to displays the most recent frame you worked on, including the measurements.

18. Click the **Series 1** row and click **Report**.

The **Analysis Browser** appears and displays a report of the measurements you made for that series, listed in order by application package.

19. Click **Export**.

The **Export Report** window appears.

20. In the **Export Report** window:

   a. Browse to the folder where you want to export your report.

   b. If you want to create a new folder, select the folder that will hold the new folder, click **New Folder**, type the folder name in the **New Folder Name** dialog box, and then click **OK**.

   c. In the **Options** area, modify the title of the report in the **Save As** box if required.

   d. Click **OK**.

The system exports your report.

You have successfully acquired and analyzed an image, and exported your report.

**Related information**

- *Vevo 2100 Imaging System workspaces* (page 44)
- *Managing your studies* (page 125)
- *Acquiring image data* (page 100)
- *Analyzing image data* (page 156)
Vevo fundamentals

This section introduces you to the fundamentals of the Vevo 2100 Imaging System and shows you how they work.

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Chapter 4

How the Vevo 2100 Imaging System works

The Vevo 2100 Imaging System is easy to work with and understand because you work with three simple concepts:

- Image acquisition modes
- Operators
- Studies

WARNING: Before using the VEVO 2100 any operator must read and observe the safety warnings and precautions in Safety (page 429).

This chapter shows you how these concepts work together to help you generate useful image data.

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Operators ..................................................................................................... 36
Studies, series and images .......................................................................... 37
Image acquisition modes .......................................................................... 37

Turning your system On and Off

Before you power up your system, ensure that the AC power cord is plugged into the wall outlet using the proper plug. See Plug (page 27) for more information.

WARNING: Do not modify the attachment plug or use an adapter. This could cause an electrical hazard. If you need to use a different plug, contact a Technical Support Representative at 1-866-416-4636 (North America, toll-free), +800 0751 2020 (Europe, toll-free) or by email at support@visualsonics.com.
Chapter 4: How the Vevo 2100 Imaging System works

CAUTION: Before connecting the system ensure the voltage is correct. Ensure the power cable is undamaged before plugging the system directly into the wall outlet. Use of an extension cord or a power bar is discouraged.

The voltage is specified on the power connection plate on the rear panel of the system.

To turn your system ON:

1. On the rear panel, push up the Main Power switch. This connects the system to the power source and turns on the internal fans, but it does not turn on the control.

2. On the left side of the control panel module, press the Computer Standby switch. This is a toggle switch, so when you press it, it does not stay pushed in like a light switch. Instead it returns to its original position. This is normal.

The system starts the control panel backlights, the display monitor and the computer operating system.

To turn your system OFF:

1. Ensure that you have stored all the image data that you are working on.

2. Press the Computer Standby switch.

   The computer shuts down, the monitor powers down, and the control panel backlights turn off. The fans continue to run.

3. If you need to turn off all power to the system:
   a. Let the fans run for 10 minutes to safely cool down the internal components.
   b. Push down the Main Power switch.

Related information

- Plug (page 27)
Application packages

Application packages are predefined groups of image acquisition settings. This way you can quickly get an optimal image to work with, and when you're ready to take your measurements, you can quickly cycle through the pre-ordered measurements protocol for your application.

The system includes two default application packages:

- General imaging
- Cardiology

When you start your system, you select the application package for the work you are doing.

For example, if you are doing cardiology imaging you select the Cardiology package. Then The system configures the imaging acquisition parameters for optimal cardiology imaging.

Operators

Operators are the people — or, more precisely, the user profiles — that use the system. You can set a password for an operator to restrict other operators from unlocking and deleting a study that an operator owns.

Related information

- Working with operator profiles (page 61)
Studies, series and images

Studies in the Vevo 2100 Imaging System are like studies in a paper based system. They work much like a file directory and hold all the series 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).

Related information
- Creating a study (page 127)
- Creating a series (page 132)
- Acquiring data in an image mode (page 120)

Image acquisition modes

The Vevo 2100 Imaging System provides a range of high-resolution micro-ultrasound imaging modes to achieve different imaging objectives.

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. If you have seen a conventional ultrasound image then you are already familiar with B-Mode.

B-Mode is also used:
- In other imaging modes as the background orientation image over which the active mode data is applied
- 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

Related information
- Mode window workspace (page 44)
- Acquiring B-Mode images (page 190)
- Analyzing B-Mode images (page 202)
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 fundamentally differently than B-Mode. Where B-Mode uses multiple scanning beams to create its image, M-Mode uses just one.

So, when you have guided your transducer beam to the depth that gives you a proper cross-section of the heart, you can then set M-Mode to lay its single beam across that cross-section. In effect, it is like positioning a tight string through the heart, and recording the movement of the heart structure cross-sections along that string.

This way, the movement of the heart structures move up and down that single line so you can then take measurements along that line over time. These movements over time are the waves that you see in the M-Mode image.

Related information

- Mode window workspace (page 44)
- Acquiring M-Mode images (page 225)
- Analyzing M-Mode images (page 235)

PW (Pulsed Wave) Doppler Mode overview

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 system speakers.

Related information

- Mode window workspace (page 44)
- Acquiring PW Doppler Mode images (page 246)
- Acquiring PW Tissue Doppler Mode images (page 260)
- Analyzing PW Doppler Mode images (page 262)

Color Doppler Mode overview

Color Doppler Mode uses Doppler principles to determine the mean velocities of blood within the region of interest. The system then applies color that represents these various velocities under the convention of BART (Blue=Away Red=Toward).

This mode is useful for bloodflow 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

### Related information
- Mode window workspace (page 44)
- Acquiring Color Doppler Mode images (page 305)
- Analyzing Color Doppler Mode images (page 315)

#### 3D-Mode overview
3D-Mode provides a three-dimensional view of an area of interest. The system acquires the 3D data by creating a rapid series of B-Mode slices, then combining these slices into a whole image.

You can then use the analysis tools to manipulate the three-dimensional renderings and make volumetric measurements of the structures you are interested in.

### Related information
- Mode window workspace (page 44)
- Acquiring 3D-Mode images (page 275)
- Analyzing 3-D Mode images (page 288)

#### Power Doppler Mode overview
Power Doppler Mode provides tools to visualize and measure flow in 2D and/or 3D. This mode is useful for applications such as detecting vascularity in and around orthotopic and subcutaneous tumors and producing a measure of relative quantification.

### Related information
- Mode window workspace (page 44)
- Acquiring Power Doppler Mode images (page 321)
- Analyzing Power Doppler Mode images (page 333)

#### Contrast Mode overview
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

**Related information**

- *Mode window workspace* (page 44)
- *Acquiring Contrast Mode images* (page 338)
- *Analyzing Contrast Mode images* (page 352)
Chapter 5

Logging on

This chapter walks you through the procedures for logging on to the system and selecting yourself as the active operator.

In this chapter
Logging on the very first time the system is used ............................................................41
Logging on for a typical session..........................................................................................42

Logging on the very first time the system is used

When you are the first person ever to log on to the Vevo 2100 Imaging System, the logon procedure is different than the standard logon for a typical session. This is because no-one has added any administrator profiles or operator profiles yet.

To log on the very first time the system is used:

1. On the back of the control panel module turn on the **Main Power** switch.
2. On the left side of the control panel module turn on the **Computer Standby** switch.
   - The control panel lights turn on.
   - The Vevo 2100 Imaging System software starts and displays the acquisition **Presets** dialog box

   ![Presets dialog box](image)

3. In the **Application** list, select the application package you want to work with.
4. Click **OK**.

You can now start a new acquisition session.

You should add an administrator now and then add the operators.
Next steps

- Adding an administrator (page 62)
- Adding an operator (page 63)

Related information

- Logging on for a typical session (page 42)
- Application packages (page 36)

Logging on for a typical session

Use the following procedure after the administrator has created your operator profile.

**To log on for a typical session:**

1. On the back of the control panel module turn on the **Main Power** switch.
2. On the left side of the control panel module turn on the **Computer Standby** switch.
   - The control panel lights turn on
   - The Vevo 2100 Imaging System software starts and displays the dialog box to select an application.
3. In the **Application** list, select the application package you want to work with and click **OK**.
The system initializes the transducer and opens the **Study Browser** window.

4. In the **Study Browser** window, select your operator name.

Any acquisition work you do – such as creating a new study, or a new series, or creating new images – is recorded by the system as being completed by this operator.

**Related information**

- *Changing the active operator* (page 67)
- *Application packages* (page 36)
This chapter describes the primary software workspaces that you use when you work with the Vevo 2100 Imaging System.

In this chapter
Mode window workspace....................................................................................................44
Study Browser window workspace ....................................................................................49
Study Information window workspace..............................................................................50
Preferences window workspace..........................................................................................51
Analysis Browser window workspace ...............................................................................53
Export and Copy To windows workspaces .......................................................................54

Mode window workspace

The Mode window is the workspace you use whenever you view image data in any ultrasound imaging mode.

To open a Mode window:

- On the control panel, press one of the Mode keys. For example, press **B-Mode**. The system displays the Mode window and begins acquiring B-Mode image data.
- If you are in 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.
The following illustration and table describes the information and features in the Mode window.

A typical Mode window workspace. This example is a B-Mode window displaying a stored cine loop.

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Image data panel</td>
<td>Displays the image data that the transducer produces, and displays the physiological data if you are acquiring it. When you export a stored image and configure your export to send only the Image Area, this is the image area that the system exports.</td>
</tr>
<tr>
<td>2 Micro-ultrasound image</td>
<td>Displays the data that the transducer acquires. When you review an image, this is the workspace where you use the image measurement tools to apply your measurements.</td>
</tr>
<tr>
<td>3 Depth ruler</td>
<td>Indicates the depth from the transducer face. The triangular arrow indicates the focal length(s) of the transducer. When you acquire image data, use the Depth control on the control panel to increase or decrease the depth that you can see.</td>
</tr>
<tr>
<td>4 Focal depth indicator</td>
<td>When you acquire data in B-Mode, use the Focal Zones control on the control panel to add up to three focal zones.</td>
</tr>
<tr>
<td>5 Transducer orientation indicator</td>
<td>The line in this icon corresponds to the orientation ridge on the transducer and indicates the orientation of the probe relative to the image. If your transducer is acquiring at 180 degrees the wrong way, you can click the indicator to flip the image.</td>
</tr>
</tbody>
</table>
Chapter 6: Vevo 2100 Imaging System workspaces

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td><strong>Dynamic range bar.</strong> Indicates the dynamic range of the display. When you acquire data, use the Dynamic Range control on the control panel to change the range.</td>
</tr>
<tr>
<td>7</td>
<td><strong>Physiological data trace panel.</strong> Displays your animal's dynamic heart rate, temperature, respiration rate and blood pressure data. This information comes from the Advanced Physiological Monitoring Unit that connects to the Vevo Imaging Station.</td>
</tr>
<tr>
<td>8</td>
<td><strong>Physiological data values.</strong> Appears only on a stored image or when you pause the system. Can display the numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature.</td>
</tr>
<tr>
<td>9</td>
<td><strong>Cine loop range control.</strong> Appears only on a stored or acquired cine loop. Displays the length of the cine loop range. The triangular white marker identifies the individual frame number within the cine loop. You can drag the left and right vertical markers to display only the image frames in that range.</td>
</tr>
<tr>
<td>10</td>
<td><strong>Physiological live display.</strong> Appears in real time during image acquisition and can display the numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature. This area also displays the image data storage capacity progress bar so you can see when you should start to back up your image data to free up space on the system.</td>
</tr>
</tbody>
</table>
| 11   | **Dynamic control panel feedback.**  
- Displays the changing setting values while you use a control panel control until you stop and the system redraws the image. Then the system displays the setting value in the Mode settings panel.  
- Displays confirmation messages when you store an image. |
| 12   | **Left panel.** Displays a unique set of controls and information sections depending on the control key you press:  
- Press **Mode Settings** to set the panel to display the Mode settings. This is the default panel when you open a Mode window.  
- Press **Measure** to set the panel to display the measurement tools. These tools are not available when you are acquiring or reviewing images.  
- Press **Physio Settings** to set the panel to display the options for a) viewing and manipulating physiological data input from the Advanced Physiological Monitoring Unit and b) manipulating the Respiration Gating and ECG Trigger controls.  
For complete information on how each panel works, see *Left panel workspace* (page 47). |
| 13   | **Operator details**  
- Displays your institution name if you added it in the Preferences window.  
- Displays your operator name if you selected it for your session.  
- Identifies the model number of the transducer that is acquiring imaging data (if you are in an image acquisition session) or the transducer that acquired the data (if you are in an image analysis session). |
Area Description

**Image details**
- Displays the system default study name and series name (unless you have customized them in the Study Information section of the Study Information window).
- Displays the Animal ID if you added it in the Series Information section of the Study Information window.
- Displays the image label if you added it by pressing Image Label.

**Image status**
The top (yellow) line identifies the ultrasound mode that the image was acquired in (for example B-Mode). The lower (white) line identifies the state of the image:
- **Acquired.** Confirms that the system has acquired the image after you press Scan/Freeze. Note that this does not mean that the image is saved. You must press Cine Store or Frame Store to store the image.
- **Stored.** Confirms that the system stored the image after you press Cine Store or Frame Store.
- **Recalled.** The image was opened from the Study Browser.
- Nothing appears below the yellow mode label while you are in the process of acquiring data.

**Time stamp/system status.** The top two (white) lines display the actual time when the system acquired the visible frame. The lower (yellow) line identifies the current state of the system:
- **System Active.** The system is acquiring image data.
- **System Paused.** The system is displaying the acquired image after you press Scan/Freeze.
- **Review.** The system is displaying a stored image.

**Related information**
- Control panel (page 57)
- Setting up your Vevo 2100 Imaging System (page 101)
- Working with physiological data (page 109)
- Typical acquisition session workflow (page 120)

**Left panel workspace**
You can set the left panel to display one of the following workspaces:
- Mode settings
- Measurements tools
- Physiological data options (not applicable in 3D-Mode)
To select the panel workspace you want to work with:
Press the appropriate key on the control panel as described in the following illustration and table.

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Mode Settings</td>
<td>panel workspace. Read-only. Press <a href="#">Mode Settings</a>.</td>
</tr>
<tr>
<td><strong>2</strong> Measurements</td>
<td>panel workspace. Tools are only available when you are reviewing an individual frame and you pause the playback. During image acquisition, the tools are not available. Press <a href="#">Measure</a> (or click <a href="#">Measurements</a> on the workstation).</td>
</tr>
<tr>
<td><strong>3</strong> Physiological data options</td>
<td>panel workspace. The Physiological Range, Respiration Gating and ECG Trigger sections are only available during image acquisition. Press <a href="#">Physio Settings</a> (or click <a href="#">Physiological</a> on the workstation).</td>
</tr>
</tbody>
</table>

**Related information**
- Mode window workspace (page 44)
- Viewing physiological data (page 110)
Chapter 6: Vevo 2100 Imaging System workspaces

Study Browser window workspace

The Study Browser window is the exploration workspace you use to manage your studies, study series, and individual images.

The Study Browser works in many ways like the Explorer window on your Windows PC:

- Expand a study listing to view the study series that are in the study
- Expand a study series listing to view the images that are in the study series
- Double-click an image listing to view the image in a Mode window

To open your Study Browser:

Press Study Management. The system displays the Study Browser window.

The following illustration and table describes the information and features in the Study Browser.

![Study Browser window highlighting the study, series and image items in the list](image)

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Studies list. Lists all the available studies, the series groupings that you create within each study, and the individual images that you create within each study series.</td>
</tr>
<tr>
<td>2</td>
<td>Study listing.</td>
</tr>
</tbody>
</table>
Area Description

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Series listing within a study.</td>
</tr>
<tr>
<td>2</td>
<td>Image listing within a series.</td>
</tr>
<tr>
<td>3</td>
<td>Operator selection list.</td>
</tr>
<tr>
<td>4</td>
<td>Study Browser window commands.</td>
</tr>
<tr>
<td>5</td>
<td>Image thumbnails or study notes for the selected series.</td>
</tr>
</tbody>
</table>

**Related information**

- Creating a study (page 127)
- Creating a series (page 132)
- Adding images to a study series (page 122)

**Study Information window workspace**

Use the **Study Information** window to:

- Display or manage the description information for a study
- Display or manage the description information for a series within a study

▶ **To open the Study Information window:**

- When you are in the **Study Browser** and you have selected a study listing or series listing, press **Study Info**. If you select the row for a series, the system displays the information for the series and the study that contains the series. If you select the row for a study, the system only displays the information for the study.
- When you are in the **Study Browser**, press **New**. You can create and describe a new study.
- When you are in a **Mode** window acquiring or reviewing image data, press **Study Info**.
The following illustration and table describes the information and features in the **Study Information** window.

**Study Information window displaying the view when you select a series and then press **Study Info**.**

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Study Information</strong> section. Includes the information boxes that describe a study.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Series Information</strong> section. Includes the information boxes that describe a series within a study.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Study Information</strong> window commands.</td>
</tr>
</tbody>
</table>

**Related information**
- Modifying the information properties of a study (see page 129)

---

**Preferences window workspace**

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

Use the **Preferences** window to configure defaults that are available to all operators on the system.

**To open the Preferences window:**
- Press **Prefs**.
In the **Study Browser**, click **Prefs**.

- If you are analyzing data in a Mode window on the workstation, click the icon in the image tools icon panel.

The following illustration and table describes the information and features in the **Preferences** window.

---

**Preferences window, displaying the General tab preference sections**

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td>General preferences tab. Use this tab primarily to specify your acquisition settings.</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>Operator preferences tab. Use this tab to add, modify, delete and manage the profiles and rights for the operators and administrators who access the system.</td>
</tr>
<tr>
<td><strong>3</strong></td>
<td>Measurement preferences tab. Use this tab to customize the measurement packages you want the system to display, as well as specify which protocol and protocol measurements you want the system to display.</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td>Annotation preferences tab. Use this tab to customize the way you view and add annotations when you analyze the image data that you have acquired.</td>
</tr>
<tr>
<td><strong>5</strong></td>
<td>Presets preferences tab. Use this tab to create custom acquisition presets.</td>
</tr>
<tr>
<td><strong>6</strong></td>
<td>Maintenance tab. Use this tab to manage system level features.</td>
</tr>
</tbody>
</table>

---

**Related information**

- Setting your operating preferences (page 69)
Analysis Browser window workspace

The Analysis Browser window displays a report of the measurements and calculations for one or more studies or just the study series you select in the Study Browser.

To open the Analysis Browser window:

1. Press Study Management.
   The system displays the Study Browser.
2. Select a study listing or study series listing and click Report.
   The system displays a report of the measurements and calculations for the study or the study series.

The following illustration and table describes the information and features in the Analysis Browser.

![Analysis Browser displaying a report of the measurements and calculations for a study](image)
Chapter 6: Vevo 2100 Imaging System workspaces

### Report details.
- If you select a study listing in the **Study Browser** before you click **Analysis**, the report details display all the measurements and calculations for all images in all series in the study.
- If you select a series listing in the **Study Browser** before you click **Analysis**, the report details display only the measurements and calculations for the images in that series.

### Analysis Browser window commands.

### 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 window.

### Related information
- Exporting an image analysis report (page 185)

---

## Export and Copy To windows workspaces

The system provides a common workspace environment for transferring data from your Vevo 2100 Imaging System. You see this workspace when you are:

- Copying studies from the **Study Browser**
- Exporting images from the **Study Browser**
- Exporting report data from the **Analysis Browser**

### To open the Copy To window:
1. Press **Study Management**. The system displays the **Study Browser**.
2. Select one or more studies and click **Copy To**.

### To open the Export Image window:
1. Press **Study Management**. The system displays the **Study Browser**.
2. Select one or more studies and/or series and click **Export**.

### To open the Export Report window:
1. Press **Study Management**. The system displays the **Study Browser**.
2. Select one or more studies and/or series and click **Analysis**. The system displays the **Analysis Browser**.
3. Click **Export**.
Chapter 6: Vevo 2100 Imaging System workspaces

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

---

**Export Image** window displaying the export information and setup options for an image

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Folder browser. Functions the same way your Explorer window works on your Windows PC: browse the folders to find your destination folder.</td>
</tr>
</tbody>
</table>
| 2    | File transfer information and options.  
  - The Export Type section only appears when you are exporting series images or analysis reports  
  - The Selected section is read-only and shows you how many items you are exporting or copying, and the space required and available on your data storage device  
In the Export Type section, when you select an export type, the Options section dynamically displays the specific file type options for the type of content you are exporting. |
| 3    | Export window commands.  
  - If you need to create a new folder to hold the file you are exporting, click New Folder. The system adds a new folder inside the selected folder in the folder browser window.  
  - When you have set up your export location and your file transfer options, click OK. |
Related information

- Exporting images (page 139)
- Exporting measurements and calculations (page 185)
Chapter 7

Control panel

This chapter describes the physical controls on the cart's control panel that you use to complete your image acquisition and image analysis tasks.

In this chapter
Control groupings...........................................................................................................................................57

Control groupings

The keys, dials, toggles, sliders and rocker switches on the panel are situated so that the image acquisition keys you will use most often are grouped as closely as possible to the trackball.

Related information

- For a functional description of each control on the control panel, see Descriptions of control panel controls (page 406)
- Control panel controls for B-Mode (page 194)
- Control panel controls for M-Mode (page 229)
- Control panel controls for PW Doppler Mode (page 251) (includes PW Tissue Doppler Mode controls)
- Control panel controls for Color Doppler Mode (page 309)
- Control panel controls for 3D-Mode (page 281)
- Control panel controls for Power Doppler Mode (page 327)
- Control panel controls for Contrast Mode (page 345)

NOTE: In the procedures in this manual all controls on the control panel are displayed in Control Block format, and software commands and labels are displayed in Bold. For example:

"Press Study Management. The Study Browser appears."
The Vevo® Imaging Station is VisualSonics’ advanced system for handling, monitoring and managing mice and rats during imaging procedures. This component-based apparatus helps you position the anesthetized animal in a stable position in relation to the transducer so you can:

- Maintain the correct image plane during an imaging session
- Monitor and maintain the animal’s ECG, heart rate, and core body temperature and display and record this data in the Vevo 2100 Imaging System in real time
- Manipulate the animal for image-guided injection and embryonic aspiration procedures

The following illustration and table describes the components of the Vevo® Imaging Station.
### Chapter 8: Vevo Imaging Station

#### Area Description

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Animal handling and physiological monitoring system.</strong> Use this system to secure the subject animal, support the manipulation of the animal during imaging, ensure the comfort of the animal during the imaging session, and monitor the animal’s blood pressure, ECG, temperature and heart rate.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Integrated rail base.</strong> Provides the stable rail for attaching, sliding and securing the animal platform system, injection system and transducer mounting system. You can interchange these systems and set them up for left-handed or right-handed people.</td>
</tr>
</tbody>
</table>
| 3 | **3D motor system** (optional). Captures data sets for 3D volumetric measurements. The transducer connects to the bottom of the system. The system moves the transducer from one side to the other as the transducer acquires cross section slices. The slices combine to create the 3D image.  

**WARNING:** The 3D motor stage could cause a hazard to fingers during a 3D scan as the motor stage moves. Ensure that fingers are kept away from the 3D motor stage during a 3D scan. |
| 4 | **Transducer mounting system.** Secures the transducer in a stationary position when you position it at the desired image plane. In this configuration, the 3D motor system is attached to the mounting system and the transducer clamp is connected to the connector on the bottom of the 3D motor system. |

#### Related information

- *Vevo Imaging Station Operator Manual* (see your printed manual)
- *Setting up your Vevo 2100 Imaging System* (page 101)
- *Working with physiological data* (page 109)
Managing operator access

The Vevo 2100 Imaging System provides tools for administrating your operators' access to the system. This section shows you how to use these tools.

In This Section
Working with operator profiles........................................................................................................61
Chapter 9

Working with operator profiles

An operator is any person who works with the image data on the system. An operator profile is the access and privilege settings that apply to an operator. This chapter shows you how to set up an access and privilege profile for each person who can operate the system.

In this chapter

Responsibilities for administrators, owners and operators .............................................61
Adding an administrator ......................................................................................................62
Adding a standard operator ................................................................................................63
Modifying an operator.........................................................................................................64
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Responsibilities for administrators, owners and operators

Individual users can be operators, owners and administrators. These roles are described in the following table.

<table>
<thead>
<tr>
<th>User role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>A standard operator can:</td>
</tr>
<tr>
<td>operator</td>
<td>▪ Acquire and review image data</td>
</tr>
<tr>
<td></td>
<td>▪ Lock or unlock their own studies, and lock or unlock studies owned by</td>
</tr>
<tr>
<td></td>
<td>other operators that are not password protected</td>
</tr>
<tr>
<td></td>
<td>▪ Change their own operator password, if they have one</td>
</tr>
<tr>
<td>Owner</td>
<td>The name of the operator who assigned their name to a specific study</td>
</tr>
</tbody>
</table>
## User role Description

<table>
<thead>
<tr>
<th>User role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrator</td>
<td>An administrator is an operator with additional privileges. An administrator can:</td>
</tr>
<tr>
<td></td>
<td>- Create new operators and administrators</td>
</tr>
<tr>
<td></td>
<td>- Delete any operator or administrator</td>
</tr>
<tr>
<td></td>
<td>- Assign, remove or change a password to an operator or administrator</td>
</tr>
<tr>
<td></td>
<td>- Lock or unlock any study</td>
</tr>
</tbody>
</table>

After VisualSonics delivers the Vevo 2100 Imaging System, every operator you create maintains full administrator rights until someone assigns administrator rights to themselves or to someone else.

### Related information
- Working with operator passwords (page 65)
- How passwords and study locks work (page 130)

## Adding an administrator

An administrator is an operator with additional privileges. An administrator can:

- Create new operators and administrators
- Delete any operator or administrator
- Assign, remove or change a password to an operator or administrator
- Lock or unlock any study

### Important conditions

Because every operator has full administrator rights until someone assigns themselves or someone else as an administrator, you should assign an administrator to the system as soon as you can after VisualSonics installs your Vevo 2100 Imaging System.

**CAUTION:** If you do not create at least one Administrator operator as part of your operator group, any operator can add or delete other operators’ studies.

You can create any number of administrators, but remember that each administrator can modify the settings of another administrator, so be careful.

### To add an administrator:

1. Press **Prefs**. The Preferences window appears.
2. Click the **Operator** tab and then click **Add**.

3. In the **Operator Properties** dialog box:
   a. In the **Name** box, type a name for the operator. Typically this is the user’s personal name.

   **Notes:** You cannot type the same name for two operators. Also, you cannot modify the name after you have added the operator, so make sure you type the correct name.

   b. In the **Type** choice, select **Administrator**.

   c. Select the **Password Protected** check box.

      The **Password** boxes become active.

   d. In the **Password** box, type the password, then tab to the **Retype Password** box and retype it.

4. Press **OK**.

   The system creates the new administrator profile and lists it in the **Operator** list.

5. Click **OK**.

**Related information**

- **Adding a standard operator** (page 63)
- **How passwords and study locks work** (page 130)

---

**Adding a standard operator**

Only an administrator can add an operator or another administrator.

A standard operator can:

- Acquire and review image data
- Lock or unlock their own studies, and lock or unlock studies owned by other operators that are not password protected
- Change their own operator password, if they have one

**To create an operator:**

1. Press **Prefs**. The **Preferences** window appears.
2. Click the **Operator** tab and then click **Add**.
3. In the **Operator Properties** dialog box:
Chapter 9: Working with operator profiles

a. In the **Name** box, type a name for the operator. Typically this is the user's personal name.

**Notes**: You cannot type the same name for two operators. Also, you cannot modify the name after you have added the operator, so make sure you type the correct name.

b. In the **Type** choice, select **Standard**.

c. If you want to give this operator password protection to prevent non-administrators from deleting their studies, select the **Password Protected** check box.

The **Password** boxes become active.

d. In the **Password** box, type the password, then tab to the **Retype Password** box and retype it.

e. Press **OK**.

4. Enter your password and click **OK**.

The system creates the new operator profile and lists it in the **Operator** list.

5. Click **OK**.

**CAUTION**: If you do not create at least one **Administrator** operator as part of your operator group, any operator can add or delete other operators' studies.

**Next step**

- *Adding an administrator* (page 62)

**Related information**

- *How passwords and study locks work* (page 130)

**Modifying an operator**

An operator profile is the information that describes:

- The identity of an operator
- The operator's user type (standard or administrator)
- The operator's password, if they have one

**Important conditions**

- Only an administrator can modify the profile of another operator
To modify an operator profile:

1. Press Prefs and then click the Operator tab.
2. In the list of operators, select the operator you want to modify and click Modify.

   The Operator Properties dialog box appears.
3. Modify the properties and click OK.

   The system stores your modifications and returns you to the Preferences window.
4. Click OK.

Deleting an operator

When you delete an operator, the system only deletes the operator profile. The system does not affect the operator's studies in any way.

**Important conditions**

Only an administrator can delete another operator or their own administrator profile.

To delete an operator:

1. Press Prefs and then click the Operator tab.
2. In the list of operators, select the operator you want to delete, press DEL and confirm the deletion.

   The system deletes the operator profile and returns you to the Preferences window.
3. Click OK.

Working with operator passwords

Operator passwords prevent non-administrators from deleting studies that were created and locked by another operator. If you have a password and you select the lock check box for your studies, only you or an administrator can delete them.
Chapter 9: Working with operator profiles

**CAUTION**: If you do not create at least one **Administrator** operator as part of your operator group, any operator can add or delete other operators’ studies.

### Important conditions

- You can modify your own password
- Only an administrator can modify the password of another operator

#### To add a password to an operator:

1. Press **Prefs** and then click the **Operator** tab.
2. Select the name of the operator and then click **Modify**.
3. In the **Operator Properties** window:
   a. Select the **Password Protected** check box.
      The **Password** boxes become active.
   b. In the **Password** box type the password, then tab to the **Retype Password** box and retype it.
   c. Click **OK**.

   The system stores the password and returns you to the **Operator** list.

#### To change an operator password:

1. Select the name of the operator and then click **Modify**.
2. In the **Operator Properties** window:
   a. In the **Password** box select and delete the existing password, then type the new password.
   b. Tab to the **Retype Password** box and type the new password over the old one.
   c. Click **OK**.

   The system stores the new password and returns you to the **Operator** list.

#### To remove password access for an operator:

1. Select the name of the operator and then click **Modify**.
2. In the **Operator Properties** window:
   a. Clear the **Password Protected** check box.
   b. Click **OK**.
The system stores the password and returns you to the Operator list.

**Related information**

- Locking a study (page 131)
- How passwords and study locks work (page 130)

---

**Changing the active operator**

The active operator is the operator who is listed:

- In the operator box located above the list of studies in the Study Browser.

*When you click New to create a new study, the operator you select here is the default owner of the new study*

- In the upper-left corner of the Imaging Mode window.

Any work you do – such as creating a new study, or working on an existing or new series, or creating new images – is recorded by the system as being completed by this operator.

**To change the active operator:**

1. Press Study Management. The Study Browser appears.
2. In the operator box select the name you want to be active.
3. If your new operator name requires a password, in the Password box type the password.
4. Click OK.
   The system displays the new active operator name.
Chapter 9: Working with operator profiles

Sorting the list of operators

To sort the list of operators:

1. Press Prefs and then click the Operator tab.
2. Click the column heading of the column you want to sort the entries by.
   - For the Name column, the system sorts the entries in alphabetical order. Click the heading to switch the sort order from ascending to descending.
   - For the Type column, the system sorts the entries by type. Click the heading to switch the sort order from Administrator entries first to Standard operator entries first.
Section 4

Setting the operating preferences

The Preferences window provides a series of tabs you can use to customize the way you work with the Vevo 2100 Imaging System.

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Setting the Measurement tab preferences ......................................................... 80
Setting the Annotation tab preferences ............................................................ 88
Setting the Presets tab preferences ................................................................. 91
Setting the Maintenance tab preferences ......................................................... 97
Chapter 10

Setting the General tab preferences

Use the General preferences tab to customize a range of frequently used features.

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Auto SAVE preferences ......................................................... 72
Auto SAVE On Scan Completion preferences ......................... 72
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General preferences

Use the General preferences section to describe your facility.

To display the name of your institution in the Mode window:

1. From the Study Browser (page 49) click Prefs and then click the General tab.
2. In the Institution box, type the name of your institution.
3. Click OK.

The system displays the name beneath the VisualSonics logo in the Mode window when you acquire or review image data.
Cine Loop Size preferences

Use the **Cine Loop Size** section to specify the amount of continuous image data you want the system to keep in memory when you acquire a cine loop.

![Cine Loop Size section displaying the default cine loop size values for each Mode that supports cine loops](image)

While you acquire data, the system's playback memory holds your most recent image data in a buffer. The size of the buffer is determined by the **Cine Loop Size** preference you specify.

**Examples:**

- If you set your B-Mode cine loop size to 100 frames and you scan in B-Mode for two minutes, when you press **Cine Store** or **Scan/Freeze** the system records only the last 100 frames of image data that you acquired.

- If you set your **M-Mode** cine loop size to 5 seconds and you scan in M-Mode for two minutes, when you press **Cine Store** or **Scan/Freeze** the system records only the last 5 seconds of image data that you acquired.

**To set the number of frames or seconds for a cine loop:**

1. From the **Study Browser** (page 49) click **Prefs** and then click the **General** tab.
2. In the **Cine Loop Size** section, type a value in the appropriate box.
3. If you select **Max** for B-Mode, Contrast Mode or CF Doppler Modes, the system sets the cine loop to acquire the maximum number of image frames based on the current configuration of the system.
4. Click **OK**.
   
The system saves your preferences.
Chapter 10: Setting the General tab preferences

Auto SAVE preferences

Use the Auto SAVE feature when you want to save a cine loop or an image frame without using the Cine Store or Frame Store controls.

To set the system to automatically save an image when you label an acquired image:

1. From the Study Browser (page 49) clickPrefs and then click the General tab.
2. In the Auto SAVE section, set your preference settings as described in the following table.

<table>
<thead>
<tr>
<th>Preference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto SAVE on Image Label</td>
<td>Activates the feature. Select the check box.</td>
</tr>
<tr>
<td>Image to Auto SAVE</td>
<td>Specifies what type of image the system saves after you label your image. In the list, select one of the following types:</td>
</tr>
<tr>
<td></td>
<td>▪ Entire Cine Loop</td>
</tr>
<tr>
<td></td>
<td>▪ Current Frame</td>
</tr>
</tbody>
</table>

3. Click OK.

To Auto SAVE an image when you are scanning:

1. During your image acquisition scan, press Scan/Freeze.
2. Press Image Label, type the label name and click OK. The system saves either an entire cine loop or a single frame based on what you set as your preference in the Auto SAVE section.
3. Press Scan/Freeze to continue scanning, or press Study Management to see the listing of the new image in the Study Browser.

Auto SAVE On Scan Completion preferences

Use the Auto SAVE On Scan Completion options when you want the system to instantly apply the Auto SAVE (page 72) feature when an operator presses Scan/Freeze or Pre Trigger to complete a scan.

To set the Auto SAVE On Scan Completion options:

1. From the Study Browser (page 49) clickPrefs and then click the General tab.
2. In the **Auto SAVE On Scan Completion** section, select the check boxes for the applicable imaging modes.

3. Click **OK**.

---

**Mode Screen Layout preferences**

Use the **Mode Screen Layout** preference to change the relative size of the B-Mode scout window to the mode data window when you are in the following dual window modes: M-Mode, PW Doppler Mode and Tissue Doppler Mode.

**To set the Mode Screen Layout preferences:**

1. From the **Study Browser** (page 49) click **Prefs** and then click the **General** tab.
2. In the **Mode Screen Layout** section, click the appropriate layout graphic.
3. Click **OK**.

---

**Image Export preferences**

Use the **Image Export** preference to include or not include the date and time stamp in the header area of any image you export.

**To include the date and time stamp in the header area of your image export:**

1. From the **Study Browser** (page 49) click **Prefs** and then click the **General** tab.
2. In the **Image Export** section click the **Show Date/Time on Image Header** check box.
3. Click **OK**.

---

**PW Doppler Scale preferences**

Use the **PW Doppler Scale** preference section to select the scale type for the spectral display (either velocity or frequency) when you acquire or analyse PW Doppler image data.

**To set the PW Doppler scale:**

1. From the **Study Browser** (page 49) click **Prefs** and then click the **General** tab.
2. In the **PW Doppler Scale** section, select the scale you want to work with:
- Select **Velocity** to set the scale to measure the data in mm/s
- Select **Frequency** to set the scale to measure the data in kHz

3. Click **OK**.

The system applies the selected scale on the Y axis.

Contrast Mode preferences

Use the Contrast Mode section to set the default parameters for a pre-triggered destruction burst event for an injected contrast agent.

To set the default burst event parameters:

1. From the **Study Browser** (page 49) click **Prefs** and then click the **General** tab.
2. In the **Contrast Mode** section, configure the settings as described in the following table:

<table>
<thead>
<tr>
<th>Preference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destruction</td>
<td>From the drop-down list select one of the following two options.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Internal</strong>. The system applies the ultrasound burst through the array that you connect to the front panel of the Vevo 2100 Imaging System</td>
</tr>
<tr>
<td></td>
<td>• <strong>External</strong>. The system applies the burst through the external Vevo SoniGene transducer that you connect to the <strong>Parallel</strong> port on the rear panel of the Vevo 2100 Imaging System.</td>
</tr>
<tr>
<td>Seconds</td>
<td>From the drop-down list select the appropriate length of the destruction burst.</td>
</tr>
<tr>
<td></td>
<td>• For internal bursts, you can select 0.1, 0.25, 0.5, 1.0 seconds</td>
</tr>
<tr>
<td></td>
<td>• For external bursts, you can select 1, 2.5, 5, 10, 15 seconds</td>
</tr>
</tbody>
</table>
## Preference Description

<table>
<thead>
<tr>
<th>Preference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence</td>
<td>From the drop-down list select the moment in the pre-triggered cine loop when the system begins the destruction burst. The value is set as a percentage. For example, if your cine loop is set to 200 frames and you set the value to 25%, the system will run the destroy burst at frame 50.</td>
</tr>
<tr>
<td>Destroy</td>
<td>Position</td>
</tr>
</tbody>
</table>

3. Click OK.

### Physiological Enable preferences

Use the **Physiological Enable** options to globally enable or disable the system's ability to save the Respiration, Blood Pressure and Temperature physiological signal inputs along with the ultrasound image.

#### How physiological data inputs work

The system receives the physiological signal inputs from the Advanced Physiological Monitoring Unit through the **Physio Data** port on the rear panel of the cart.

Enabling or disabling an input determines whether or not you can work with it in other workspaces in the system.

When you select an input, you can control whether or not to control the display of the real-time physiological data in two places:

- **The Physiological Live Display** section of the General tab in the Preferences window.
  
  For example, as illustrated below, if you select the Respiration check box but clear the Blood Pressure and Temperature check boxes, you will only see the Respiration display control check box. (Note: The ECG signal input cannot be disabled, so you will always be able to control whether or not to display it.)

  ![Physiological Live Display](image)

  In this example, you would only be able to show or hide the Respiration data in the physiological live display strip at the bottom right corner of the screen.

- **The Physiological Display** section in the Physio Options left panel display in a mode window.
For example, as illustrated below, if you select the Respiration check box but clear the Blood Pressure and Temperature check boxes, you will only see the Respiration display control check box. (Note: The ECG signal input cannot be disabled, so you will always be able to control whether or not to display it.)

To enable or disable a physiological data input:

1. From the Study Browser (page 49) click Prefs and then click the General tab.
2. In the Physiological Enable section select or clear the appropriate check box.

Related information
- Physiological Live Display preferences (page 76)
- Physiological Alarm Levels (page 77)

Physiological Live Display preferences

While you scan your animal, the live data monitor panel at the bottom of the screen displays the real-time numeric data input values for the animal's live ECG, core body temperature, respiration rate and blood pressure (if an external blood pressure device is connected to the Advanced Physiological Monitoring Unit).

Use the Physiological Live Display preferences section to specify which data inputs you want to show or hide. If one or more of the input options is dimmed and unavailable, look in the Physiological Enable preferences section directly above it, and select the check box for that input to make the check box selectable.

To show or hide specific trace values in the live data monitor panel:

1. From the Study Browser (page 49) click Prefs and then click the General tab.
2. In the Physiological Live Display section, select or clear the required check boxes as described in the following table.

<table>
<thead>
<tr>
<th>Preference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>View ECG</td>
<td>Displays the green numeric beats-per-minute value</td>
</tr>
<tr>
<td>View Respiration</td>
<td>Displays the yellow numeric respiratory value</td>
</tr>
</tbody>
</table>
Chapter 10: Setting the General tab preferences

<table>
<thead>
<tr>
<th>Preference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>View Blood Pressure</td>
<td>Displays the red numeric blood pressure value</td>
</tr>
<tr>
<td>View Temperature</td>
<td>Displays the blue numeric temperature value</td>
</tr>
</tbody>
</table>

3. Click OK.

The live data monitor panel displays the real-time vital signs of the animal based on the preferences you selected.

![Live data monitor panel highlighting the real-time values for the selected traces](image)

**Related information**

- **Physiological Enable preferences** (page 75)
- **Physiological Alarm Levels** (page 77)

---

**Physiological Alarm Levels**

Use the **Physiological Alarm Levels** preferences section to set the low and high physiological data limits beyond which the system displays the pulsing red alarm signal as shown in the following illustration.

![Physiological alarm signal](image)

You can specify the limits for ECG, respiration and temperature.

**To set the physiological data threshold levels:**

1. From the **Study Browser** (page 49) click **Prefs** and then click the **General** tab.
2. In the **Physiological Alarm Levels** section:
   a. If you want to activate the alarm for one of the data inputs, select the appropriate check box.
   b. Type your desired limit values in the **Lower** and **Upper** boxes.
3. Click OK.
Chapter 10: Setting the General tab preferences

Related information

- Physiological Enable preferences (page 75)
- Physiological Live Display preferences (page 76)
Chapter 11

Setting the Operator tab preferences

The Operator tab is the workspace you use to create and manage the operator profiles for the people who use the Vevo 2100 Imaging System.

Administrating your operators (page 60) provides complete instructions on how to work with operator profiles.

Related information
- Adding a standard operator (page 63)
- Adding an administrator (page 62)
- Modifying an operator’s properties (page 64)
- Deleting an operator (page 65)
- Working with operator passwords (page 65)
- Changing the active operator (page 67)
- Sorting the list of operators (page 68)
Chapter 12

Setting the Measurement tab preferences

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.

The system includes five permanent measurement packages:

- Abdominal Package
- Cardiac Package
- Embryology Package
- Ophthalmology Package
- Vascular Package

Use the Measurement preferences tab to customize the way you work with the measurements you create when you analyze acquired image data.

In this chapter
Measurement Package preferences.................................................................80
Measurement Parameters preferences..........................................................84
Measurement Display preferences.......................................................................85

Measurement Package preferences

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

Creating custom measurement packages

A custom measurement package is a copy of an existing measurement package that you customize to include the protocols that you want to work with.

Note: The system does not alter or delete custom measurement packages when you update the system software.

To create a custom measurement package:

1. From the Study Browser (page 49) click Pref 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. Beside the **Measurement Package** section:
   - Select the **Enable Package** check box so that the measurement package will appear in the list of available packages when you are selecting measurements in the left panel
   - Clear the check box to hide the measurement package

5. In the middle panel:
   a. Select or clear the check boxes to set the protocols you want the system to display in the measurement panel (page 164).
   b. Expand individual protocols and then select or clear the check boxes to set the measurements you want the system to display in the measurement panel.

6. In the **Measurement Parameters** list expand the generic measurement types and select or clear the parameters that you want the system 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 the default system-defined measurement packages.

#### To modify a custom measurement package:

1. From the **Study Browser** (page 49) click **Prefs** 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:
   a. Select or clear the check boxes to set the protocols you want the system to display in the measurement panel (page 164).
   b. Expand individual protocols and then select or clear the check boxes to set the measurements you want the system to display in the measurement panel.

4. In the **Measurement Parameters** list expand the generic measurement types and select or clear the parameters that you want the system to display as part of each measurement label.
Chapter 12: Setting the Measurement tab preferences

5. Click Save.

To delete a custom measurement package:

1. In the Measurement Package drop-down list select the package you want to delete.
2. Click Delete and then click OK.

Exporting and importing custom measurement packages

You can export or import custom measurement packages. However, you cannot export or import the default measurement packages that are included with the system.

To export a custom measurement package:

1. From the Study Browser (page 49) click Prefs 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 Package File window, browse to the directory in the external storage location where you want to export the package and then click OK.

To import a custom measurement package:

1. From the Study Browser (page 49) click Prefs and then click the Measurement tab.
2. In the Measurement Package section click Import.
3. In the Import Package File 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. Beside the Measurement Package section:
   - Select the Enable Package check box so that the measurement package will appear in the list of available packages when you are selecting measurements in the left panel
5. Clear the check box to hide the measurement package
Activating measurement packages

To activate a measurement package when you create a new study or series:

1. Press **New** and then click **New Study** or **New Series**.
2. Complete the required fields including the **Measurement Package** field and then click **OK**.

To activate a measurement package from a mode window:

1. Open an existing image from the Study Browser or start imaging.
2. Press **Measure** to view the measurement tools.
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. Press **Prefs** and then click the **Measurement** tab.
2. In the **Measurement Package** drop-down list, select the package you want to activate.
3. Ensure that the **Enable Package** check box is selected.
4. Click **Activate** and then click **OK**.

When you analyze an image, the measurement package you selected is active when you begin to add measurements.

Showing/hiding measurement packages in a mode window

To show or hide a measurement package when you are working in a mode window:

1. From the **Study Browser** (page 49) click **Prefs** and then click the **Measurement** tab.
2. Beside the **Measurement Package** section:
   - Select the **Enable Package** check box so that the measurement package will appear in the list of available packages when you are selecting measurements in the left panel
   - Clear the check box to hide the measurement package
Measurement Parameters preferences

Use the Measurement Parameters section to select the measurement parameters that you want the system 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 default measurement packages that are included with the system.

To select the measurement parameters to display:

1. From the Study Browser (page 49) click Prefs and then click the Measurement tab.
2. Expand the appropriate measurement and then select the parameter check boxes that you want the system to display.

   ![Measurement Parameters](image)

   In this example, for the Angle measurement, the operator selects the following parameters:
   - Blood Pressure
   - Degrees

3. Set the parameters for any other measurements you want to customize.
4. Click OK.

   The system saves your measurement parameters preferences.

When you add a measurement

- In the Mode window, on the ultrasound image the system displays only the measurement parameters you selected in the Measurement Parameters section
Chapter 12: Setting the Measurement tab preferences

- In the Mode window, on the Measured Values section in the measurements panel the system lists only the selected measurement parameters.

![Measured Values screenshot]

**Related information**

- Modifying the properties of a measurement (page 170)

---

### Measurement Display preferences

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 *default* measurement packages that are included with the system.

#### To customize the measurement display settings:

1. Press `Prefs` 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 configure the measurement display style options as described in the following table.

<table>
<thead>
<tr>
<th>Preference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Show</td>
<td>When you select the check box. The system makes the list of measurement protocols available so you can add measurements to your image.</td>
</tr>
<tr>
<td>Measurements</td>
<td>When you clear the check box... The system:</td>
</tr>
<tr>
<td></td>
<td>- Hides any measurements that have already been made in the image but not in the list of measured values.</td>
</tr>
<tr>
<td></td>
<td>- Dims the list of measurements so you can see the list items but you cannot work with them.</td>
</tr>
</tbody>
</table>

**IMPORTANT:** You must select this check box to add measurements to your image data.
### Preference Description

<table>
<thead>
<tr>
<th>Preference</th>
<th>Description</th>
</tr>
</thead>
</table>
| Show Values and Labels on Image   | **When you select the check box...** When you apply a protocol measurement in the image area, the system displays the name of the protocol measurement and all the parameter values that you specified in the Measurement Parameters preferences section.  
**When you clear the check box...** The system:  
- Displays only the measurement index number in the image area  
- Displays measurement labels and values in the Measured Values list |
| Show Embryo Index                 | Displays the index of the embryo specified by horn: number field                                                          |
| Show Protocol Name                | When you apply a protocol measurement in the image area, the system adds the name of the protocol to the name of the measurement. |
| Numeric Precision                 | Sets the number of digits to display after the decimal for non-integer measurement values.                               |
| Auto Point Spacing                | Sets how densely you want the system to add caliper points when you add a measurement using the Traced Distance ROI or the Polygon ROI trace tool. Drag the slider to set the caliper density. |
| Caliper Size                      | These two drop-down lists control the appearance of the lines that appear when you add a measurement.                   |
| Line Thickness                    | Line thickness: Heavy  
  Caliper size: Small  
Line thickness: Thin  
  Caliper size: Small  
Line thickness: Thin  
  Caliper size: Large |
| Font                              | These two drop-down lists control the style of text that appears on your image when you add a measurement or an annotation. |

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

The system applies your new settings to the next measurements you add. The settings do not alter the appearance of any existing measurements.
To modify the properties of an existing measurement, right-click the measurement, select Properties, then complete your changes in the Measurement Properties box.

**Related information**

- Modifying the properties of a measurement (page 170)
Chapter 13

Setting the Annotation tab preferences

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

In this chapter

Measurement Package preferences.....................................................................................88
Annotation Display preferences..........................................................................................88
Annotations preferences.......................................................................................................89

Measurement Package preferences

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 preferences (page 80).

Annotation Display preferences

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 default measurement packages that are included with the system.

To set the annotation style for a custom measurement package:

1. From the Study Browser (page 49) click Prefs 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 configure the style preferences as described in the following table.
Chapter 13: Setting the Annotation tab preferences

<table>
<thead>
<tr>
<th>Preference</th>
<th>Description</th>
</tr>
</thead>
</table>
| Show Annotations| When you select the check box... You can press Update and select or create an annotation.  
When you clear the check box... The system:  
• Hides any annotations that have already been made  
• Cannot make any annotations |

**IMPORTANT**: You must select this check box to add annotations to your image data.

| Line Style | Select the line style that you want the system to use for the line that you can extend 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.

You can customize the list of annotations for custom measurement packages. You cannot customize the list of annotations for the default measurement packages that are included with the system.

To customize the list of available annotations for a custom measurement package:

1. From the **Study Browser** (page 49) click **Prefs** 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, click the commands described in the following table to manage the revisions to your list.

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add Image Group</td>
<td>Adds an item at the bottom of the top-level list. Type the custom name for the image group and press <strong>ENTER</strong>.</td>
</tr>
<tr>
<td>Add Physiological Group</td>
<td>Adds an item at the bottom of the top-level list. Type the custom name for the image group and press <strong>ENTER</strong>.</td>
</tr>
</tbody>
</table>
Chapter 13: Setting the Annotation tab preferences

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add Annotation</td>
<td>Adds an item at the bottom of the second-level list under the selected top level item. <strong>Note:</strong> You cannot create a third level list by adding a sub item to a selected sub item.</td>
</tr>
<tr>
<td>Edit label</td>
<td>Selects the text of the selected item in the list. To rename the item, type the new name and press <strong>ENTER</strong>.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the selected item.</td>
</tr>
<tr>
<td><strong>CAUTION:</strong></td>
<td>When you delete a top-level item the system also deletes all the sub-items.</td>
</tr>
<tr>
<td>Move Up</td>
<td>Moves the selected item above the previous item in the list.</td>
</tr>
<tr>
<td>Move Down</td>
<td>Moves the selected item below the next item at the same level in the list.</td>
</tr>
</tbody>
</table>

4. In the **Measurement Package** section click **Save**.
Chapter 14

Setting the Presets tab preferences

Use the Presets preferences tab to change a default transducer application or to change a default Mode preset.

In this chapter

Transducer preferences ................................................................. 91
Applications preferences .............................................................. 92
Mode Settings Presets preferences .................................................. 95
Preset Settings section .................................................................. 96

Transducer preferences

A transducer application contains the imaging Mode presets you use to instantly optimize your image during an acquisition session.

Use the Transducer preferences section to select the transducer you are going to use to acquire image data. This section lists all the transducers that the Vevo 2100 Imaging System supports.

To specify the default application for a transducer:

1. From the Study Browser (page 49) click Prefs and click the Presets tab.
2. In the Transducer section, in the drop-down list select the appropriate transducer as described in the following table.

<table>
<thead>
<tr>
<th>Transducer</th>
<th>Collar color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS-200</td>
<td>Orange</td>
<td>Rabbit, general and abdominal imaging</td>
</tr>
<tr>
<td>MS-250</td>
<td>Yellow</td>
<td>Rat cardiology and abdominal imaging</td>
</tr>
<tr>
<td>MS-400</td>
<td>Red</td>
<td>Optimized for mouse cardiovascular imaging with frame rates greater than 300 frames per second</td>
</tr>
<tr>
<td>MS-550D</td>
<td>Blue</td>
<td>Mouse cancer and abdominal imaging</td>
</tr>
<tr>
<td>MS-550S</td>
<td>Gray</td>
<td>Optimized for mouse embryology imaging and injection</td>
</tr>
</tbody>
</table>

3. In the Applications list click the button beside the name of the application you want to be the default.
Chapter 14: Setting the Presets tab preferences

TIP: Be sure to click the round button, not the row listing. If you click the row listing, you only display the Mode preset parameters for that application, you do not actually activate the application. You must click the button beside the row to activate it as the default.

4. Click OK.
   This application remains active until you either disconnect the transducer or return to the Presets tab and activate a different application.

   To activate the default transducer application:
   - Create a new study (page 127)
   - Create a new series (page 132)
   - Connect a new transducer (page 106)

Applications preferences

A transducer application contains the imaging Mode presets you use to instantly optimize your image during an acquisition session.

Use the Applications preferences section to create and manage these applications.

Creating a custom application

Each transducer includes factory default applications that contain the imaging Mode presets you use to instantly optimize your image during an acquisition session.

You cannot modify these factory default applications. However, you can create custom applications based on existing applications.

   To create a custom transducer application:
   1. From the Study Browser (page 49) click Prefs and click the Presets tab.
   2. In the Applications section below the list click New.
   3. In the New Application box:
Chapter 14: Setting the Presets tab preferences

a. In the **Copy From** drop-down, select an existing application that contains the Mode presets that are similar to what you want to create.

![New Application](image)

b. In the **Name** box type the name of the custom application.

c. Click **OK**.

The new application appears in the Applications list in the **Presets** tab.

▶ **To activate the custom transducer application:**

- Create a new study (page 127)
- Create a new series (page 132)
- Connect a new transducer (page 106)

**Exporting a transducer application**

To export a transducer application:

1. From the **Study Browser** (page 49) click **Prefs** and then click the **Presets** tab.
2. Select the transducer from the **Transducer** list.
3. In the **Applications** list click the button beside the name of the application you want to export.

   **TIP**: Be sure to click the round button, not the row listing. When you click the row listing, you display the Mode presets for that application, you do not select the application for export.

4. Click **Export**.

   The **Presets Export** window appears.

5. In the folder browser, browse to the location where you want to export your cine loops and select the folder.

6. If you need to create a new folder to contain the cine loops you are exporting:
   
   a. Click **New Folder**.
   
   b. Type the name of the new folder and click **OK**.
The system adds a new folder inside the selected folder in the folder browser window.

c. Select the new folder.

7. Click **OK**.

The system exports the application as an AXML file along with a folder that contains the PXML files for all the Mode settings presets that are associated with the application.

---

**Importing a transducer application**

To import a transducer application:

1. From the **Study Browser** (page 49) click **Prefs** and then click the **Presets** tab.
2. In the **Transducer** section select the transducer from the **Transducer** list.
3. Click **Import**.

   The **Presets Import** window appears.

4. In the folder browser:
   a. Browse to the folder that contains the application. Application files appear with the VisualSonics symbol.

   b. Select the application and click **OK**.

The system returns to the **Presets** tab. The application you imported appears in the Applications window in alphabetical order.

---

**Deleting a transducer application**

To delete a transducer application:

1. From the **Study Browser** (page 49) click **Prefs** and then click the **Presets** tab.
2. Select the transducer from the **Transducer** list.
3. In the **Applications** list click the name of the application you want to delete.
4. Click **Delete** and click **Yes** at the confirmation prompt.

---

**Mode Settings Presets preferences**

A mode preset is the group of control panel control levels that are optimized for a specific imaging task.

Use the **Mode Presets Settings** preferences section to:

- View the parameters for a mode preset
- Set the default preset for an imaging mode

**Related information**

- *Selecting a preset during image acquisition* (page 107)
- *Creating a custom Mode settings preset* (page 107)
- *Modifying a custom Mode settings preset* (page 108)

**Selecting the default preset for a mode**

A default preset for a mode is the set of saved acquisition parameters that is instantly applied to image data when an operator begins scanning in that mode.

- **To specify the default preset for a mode:**
  1. From the **Study Browser** (page 49) click **Prefs** and then click the **Presets** tab.
  2. In the **Transducer** section select the transducer from the drop-down list.
  3. In the **Applications** section select the appropriate application.
  4. In the **Select a Mode** section select the mode for which you want to set the default preset.

      The system populates the Mode Presets list below it with the presets for that mode.

  5. In the **Mode Presets** section, click the button beside the name of the preset you want to be the default.

      **TIP:** Be sure to click the round button, not the row listing.

  6. Click **OK**.

- **To activate the default preset:**
  - Create a new study (page 127)
- Create a new series (page 132)
- Connect a new transducer

Related information
- Selecting a preset during image acquisition (page 107)
- Creating a custom Mode settings preset (page 107)
- Modifying a custom Mode settings preset (page 108)

Deleting a mode settings preset
You can delete any preset in any custom application, but you cannot delete a default preset.

To delete a mode settings preset:
1. From the Study Browser (page 49) click Prefs and click the Presets tab.
2. Select the transducer from the Transducer list.
3. In the Applications list click the application that includes the mode with the preset you want to delete.
4. In the Select A Mode list, select the mode that contains the preset you want to delete.
5. In the Mode Settings Presets list click the name of the preset you want to delete.
6. Click Delete and click Yes at the confirmation prompt.

Preset Settings section
The Preset Settings section displays the parameters of the preset you select in the Mode Presets subsection.
Setting the Maintenance tab preferences

Use the Maintenance preferences tab to manage system level features.

In this chapter
Monitor preferences.................................................................97
Systems Log preferences.......................................................97
Upgrade preferences.............................................................98

Monitor preferences

Use the Monitor preferences section to calibrate the settings on the system's wide-screen display so the display will be optimized for the location in your facility.

The objective of the calibration is to ensure that each of the two boxes (the dark box on the left and the light box on the right) display the smaller box inside the larger outline. The section steps you through the procedure to calibrate your monitor properly.

Systems Log preferences

The Vevo 2100 Imaging System creates an error log file when a significant error occurs. The system log file appears as a line item in the Systems Log section.

Use this preferences section to export the system log data to VisualSonics for troubleshooting analysis.

To export a system log file:
1. From the Study Browser (page 49) click Prefs and then click the Maintenance tab.
2. In the System Log section select the error log you want to export and then click Export.
3. In the Export System Log window, browse to the directory in the external storage location where you want to export the error log and then click OK.
Upgrade preferences

When VisualSonics issues a software upgrade, the Company sends you a CD-ROM disk that includes the software upgrade files.

Use the Upgrade section to launch the procedure to install the upgrade on your Vevo 2100 Imaging System or Vevo 2100 Workstation.

To install a software upgrade:

1. Insert the Vevo® 2100 System Upgrade Version CD-ROM disk into the DVD drive on the left side of the system.
2. From the Study Browser (page 49) click Prefs and then click the Maintenance tab.
3. In the Upgrade section click Upgrade.
   The Upgrade window appears.

4. In the file browsing panel on the left, click (in this example) the PN 12038 (E:\) in the DVD drive. In the Available Upgrades section the system lists the available upgrades.
5. Select the upgrade from the description table and click Upgrade.
The **Upgrade** prompt appears.

6. In the Upgrade box:
   - If you are not sure that you have saved your work, click **No** to cancel the install, save your work and then run the installation process again.
   - If you know that all your work is saved, click **Yes** to continue the install.

7. The system installs the upgrade and then restarts.
Section 5

Acquiring image data

This section walks you through all the steps you need to take so you can start an image acquisition session.

**WARNING:** The Vevo 2100 is not to be used on any living human being.

**WARNING:** High levels of ultrasound energy can damage tissue. Do not touch the transducer when acoustic power could be generated.

In This Section

- Setting up your Vevo 2100 Imaging System.................................................................101
- Setting up Mode settings presets .............................................................................107
- Setting up to acquire physiological data .....................................................................109
- Acquiring image data ...............................................................................................120
- Saving image data .....................................................................................................122
Chapter 16

Setting up your Vevo 2100 Imaging System

This chapter walks you through the steps for setting up your Vevo 2100 Imaging System and your subject for an image acquisition session.

In this chapter

Working with transducers .................................................................................................101
Working with the 3D motor stage (optional)...................................................................102
Connecting the transducer to the Vevo 2100 Imaging System......................................106

Working with transducers

This chapter shows you how to set up and work with the array transducer that acquires the micro-ultrasound images.

Selecting the appropriate transducer for your study

VisualSonics offers a range of transducers with frequencies ranging from 12.5MHz to 45MHz to serve a broad range of applications as described in the following table.

<table>
<thead>
<tr>
<th>Transducer</th>
<th>Collar color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS-200</td>
<td>Orange</td>
<td>Rabbit, general and abdominal imaging</td>
</tr>
<tr>
<td>MS-250</td>
<td>Yellow</td>
<td>Rat cardiology and abdominal imaging</td>
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<td>MS-400</td>
<td>Red</td>
<td>Optimized for mouse cardiovascular imaging with frame rates greater than 300 frames per second</td>
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<tr>
<td>MS-550D</td>
<td>Blue</td>
<td>Mouse cancer and abdominal imaging</td>
</tr>
<tr>
<td>MS-550S</td>
<td>Gray</td>
<td>Optimized for mouse embryology imaging and injection</td>
</tr>
</tbody>
</table>

Next step

- Connecting and disconnecting the transducer (page 106)

Related information

- Array transducer (page 19)
Storing the transducer

You can store the transducer in the transducer and gel holder attached to the side of the Vevo 2100 Imaging System, nose upward and with the cable directed toward the front of the cart.

Use the spring-loaded cable holder to ensure that the cable does not get twisted.

When you move the transducer from one facility to another, always use the dedicated case that is provided with the cart.

Follow these guidelines when you store the transducer in its case:

- Make sure that the transducer is clean and dry before you store it in the case.
- Place the transducer in the case carefully so the cable doesn't kink.
- Don't store the transducer in areas of extreme temperatures or in direct sunlight.
- Store the transducer separately from other instruments so it won't get damaged accidentally.

Related information

- Front view of the Vevo 2100 Imaging System (page 17)

Working with the 3D motor stage (optional)

VisualSonics provides a 3D motor stage for customers who need to perform 3D volumetric measurements. The 3D motor stage connects to the Vevo Imaging Station.

**IMPORTANT:** During 3D data acquisition, ensure that the animal under the transducer is flat in relation to the 3D scan direction to prevent unintended contact with the animal when the transducer moves.

Connecting the 3D motor stage to the Vevo Imaging Station

The 3D motor stage features a Quick Release post on the top to connect to the Vevo Imaging Station, and a Quick Release mount on the bottom to affix the transducer clamp.
To connect the 3D motor stage to the Vevo Imaging Station:

1. Insert the quick release post into the quick release mount located on the Imaging Station arm.

2. Carefully line up the holes on the post with the pins on the quick release mount.

3. Finger tighten the knob on the quick release mount.

4. Connect the 3D motor cable to the 3D Motor connector on the rear panel of the Vevo 2100 Imaging System.

Connecting the transducer to the 3D motor stage

When you use the Vevo Imaging Station, you must secure the transducer within the transducer clamp.

To connect the transducer to the 3D motor stage:

1. Insert the Quick Release post on the transducer clamp into the Quick Release mount on the 3D motor stage unit so that the pins on the mount fit into the holes on the Quick Release post.

2. Tighten the Quick Release mount until it is finger tight.
Chapter 16: Setting up your Vevo 2100 Imaging System

3. Lift the latch to open the clamp and then place the collar of the transducer in the clamp.
4. Close the moving arm of the clamp and then pull the latch down to the 45° notch. This transducer rotation lock setting holds the transducer but provides enough freedom for you to rotate it.

5. To set the transducer to any of the at the desired 90-degree angle in the clamp turn the transducer until you feel the collar snap into position.

6. Close the clamp and push the latch down until it locks into place as shown in the following illustration.
Connecting the transducer to the Vevo 2100 Imaging System

**WARNING**: Before connecting or disconnecting any transducer the Vevo 2100 Imaging System must be switched off or the transducer cable disconnected from the rear panel to avoid physical contact with hazardous acoustic transmissions.

- **To connect the transducer connector to the transducer port:**
  1. Turn the lock handle to the horizontal (unlocked) position.
  2. Line up the locking pin on the transducer connector with the lock notch on the transducer port.
  3. Push in the connector and then turn the lock handle to the vertical (locked) position.

- **To disconnect the transducer:**
  
  Turn the lock handle to the horizontal (unlocked) position and pull the connector out.

**Related information**

- *Array transducer* (page 19)
Chapter 17

Setting up Mode settings presets

If you often use a particular imaging Mode in a similar way, you can optimize your acquisition settings on the control panel and then save them as a single preset.

This chapter shows you how to use and manage these presets.

In this chapter
- Selecting a preset during image acquisition ................................................................. 107
- Creating a custom Mode settings preset ................................................................. 107
- Modifying a custom Mode settings preset ................................................................. 108

Selecting a preset during image acquisition

To select a Mode settings preset:

1. Begin acquiring data.

2. While the system is acquiring data push the Presets control up or down to scroll through the list of stored presets for the Mode you are imaging in. The preset name appears in the left panel (press Mode Setting to set the left panel to display the mode settings).

The system applies the preset to your image data.

Creating a custom Mode settings preset

Every transducer application includes factory presets for each imaging Mode. You can create custom presets that store your own settings.
Chapter 17: Setting up Mode settings presets

IMPORTANT REMINDER: When you create a custom preset, it only applies to that specific mode in that specific application for that specific transducer.

To create a custom Mode settings preset:

1. Begin acquiring image data in the imaging mode for which you want to create a preset.
2. Use the control panel controls to optimize your image.
3. Press **Save Preset**.
4. In the **Save Preset Settings** box type the name of your preset and click **OK**.

The new preset appears in the Mode-specific list box below the **Mode Settings Presets** list box in the **Preferences** window **Presets** tab for that specific application and that specific transducer.

Related information
- **Acquiring data in an image mode** (page 120)

---

Modifying a custom Mode settings preset

> To modify a custom Mode settings preset:

1. Begin acquiring image data in the imaging mode for which you want to create a preset.
2. Use the control panel controls to optimize your image.
3. Press **Save Preset**.
4. In the **Save Preset Settings** box:
   a. In the drop-down list select the preset you want to update.
   b. Click **OK**.

The system updates the preset with the new settings.
Chapter 18

Setting up to acquire physiological data

The Advanced Physiological Monitoring Unit tracks your animal's heart rate, temperature, respiration rate and blood pressure (optional with a third-party blood pressure device).

**NOTE:** The system is only compatible with the THM-150 Advanced Physiological Monitoring Unit. The THM-100 is not supported.

This chapter walks you through the steps for setting up the unit so you can acquire accurate, reliable physiological data.

**In this chapter**

- Physiological data sources ................................................................. 109
- Connecting the blood pressure equipment ............................................. 110
- Configuring the physiology data display settings ...................................... 110

**Physiological data sources**

The Vevo 2100 Imaging System can monitor, display and record the physiological data from a subject when the subject is connected to the Advanced Physiological Monitoring Unit. The data source connections for this data are described in the following table.

<table>
<thead>
<tr>
<th>Physiology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECG</td>
<td>The animal's ECG signal is captured through the electrode pads on the Advanced Physiological Monitoring Unit. The pads transmit the animal's ECG to a controller box. Connect the ECG cable to the controller box, and connect the keyed end of the cable to the rear panel of the Vevo 2100 Imaging System.</td>
</tr>
<tr>
<td>Respiration</td>
<td>The animal's respiration rate is monitored through the electrode pads on the Advanced Physiological Monitoring Unit and is derived from the ECG signal.</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>The animal's blood pressure can be monitored by a third-party blood pressure monitoring system. The signal is sent through the Advanced Physiological Monitoring Unit to the Vevo system and the blood pressure trace viewed on screen within the software.</td>
</tr>
<tr>
<td>Body temperature</td>
<td>The animal's temperature is monitored through the rectal probe connected to the Advanced Physiological Monitoring Unit.</td>
</tr>
</tbody>
</table>
Chapter 18: Setting up to acquire physiological data

Related information

- For detailed information on preparing your animal and the animal platform, refer to your *Vevo Imaging Station Operator Manual*.
- Setting the General tab preferences (page 70)
- Connecting the blood pressure equipment (page 110)
- Configuring the physiology data display settings (page 110)

Connecting the blood pressure equipment

The Vevo Imaging Station provides a BNC connector as part of its Advanced Physiological Monitoring Unit as shown in the following illustration.

Configuring the physiology data display settings

When you are acquiring image data, click **Physio Settings** to display the options for controlling the individual physiology data inputs that appear in the physiology window. This section describes how to configure these options.
Physiological Display section

Use the Physiological Display section in the left panel to activate or deactivate the display controls for the individual physiological data inputs.

The selections you make in this section apply both when you are acquiring image data and when you are reviewing it.

To activate or deactivate the display controls for the individual physiological inputs:

1. Open an image mode window by beginning to acquire data in any imaging mode or opening any image from the Study Browser.

2. Press **Physio Settings**.

   The left panel displays the physiological display setting sections.

3. In the Physiological Display section select or clear the required check boxes as described in the following table.

<table>
<thead>
<tr>
<th>Preference</th>
<th>Check box selected</th>
<th>Check box cleared</th>
</tr>
</thead>
<tbody>
<tr>
<td>View Physiology</td>
<td>Activates all the individual data input display controls in the section. You can only access this check box when you have frozen your scan or paused a cine loop review.</td>
<td>Dims all the available physiological controls in the left panel so you cannot access them.</td>
</tr>
<tr>
<td>ECG</td>
<td>Displays the green ECG trace line (and numerical data values when you stop imaging) in the physiological trace window. During imaging, activates the ECG waveform slider control in the Physiological Range section in the left panel. Displays the ECG Trigger section in the left panel.</td>
<td>Hides the ECG trace line and data. Dims the ECG waveform slider control. Hides the ECG Triggering section.</td>
</tr>
<tr>
<td>Respiration</td>
<td>Displays the yellow respiration trace line (and numerical data values when you stop imaging) in the physiological trace window. During imaging, activates the Respiration waveform slider control.</td>
<td>Hides the trace line and data. Dims the waveform slider control.</td>
</tr>
<tr>
<td>Invert</td>
<td>Flips the display of the Respiration trace line vertically.</td>
<td>Flips back the display of the Respiration trace line vertically.</td>
</tr>
<tr>
<td>BP</td>
<td>Displays the red BP trace line (and numerical data values when you stop imaging) in the physiological trace window. During imaging, activates the BP waveform slider control.</td>
<td>Hides the trace line and data. Dims the waveform slider control.</td>
</tr>
</tbody>
</table>
## Preference

<table>
<thead>
<tr>
<th>Preference</th>
<th>Check box selected</th>
<th>Check box cleared</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP Derivative</td>
<td>Displays the purple blood pressure derivative trace line. This data displays the velocity of change in the BP value. During imaging, activates the blood pressure derivative waveform slider control.</td>
<td>Hides the trace line and data. Dims the waveform slider control.</td>
</tr>
<tr>
<td>Temp</td>
<td>Displays the Temp trace line (and numerical data values when you stop imaging) in the physiological trace window.</td>
<td>Hides the trace line and data.</td>
</tr>
</tbody>
</table>

4. Click OK.

The system applies your settings the next time you begin acquiring image data.

**Troubleshoot**

If one of the data input options does not appear in the section, it has been disabled in the Physiological Enable preferences section in the General tab of the Preferences window.

**Related information**

- Physiological Enable preferences (page 75)

**Physiological Range section**

If you are acquiring physiological data, the system can display the data values in the physiological data window located below the mode data window.

Use the Physiological Range section to optimize the display scale for an individual trace so you can make the most use of the height of the physiological display window.

**IMPORTANT:** You can only optimize the scale for each trace while you are acquiring data. You cannot optimize the scales when you review an image.

**Troubleshooting before you begin**

- If an ECG, Respiration or BP slider control is visible but dimmed and you cannot access it, select the check box for that data stream in the Physiological Display section at the top of the left panel.
- If an ECG, Respiration or BP slider control does not appear in this section, enable the check box for the data input in the Physiological Enable preferences section of the General tab in the Preferences window.
To increase or decrease the amplitude of the waveform:

1. Begin acquiring data in an imaging mode.
2. Press **Physio Settings**.
   The left panel displays the physiological display setting sections.
3. In the **Physiological Range** section:
   - To make the waveform for the selected trace smaller, increase the range value in the slider.
   - To make the waveform for the selected trace larger, decrease the range value.

**Related information**
- Graphical Display preferences (page 111)
- Physiological Enable preferences (page 75)

**Blood Pressure section**

As a best practice, calibrate the Vevo 2100 Imaging System software for your blood pressure monitoring device before you begin acquiring blood pressure data.

However, you can run the calibration procedure at any time even when you are reviewing image data, as long as the blood pressure monitoring device is connected to the system. This only affects the physiological live display values, not the blood pressure values that are already acquired.

The following manual and import calibration procedures assume that your blood pressure monitoring system includes a built-in calibration function.

**Blood Pressure Calibration options**

Use the **Blood Pressure** section to set your preferences for calibrating your pressure scale as described in the following table.

<table>
<thead>
<tr>
<th>Preference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Calibration</td>
<td>Select this option if the Vevo 2100 Imaging System does not support your blood pressure instrument.</td>
</tr>
<tr>
<td>Import Calibration</td>
<td>Select this option if the Vevo 2100 Imaging System does support your blood pressure instrument.</td>
</tr>
</tbody>
</table>

**Related information**
- Manually calibrating any blood pressure instrument (page 114)
- Auto-calibrating your Vevo-supported blood pressure instrument (page 114)
Auto-calibrating your Vevo-supported blood pressure instrument
The Vevo 2100 Imaging System includes pre-configured calibration settings for the Millar PCU-2000 Pressure Control

To calibrate a Vevo-supported blood pressure instrument:

1. Connect the pressure instrument to the Advanced Physiological Monitoring Unit and ensure that the Advanced Physiological Monitoring Unit is connected to the Vevo 2100 Imaging System at the Physio Data connector on the rear panel of the system. Ensure that all three systems are powered on.

2. Open an image mode window by beginning to acquire data in any imaging mode or opening any image from the Study Browser.

3. Press **Physio Settings**.

   The left panel displays the physiological display setting sections.

4. In the **Blood Pressure** section:
   a. In the upper drop-down list select **Import Calibration**.
   b. In the lower drop-down list select the preconfiguration for your pressure monitor.
   c. Click **Calibrate**.

5. The system:
   - Calibrates your pressure scale.
   - Retains the calibration settings between imaging sessions. You only need to repeat the calibration procedure if you connect a different blood pressure monitor or if you think there might be a problem with the calibration accuracy.

Manually calibrating any blood pressure instrument
The Vevo 2100 Imaging System can calibrate any blood pressure scale manually, as long as it includes a built-in calibration function.

To calibrate any blood pressure instrument:

1. Connect the pressure instrument to the Advanced Physiological Monitoring Unit and ensure that the Advanced Physiological Monitoring Unit is connected to the Vevo 2100 Imaging System at the Physio Data connector on the rear panel of the system. Ensure that all three systems are powered on.

2. Open an image mode window by beginning to acquire data in any imaging mode or opening any image from the Study Browser.

3. Press **Physio Settings**.
The left panel displays the physiological display setting sections.

4. Adjust the blood pressure monitoring system so that the output is 0 mmHg.

5. In the **Blood Pressure** section:
   a. In the upper drop-down list select **Manual Calibration**.
   b. Click **Calibrate**.
      
      The blood pressure trace (red) should move to coincide with the 0 mark on the blood pressure scale.

6. Adjust the blood pressure monitoring system to output a known level, and note the numeric value of this level.

7. In the **Blood Pressure** section:
   a. Set the BP Gain value to either 1X or 4X. The default value is 4X, which is the typical setting for most devices.
   b. Type the numeric value of the output level into the box.
   c. Click **Calibrate**.

8. The system:
   - Calibrates your pressure scale.
   - Retains the calibration settings between imaging sessions. You only need to repeat the calibration procedure if you connect a different blood pressure monitor or if you think there might be a problem with the calibration accuracy.

### Respiration Gating section

Respiration gating is a tool you can use to effectively suppress the artifacts coming from respiration and cardiac movement.

When you are acquiring image data along with physiological data, the physical movement of the subject's chest cavity may move the region of interest you want to study. This can cause artificial variations in measurements you add to saved images.

Respiration gating suppresses this effect.

#### How respiration gating works

To suppress the effect of respiration on your image data, you use the **Respiration Gating** tools to select the period of time between breaths – when the body is least affected by the breathing motion. This brief period of time is called the respiration gate. The system records image data only during the respiration gate period.

As shown in the following illustration, you work in the physiological trace window to create the respiration gate along the yellow respiration data trace line. The beginning of the respiration gate is called the *delay* point and the length of the...
gate period is called the *window* and is defined by a dark yellow background that follows the trace across the screen.

**Before you begin:**

- Your animal must be connected to the Advanced Physiological Monitoring Unit.
- In the **Physiological Enable** section of the **General** tab in the **Preferences** window, the **Respiration** check box must be selected.

**IMPORTANT:** You can only activate and control respiration gating while you are acquiring data. You cannot access these options when you review an image.

**To activate respiration gating:**

1. Begin acquiring data.
2. Press **Physio Settings**.
The left panel displays the physiological display setting sections.

3. In the **Physiological Range** section, adjust the **Respiration** slider so that the trace line is a) short enough that the peaks and valleys do not extend above or below the window and b) tall enough that you can clearly define those peaks and valleys.

4. In the **Respiration Gating** section:
   a. Select the **Respiration Gating** check box to activate the slider controls.
   b. Adjust the **Delay** slider to set the start of the gate period, after the waveform has returned to the baseline.
   c. Adjust the **Window** slider to set the duration of the data acquisition before the next breath occurs.

5. Press **Pre Trigger** to create your cine loop.
   Because **Pre Trigger** records data for a set period after you press the key, the system acquires only a portion of data during each cardiac cycle, so it takes longer to acquire the cine loop.

**Related information**

- Acquiring image data (page 120)
- Physiological data sources (page 109)
- ECG Trigger section (page 117)

**ECG Trigger section**

ECG triggering is a feature you can use to effectively acquire imaging frames at a specific time during the heart cycle.

ECG triggering suppresses this effect.

Use ECG triggering when you intend to add measurements at a specific time.
How ECG triggering works

ECG triggering acquires one single frame of image data during each cardiac cycle, at precisely the same time point after the R wave peak, as shown in the following illustration.

Before you begin

- Your animal must be connected to the Advanced Physiological Monitoring Unit.

**IMPORTANT:** You can only activate and control ECG triggering while you are acquiring data. You cannot access these options when you review an image.

To set the ECG triggering:

1. Begin acquiring data and then press.
2. Press **Physio Settings**.
   
   The left panel displays the physiological display setting sections.
3. In the **Physiological Display** section, select the View Physiology check box and then select only the ECG check box. This displays only the ECG waveform in the physiological trace window, which makes it easier to work with.
4. In the **Physiological Range** section, adjust the **ECG** slider so that the trace line is tall enough to clearly define the peak of the R wave.
5. In the **ECG Trigger** section:
a. In the **T1** row select the check box to activate the time slider control as well as the Cycles slider control at the bottom of the section.

b. Watch the B-Mode image as you adjust the slider until you find the image within the cardiac cycle that displays the tissue characteristics that you want to study (typically systole or diastole). The system sets the time point after the R wave where it will continue to acquire one single frame of image data during each cardiac cycle.

c. Adjust the **Cycles** slider to set the number of cycles (in a range from 1-10) in which the system will acquire the set number of cardiac cycles.

6. If you want to study a second image point within the cardiac cycle, select the **T2** check box and follow the same procedure to place a second trigger.

7. Press **Cine Store** to create your cine loop.

The system acquires one frame of image data for each cardiac cycle. When the selected number of cycles are completed, the cine loop is created.

**Related information**

- *Acquiring image data* (page 120)
- *Physiological data sources* (page 109)
- *Respiration Gating section* (page 115)
Chapter 19

Acquiring image data

This chapter shows you how to start acquiring micro-ultrasound image data.

Before you begin

- Ensure that you have connected a transducer to the transducer port on the front of the cart.
- Ensure that the animal is properly prepared on the animal platform and ensure that the animal is connected to the physiological data support system.

To acquire a micro-ultrasound image:

1. With the Study Browser or a Mode window open, press the key for the Mode you want to image in. For example, press B-Mode.

The system begins acquiring B-Mode data.

B-Mode window. The outlined area includes the ultrasound image data and the physiological trace data.

To switch from one image acquisition Mode to another:

1. While you are acquiring image data in one mode, press Scan/Freeze.
2. On the control panel, press the key for the new imaging mode. For M-Mode press the [M-Mode] a second time to display the M-Mode image in the lower image panel and the B-Mode scout image in the upper image panel.

The Mode window displays the image data in the new imaging Mode.

Next steps
- Saving your image data (page 122)
- Analyzing image data (page 156)
- Managing your studies (page 125)

Related information
- Connecting the transducer to the Vevo 2100 Imaging System (page 106)
- Logging on (page 41)
- Image acquisition modes (page 37)
- Quick start tutorial (page 30)
Chapter 20

Saving image data

You can save your image data in one of two ways:

- Save your data as a multiple frame animation of your image frames. This ultrasound image is called a cine loop.
- Save your data as a single frame ultrasound image called an image frame.

In this chapter
Saving a cine loop (multiple-frame animation) ............................................................... 122
Saving an image frame ....................................................................................................... 123

Saving a cine loop (multiple-frame animation)

A cine loop is a multiple-frame animation of your image frames. You can save your image data as a cine loop in every image Mode other than 3D-Mode.

B-Mode based cine loops are measured by number of frames. M-Mode and PW Doppler Mode cine loops are measured in seconds.

How cine loops work

While you acquire data, the system’s playback memory holds your most recent image data in a buffer. The size of the buffer is determined by the Cine Loop Size preference you specify in the Preferences window on the General tab.

When you save your image as a cine loop, the system saves this buffered data as an image. The buffer saves the latest acquired data.

To review your cine loop content before you save it:

1. Press Scan/Freeze.
2. Use the Cine Loop Review dial to review the current, but unsaved, cine loop frames.
3. If you don't want to save the content, press Scan/Freeze again and continue to acquire new image data.

To save your image as a cine loop:

1. Press Scan/Freeze to stop acquiring data.
2. Review the image as required and then press **Cine Store**.

3. Your **Mode** window dims and the system pauses the image acquisition.
   
   During this image acquisition pause:
   - The system captures the last number of acquired frames based on your **Cine Loop Size** preference and creates a new cine loop image.
   - In the bottom left of your **Mode** window, the system briefly displays the **Cine Stored** confirmation message.
   - The system adds your new image as an unnamed list item within the active series row in the study that you selected in the **Study Browser** before you started acquiring your data.

4. The pause ends and the system continues to acquire image data.

**Next steps**

- *Labeling an image* (page 136)
- *Opening an image* (page 136)
- *Adding generic measurements* (page 166)
- *Adding protocol measurements* (page 168)

**Related information**

- *Cine Loop Size preferences* (page 71)
- *Saving an image frame* (page 123)

### Saving an image frame

An image frame is a single non-animated image. You can save an image frame in every imaging Mode other than 3D-Mode.

**How image frames work**

While you acquire data, the system's playback memory holds your most recent image data in a buffer. The size of the buffer is determined by the **Cine Loop Size** preference you specify in the **Preferences** window on the **General** tab.
When you save your image as an image frame, the system saves the frame that is currently displayed in the Mode window.

**To save your image as an image frame:**

1. Press **Scan/Freeze** and then **Cine Store** to create a cine loop.
2. Turn the **Cine Loop Review** dial forward and back until you see the frame you want to store.
3. Press **Frame Store**.
4. Your **Mode** window pauses for a moment. During this pause:
   - The system captures the current image frame and creates a new image
   - In the monitor bar of your **Mode** window, the system briefly displays the **Frame Stored** confirmation message
   - The system adds your new image as an unnamed list item within the active series row in the study that you selected in the **Study Browser** before you started acquiring your data
5. The brief pause ends and the system continues to acquire image data.

**Next steps**

- *Labeling an image* (page 136)
- *Opening an image* (page 136)

**Related information**

- *Cine Loop Size preferences* (page 71)
- *Saving an image frame* (page 123)
Managing images, series and studies

Studies in the Vevo 2100 Imaging System are like studies in a paper based system. They work much like a file directory and hold all the series 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 acquire and save an image, the Vevo 2100 Imaging System 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.

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Working with studies .........................................................................................................................127
Working with series ...........................................................................................................................132
Working with image items in a study series .......................................................................................136
Exporting studies, series or images..................................................................................................139
Copying, deleting and importing.......................................................................................................152
Chapter 21

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 Browser window featuring the study, series and images of a selected study**

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Study.</strong> A study contains one or more grouped image sets called series. In this example, the highlighted study is named <strong>3D set - Fall</strong> and it contains one series.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Series.</strong> A series is the group of one or more images that you acquire during an acquisition session. A series in a study functions much like a sub-folder of a parent folder. In this example, the specified series is named <strong>Series 1</strong> and it contains six images.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Image.</strong> An image is either a multiple frame video-like image called a cine loop, a single image frame, or a 3D-Mode image. In this example, the specified image is named <strong>Bolus-2.</strong></td>
</tr>
</tbody>
</table>
Chapter 22

Working with studies

Studies are the largest grouping you can work with in the Study Browser. Studies contain your images. And these images are grouped into series which list all the images you create during an acquisition session.

You can organize your studies any way 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 of a series of animals at one time.

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Creating a study ................................................................. 127
Finding a study................................................................. 129
Modifying the information properties of a study .................. 129
How passwords and study locks work ................................ 130
Locking a study ............................................................... 131

Creating a study

You can create a study in one of two ways:

- Press a mode key to start acquiring image data, then press \texttt{Scan/Freeze}
- From the Study Browser press \texttt{New} on your control panel or click \texttt{New} and then click \texttt{New Study}

Creating a study by acquiring image data

When you begin imaging in a mode, the system automatically creates a new system-named study and series. This is typically the fastest way to create a study.

To create a study by acquiring image data:

1. Press the appropriate Mode key for your acquisition session.
2. The system creates a study.
Chapter 22: Working with studies

The mode window appears and displays the system-generated study name and series name.

You have successfully created a study.

3. Store images to your series and then close the series.

BE CAREFUL: If you don't store images to the first and only series of a study, the system removes both the series as well as the study when you close the series.

The Study Information window appears.

4. Complete the required fields and any optional fields as needed and click OK.

Related information

- Modifying the information properties of a study (see page 129)

Creating a study by using the New key or New button

To create a study by using the New key:

1. From the Study Browser press New on your control panel or click New and then click New Study.

2. In the New Study window:
   - The name of the current operator appears in the Owner box as well as the Acquired By box
   - The Series Name defaults to Series 1
   - The currently selected application appears in the Application box
   - The currently selected measurement package appears in the Measurement Package box

3. In the Study Name box type a name for the study.

4. (Optional) Customize additional property details (see page 129) in the boxes that are labeled in gray, then click OK.

5. The system creates the study and opens the mode acquisition window in B-Mode.

You have successfully created a study.

6. Store images to your series and then close the series.

BE CAREFUL: If you don't store images to the first and only series of a study, the system removes both the series as well as the study when you close the series.
Finding a study

When your list of studies is long and you need to find a specific study, use the Study Browser sorting features.

To find a study:

1. Press **Study Management**.
   
The Study Browser appears.
2. Click a column heading to sort the list of studies.
   - Click **Name** heading to display the list in alphanumeric order based on the name of the study. Click the heading again to switch the sort order of the column between ascending order and descending order.
   - Click the lock icon heading to display the locked studies first. Click the heading again to display the unlocked studies first.
   - Click the **Date** heading to display the list in chronological order. Click the heading again to switch the sort order of the column between ascending order and descending order.
   - Click the **Study Owner** heading to display the list in alphabetical order based on the name of the operator who owns the study. Click the heading again to switch the sort order of the column between ascending order and descending order.
3. Scroll through the list to find your study.

Modifying the information properties of a study

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

To customize the information properties for a study:

1. Open the **Study Browser** window.
2. Select the study you want to work with and then click **Info**.
   
The **Study Information** window appears and displays the **Study Information** section fields.
3. Add or modify content in the boxes as described in the following table.
Chapter 22: Working with studies

<table>
<thead>
<tr>
<th>Box</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>Read-only</td>
</tr>
<tr>
<td>Study Name</td>
<td>Required. Type your information.</td>
</tr>
<tr>
<td>Granting Institution</td>
<td>Optional. Type your information.</td>
</tr>
<tr>
<td>Study Notes</td>
<td>Optional. Type your information.</td>
</tr>
</tbody>
</table>

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

**Related information**
- *Study Browser window workspace* (page 49)
- *Study Information window workspace* (page 50)

**How passwords and study locks work**

You can review any images in any study on your Vevo 2100 Imaging System at any time. And if the study is not locked you can complete any of the following tasks at any time:

- Review the study
- Add a new series
- Add new images
- Delete an image
- Delete a series
- Delete a study
- Add/edit measurements and annotations
- Delete measurements and annotations
- Edit an image or series or study name
- Edit series information or study information

Before you can delete a study or series or image within a study, unlock the study. If the owner or an administrator added a password to their operator profile, you must contact the owner or administrator and request the password.

**Related information**
- *Locking a study* (page 131)
- *Working with operator passwords* (page 65)
Locking a study

Any operator can lock any study. When you lock a study, all the operators on the system can still review and manage the images in the study. Before you can delete a study or series or image within a study, 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. The system adds a check mark in the lock column.

To delete a locked study:

1. Select the study and click Delete.
2. If the operator or study owner who applied the lock has a password, the system prompts you to type the password before you can complete the deletion.
3. The system deletes the study.

Related information

- Study Browser window workspace (page 49)
- How passwords and study locks work (page 130)
Chapter 23

Working with series

Series are sub-groupings within studies that list all the images you create during acquisition. Use series to create useful image groupings within your study.

Whenever you create a new study, in the Study Browser the system automatically creates the first series.

Typical uses for series

Let's say your study tracks a specific set of images of one animal over a period of time. Create a new series each time you reach a time point in the study when you need to acquire images and take measurements. Add all your images for that animal to a series.

If your study tracks a specific set of images of a series of animals at specific times, create a new series at each time point and add your images for each animal to that series.

In this chapter

Creating a new series ................................................................. 132
Modifying the information properties of a series .............................. 133
Closing an active series .............................................................. 134
Deleting a series ........................................................................ 135

Creating a new series

You can create a series in one of two ways:

- Create a new study and the system automatically creates the first series in the study
- In the Study Browser, add a new series to an existing study

To create a series by creating a new study:

Create a new study using either of two methods:

- Create a study by acquiring image data (page 127)
- Create a study by using the New key or New button (page 128)
The system creates the new study and automatically creates the first series in the study.

To add a new series to an existing study:

1. In the **Study Browser**, select the study that will contain the new series.
2. Press **New**.
   
The system prompts you to create either a new study or a new series.
3. Click **New Series**.
   
The **New Series** window appears.
4. In the **Series Information** section, modify the series parameters as required.
5. Click **OK**.
   
The system starts acquiring image data in B-Mode.

---

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. Access the **Study Information** window:
   - From a mode window press **Study Info**
   - From the Study Browser, select the series row (not the study row) and then click Info or press **Study Info**
   
The **Study Information** window appears and displays the information about the study in the **Study Information** section, and information about the series in the **Series Information** section.
2. Add or modify content in the boxes as described in the following table.
### Chapter 23: Working with series

#### Box Description

<table>
<thead>
<tr>
<th>Box</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series Name</td>
<td>Required.</td>
</tr>
<tr>
<td>Acquired By</td>
<td>Required.</td>
</tr>
<tr>
<td>Date of Birth</td>
<td>Optional. Click the calendar icon and select the date that the animal was born.</td>
</tr>
<tr>
<td>Sex</td>
<td>When you select Female, the system displays the Pregnant option.</td>
</tr>
<tr>
<td>Pregnant</td>
<td>Optional. Select the check box. The system displays an optional Date Mated calendar field. If you want to add that data, click the calendar icon and select the date.</td>
</tr>
<tr>
<td>(All other fields)</td>
<td>Optional. Type in your information.</td>
</tr>
</tbody>
</table>

#### Related information

- **Study Information window workspace** (page 50)

### Closing an active series

When you are in an acquisition session adding images to your study, the series you are working with is the active series.

**To close a series:**

1. Press **Close**. Use this key:
   - When you are in a **Mode** window acquiring images)
   - When you are in the **Study Browser** (or click **Close Series**)
2. If you created your current series by starting an acquisition session, the system displays the **Study Information** window so you can define the study owner.

**Note:** Until you define the owner of the study you cannot close the study or series.

**BE CAREFUL:** If you don't store images to the first and only series of a study, the system removes both the series as well as the study when you close the series.
Deleting a series

You can delete a series from any unlocked study.

To delete a series:

1. In the Study Browser, select the series you want to delete:
   - Click to select one series
   - CTRL+click to select a collection of individual series
   - Click+SHIFT+click to select a range of series
2. Press DEL or click Delete in the Study Browser.
   The Delete Confirmation window appears.

   **DATA LOSS WARNING:** When you delete items from the Study Browser, the system completely removes the data from your system. You cannot retrieve it.

3. Click Yes.
Chapter 24: Working with image items in a study series

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

In this chapter

- Opening an image ............................................................................................................... 136
- Labeling an image .............................................................................................................. 136
- Storing an image ............................................................................................................... 137

Opening an image

To open an image:

1. In the Study Browser, expand the study and series and then select the image you want to open:
   - In the list of studies, double-click the image row
   - In the thumbnails panel, double-click the image thumbnail

The system opens the image in the Mode window.

Labeling an image

You can label a saved image while you are reviewing it in the Mode window, or when you are working with it as a list item in the Study Browser.

To label an image from the Mode window:

1. Press Image Label.
   
   The Image Label dialog box appears.
2. Type the image label name and click OK.
   
   The system:
   - Displays the name in the Image Label field above the image
   - Stores the image as either a cine loop or image frame if:
a. **AutoSAVE on Image Label** is selected in the General tab of the Preferences window
   -or-

b. The image has not been saved previously

To label an image from the Study Browser:

Method A (Vevo 2100 Imaging System control panel):

1. Expand the study and series and select the image you want to label.
   - In the list of studies, select the image row.
   - In the thumbnails panel, scroll to view the image and select the image.
2. Press **Image Label**.
   
   The **Image Label** window appears.
3. Type the image label name and click **OK**.
   
   The system displays the name in the **Name** column.

Method B (Vevo 2100 Workstation):

1. Expand the study and series and right-click the row of the image you want to add a label to.
   
   The **Image Label** window appears.
2. Type the image label name and click **OK**.
   
   The system displays the name in the **Name** column.

---

**Storing an image**

You can store a cine loop or individual frame either while you are acquiring image data or reviewing image data.

**To store a cine loop:**

1. Begin acquiring data in an imaging Mode, or review a stored cine loop from the Study Browser.
2. Press **Cine Store**.
The system saves the cine loop frames as a single image item and lists the image in the Study Browser.

To store a single-frame image:
You can use Frame Store to a single-frame image in B-Mode, Color Doppler Mode, Power Doppler Mode and Contrast Mode.

For M-Mode, PW Doppler Mode and PW Tissue Doppler Mode, this key stores the complete cine loop.

1. Begin acquiring data in an imaging Mode, or review a stored cine loop from the Study Browser.

2. Press Frame Store.

   The system saves the frame as an image item and lists the image in the Study Browser.

   **Note:** When you store a frame from a previously stored cine loop, the frame includes the same image label as the original cine loop.
Exporting studies, series or images

The Export function:

a. Translates your images from the proprietary Vevo 2100 Imaging System file format into industry formats you can work with on another computer.

b. Transfers the translated files to a network location or an external storage device that you connect to the USB ports or the Firewire port on the rear panel of the Vevo 2100 Imaging System.

In this chapter
Exporting cine loops from the Study Browser ..........................................................139
Exporting image frames from the Study Browser ......................................................142
Exporting images to DICOM from the Study Browser ...............................................145
Exporting the Study Browser list view as a text file ..................................................148
Exporting the Study Browser window content .........................................................149

Exporting cine loops from the Study Browser

Before you begin
Ensure that the Vevo 2100 Imaging System is connected through the appropriate ports on the rear panel of the system to a data storage location on your network or to an external storage device.

To export cine loops from the Study Browser:

1. Press Study Management.
   The Study Browser appears.
2. Select the cine loops you want to export.

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

   ▪ If you want to export a single cine loop, expand the study and series that contains the cine loop and select it.
   ▪ 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.
Chapter 25: Exporting studies, series or images

Important tip: When you select a series or a study that includes image frames as well as cine loops, the system only exports the selected cine loop images. You do not have to de-select the image frames. You can just select the series row or even the whole study and the system will export only the cine loops.

- Press **Select** to select one row
- Press **CTRL** + **Select** to select a collection of individual rows
- Press **Select** + **SHIFT** + scroll + **Select** to select a range of rows

3. Press **Export**.

The Export Image window appears.

4. In the folder browser, browse to the location where you want to export your cine loops and select the folder.

5. If you need to create a new folder to contain the cine loops you are exporting:
   a. Click **New Folder**.
   b. Type the name of the new folder and click **OK**.
   c. Select the new folder.

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

7. In the Options section:
   a. In the top box:
      - If you are exporting a single image, the system labels this box **Save As**. You can keep the system defined date and time stamp file name or type a new file name.
      - If you selected to export multiple images, the system labels this box **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.
   b. In the File Type box select the AVI format based on your requirements.

<table>
<thead>
<tr>
<th>AVI format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncompressed AVI</td>
<td>Largest file size. Original image quality.</td>
</tr>
<tr>
<td>Compressed AVI MS Video 1</td>
<td>Smallest file size. Good image quality.</td>
</tr>
<tr>
<td>Compressed AVI MS Media Video 9</td>
<td>Smaller file size. Best image quality.</td>
</tr>
</tbody>
</table>

**Attention: Apple Macintosh users** - Use this format to export as compressed AVI.

| Windows Audio Wave File    | Saves the audio from a PW Doppler or PW Tissue Doppler cine loop. |
c. In the **Quality** row, click **High** or **Medium** based on your requirements.

<table>
<thead>
<tr>
<th>Quality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium</td>
<td>Slightly lower resolution</td>
</tr>
<tr>
<td>High</td>
<td>Highest resolution</td>
</tr>
</tbody>
</table>

8. Click **OK**.

The system exports the images to the folder you selected and then presents the **Image Export Report**.

9. Click **OK**.

The system returns you to the **Study Browser**.

**Related information**

- Rear panel (page 21)
- Export and Copy To windows workspaces (page 54)

**Exporting a cine loop from the Mode window**

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

**Before you begin**

Ensure that the Vevo 2100 Imaging System is connected through the appropriate ports on the rear panel of the system to a data storage location on your network or to an external storage device.

**To export a cine loop from the Mode window:**

1. Press **Export**.

   The **Export Image** window appears.

2. Continue the export procedure as detailed in *Exporting cine loops from the Study Browser* (page 139).
Chapter 25: Exporting studies, series or images

Exporting image frames from the Study Browser

Before you begin

Ensure that the Vevo 2100 Imaging System is connected through the appropriate ports on the rear panel of the system to a data storage location on your network or to an external storage device.

To export image frames from the Study Browser:

1. Press Study Management.
   The Study Browser appears.
2. Select the image frames you want to export.
   - If you want to export a single image frame, expand the study and series that contains the image frame and select it.
   - 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.
   - Press Select to select one row
   - Press CTRL+Select to select a collection of individual rows
   - Press Select + SHIFT + scroll + Select to select a range of rows

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

3. Press Export.
   The Export Image window appears.
4. In the folder browser, browse to the location where you want to export your data and select the folder.
5. If you need to create a new folder to contain the image frames you are exporting:
   a. Click New Folder.
   b. Type the name of the new folder and click OK.
6. In the Export Type section click Image.
7. In the Options section:
a. In the top box:

- If you are exporting a single image, the system labels this box **Save As**. You can keep the system defined date and time stamp file name or type a new file name.

- If you selected to export multiple images, the system labels this box **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.

b. In the **File Type** box select the TIFF or BMP file format in either full screen or image area.

*Image exported as full screen BMP file*
Chapter 25: Exporting studies, series or images

c. If the system detects that the file names of any images you selected for export are identical to any file names in your export folder, the system prompts you to choose how to proceed:
   - Click Yes to overwrite the files
   - Click No to return to the Export Image window

8. Click OK.
   The system exports the images to the folder you selected and then presents the Image Export Report.

9. Click OK.
   The system returns you to the Study Browser.

Related information

- Rear panel (page 21)
- Export and Copy To windows workspaces (page 54)
Exporting an image frame from the Mode window

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

Before you begin

Ensure that the Vevo 2100 Imaging System is connected through the appropriate ports on the rear panel of the system to a data storage location on your network or to an external storage device.

To export an image frame that you are analyzing in the Mode window:

1. Press Export.
   The Export Image window appears.
2. Complete the export procedure as detailed in Exporting image frames from the Study Browser (page 142).

Exporting images to DICOM from the Study Browser

You can export saved cine loop or image frame images as DCM files that you can import into a DICOM compatible workstation. This feature supports all ultrasound modes except 3D-Mode. If you select only 3D-Mode images for export, the system disables the Export button.

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

Before you begin

Ensure that the Vevo 2100 Imaging System is connected through the appropriate ports on the rear panel of the system to a data storage location on your network or to an external storage device.

To export images to DICOM format from the Study Browser:

1. Press Study Management.
   The Study Browser appears.
2. Select the image frames you want to export.
   • 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.
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.

- Press **Select** to select one row
- Press **CTRL + Select** to select a collection of individual rows
- Press **Select + SHIFT + scroll + Select** to select a range of rows

3. Press **Export**.

The Export Image window appears.

4. In the folder browser, browse to the location where you want to export your data and select the folder.

5. If you need to create a new folder to contain the image frames you are exporting:
   a. Click **New Folder**.
   b. Type the name of the new folder and click **OK**.
      The system adds a new folder inside the selected folder.

6. In the Export Type section click **DICOM**.

7. In the Options section:
   a. In the top box:
      - If you are exporting a single image, the system labels this box **Save As**. You can keep the system defined date and time stamp file name or type a new file name.
      - If you selected to export multiple images, the system labels this box **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.
   b. In the File Type box select the compression level for your DCM export file, as described in the following table.

<table>
<thead>
<tr>
<th>Header text</th>
<th>Header text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implicit VR Little Endian</td>
<td>Image pixel data is not compressed. The Tag type is determined by the context.</td>
</tr>
<tr>
<td>Explicit VR Little Endian</td>
<td>Image pixel data is not compressed. The Tag type is explicitly defined in the file.</td>
</tr>
<tr>
<td>JPEG Baseline</td>
<td>Image pixel data is encoded with JPEG coding Process 1 (non-hierarchical with Huffman coding). This setting produces the smallest file sizes, but with some loss of image quality.</td>
</tr>
<tr>
<td>RLE Lossless</td>
<td>Image pixel data is encoded with RLE compression which compresses with no image loss.</td>
</tr>
</tbody>
</table>
c. If your DICOM system supports regions:
   - 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.
   - Clear the Export regions check box to export the file with only the calibration data for the main image area.

d. If the system detects that the file names of any images you selected for export are identical to any file names in your export folder, the system prompts you to choose how to proceed:
   - Click Yes to overwrite the files
   - Click No to return to the Export Image window

8. Click OK.
   The system exports the images as individual DCM files to the folder you selected and then presents the Image Export Report.

9. Click OK.
   The system returns you to the Study Browser.

Exported files

- If you selected any series that only contain 3D-Mode images, the system does not export any of the images.
- If you selected multiple images including 3D-Mode images, the system exports all the images except for the 3D-Mode images.

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.

Before you begin

Ensure that the Vevo 2100 Imaging System is connected through the appropriate ports on the rear panel of the system to a data storage location on your network or to an external storage device.

To export an image to DICOM from the Mode window:

1. Press Export.
Chapter 25: Exporting studies, series or images

The Export Images window appears.

2. Complete the export procedure as detailed in Exporting to DICOM from the Study Browser (page 145).

---

Exporting the Study Browser list view as a text file

The Study Browser list view is the exact representation of what appears in your Study Browser when you scroll from the top to the bottom.

When you export the Study Browser list view using the Table option, the system generates a snapshot of this view and exports it as a TXT text format file. You can then open the file in a text editor.

Before you begin

Ensure that the Vevo 2100 Imaging System is connected through the appropriate ports on the rear panel of the system to a data storage location on your network or to an external storage device.

To export the Study Browser list view as a text file:

1. Press Study Management.

   The Study Browser appears.

2. Expand the study rows and series rows as required to create the view you want to export.

3. From the Study Browser, press Export.
The Export Image window appears.

4. In the folder browser, browse to the location where you want to export your data and select the folder.

5. If you need to create a new folder:
   a. Click New Folder.
   b. Type the name of the new folder and click OK.
      The system adds a new folder inside the selected folder.

6. In the Export Type section click Table.

7. (Optional) In the Options section type a unique name to replace the default time stamp.

8. Click OK.
   The system:
   - Exports the Study Browser list view as a TXT text file.
   - Returns you to the Study Browser.

To view the Study Browser list view table:
Open the TXT file in a text editor.

Exporting the Study Browser window content

When you want to take a snapshot summary of your activity over a set period of time use the export Table feature. Export Table exports the Study Browser window content precisely as it appears, but as a TXT file.
For example if your 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.

Before you begin

Ensure that the Vevo 2100 Imaging System is connected through the appropriate ports on the rear panel of the system to a data storage location on your network or to an external storage device.

To export the Study Browser window contents:

1. Open the Study Browser window (page 49).
2. Expand the studies and series you want to view.
3. Click Export.
   
   The Export Image window appears.

4. In the folder browser, browse to the location where you want to export your cine loops and select the folder.

5. In the Export Type section click Table.

6. (Optional) In the Options section type a unique name to replace the default time stamp.

7. Click OK.
The system exports the Study Browser window contents as a TXT file to the location you specified.
Chapter 26

Copying, deleting and importing

The Vevo 2100 Imaging System provides a range of features for copying, deleting and importing study data.

In this chapter

Copying studies, series or images.................................................................152
Deleting studies, series or images.................................................................153
Importing studies.......................................................................................154

Copying studies, series or images

You can copy any number of studies from your Vevo 2100 Imaging System to a location on your network or to an external storage device.

Before you begin

Ensure that the Vevo 2100 Imaging System is connected to the external storage location through the appropriate ports on the rear panel of the system.

To copy a study:

1. In the Study Browser, select the names of the studies that you want to copy.
   - Press Select to select one row
   - Press CTRL+Select to select a collection of individual rows
   - Press Select + SHIFT+scroll+Select to select a range of rows

2. Press 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. If you need to create a new folder to contain the file you are copying:
   a. Click New Folder.
   b. Type the name of the new folder and click OK.
The system adds a new folder inside the selected folder in the folder browser window.

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**.

   The system:
   a. Copies the studies to the folder you selected.
   b. Displays the **Copy Study Report** box to summarize the details of the copy process. Click **OK** to complete the process.
   c. Returns you to the **Study Browser**.

---

### Related information

- **Rear panel** (page 21)
- **Export and Copy To windows workspaces** (page 54)

---

### Deleting studies, series or images

In the **Study Browser** list of study items, series items and image items, 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 the sub items under those rows.
   b. Select the study, series or image items you want to delete.
      - Press **Select** to select one row
      - Press **CTRL + Select** to select a collection of individual rows
      - Press **Select + SHIFT + scroll + Select** to select a range of rows

2. Press **DEL**.

**DATA LOSS WARNING:** When you delete items from the **Study Browser**, the system completely removes the data from your system. You cannot retrieve it.

The system:

a. Deletes the studies you selected.
Chapter 26: Copying, deleting and importing

**Note:** If one or more of the studies are locked, the system will not delete them.

b. Displays the **Delete Confirmation** box to summarize the details of the deletion process.

3. Click **Yes**.
   The system returns to the **Study Browser**.

---

**Importing studies**

Use this command to copy studies acquired on another Vevo 2100 Imaging System or from another storage location.

**Before you begin**

Ensure that the Vevo 2100 Imaging System is connected through the appropriate ports on the rear panel of the system to a data storage location on your network or to an external storage device.

**To import a study:**

1. From the **Study Browser** press **Copy From**.
   The **Copy Study From** window appears.

2. In the **Owner Operator** box, select your name from the list.

   **Alert: Cannot Proceed** If you do not select your name in the list, the system disables the **OK** button.

3. Select the studies you want to import to your **Study Browser**.

   **To preview the images in an external study:**
   In the folder browser browse to the folder that contains the study, expand the folder, expand the study and select a series. The system displays the thumbnails of the images.

   **To select an individual study:**
   - In the folder browser browse to the folder that contains the study, expand the folder and select the study.
   - Click the transfer button. The study name appears in the **Selected Studies** list.
4. If you want to remove a study from the **Selected Studies** list, select the study and then click **Remove**.

5. Click **OK**.

   The system:
   
   a. Imports the studies that you selected.
   
   b. Displays the **Copy Study Report** box to summarize the details of the import process. Click **OK** to complete the process.
   
   c. Returns you to your previous workspace.
Analyzing image data

This section walks you through the typical tasks you will complete when you are analyzing your images.

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Vevo Imaging Workstation ................................................................. 157
Working with cine loops ................................................................. 158
Measurement basics ................................................................. 164
Working with measurements ...................................................... 170
Working with annotations ...................................................... 175
Reporting your analysis results ...................................................... 184
VisualSonics offers an optional Vevo 2100 Workstation Software package which includes all the software tools and features that you will find on the Vevo 2100 Imaging System excluding the image acquisition tools features.
A cine loop is the trailing series of acquired images that the system holds in its memory buffer as you acquire image data.

- In B-Mode, the cine loop is a set of frames.
- In PW Doppler Mode and M-Mode, the cine loop is the data acquired over a time interval.

**In this chapter**

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- Cine loop review controls ..............................................................................................159
- Creating cine loops........................................................................................................161
- Creating a cine loop subset from a full cine loop.........................................................162
- Viewing saved physiological data ................................................................................162

---

**Cine loop workspace**

The following illustration and table describes the information and features in a frame-based cine loop.

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cine loop length bar. Represents the full length of the cine loop.</td>
</tr>
</tbody>
</table>
**Area** | **Description**  
---|---  
② **Frame counter.** Indicates the location of the current frame. The counter indicates the frame number and the total number of frames located within the buffer.  
To view another frame in the cine loop, click on the triangular frame indicator and drag it to the desired frame.  
③ **Range start frame number.**  
④ **Range start bracket.** Defines the start of the cine loop range you want to review. You can create a range within the full cine loop. Drag the bracket and then click to define the start of a subset range.  
⑤ **Range length bar.** Represents the full length of the defined range.  
⑥ **Range end bracket.** Defines the end of the cine loop range you want to review. You can create a range within the full cine loop. Drag the bracket and then click to define the end of a subset range.  
⑦ **Range end frame number.**  

**Cine loop review controls**

You can review a cine loop using either the dial controls on the Vevo 2100 Imaging System control panel or the on-screen controls on the Vevo Imaging Workstation on a PC.
Reviewing a cine loop on the Vevo 2100 Imaging System

When you are playing a cine loop on the Vevo 2100 Imaging System these are the controls you use.

To use this dial control:

- To stop and start the cine loop, press the dial
- To view a cine loop frame by frame, press the dial to stop the cine loop and then turn the dial one click at a time clockwise or counterclockwise
- To change the review playback speed, press the dial to start the cine loop and then turn the dial clockwise to speed up or counterclockwise to slow down
Scan/Freeze

During image acquisition, toggles between acquiring image data and freezing the acquisition. When you freeze the acquisition the system stores cine loop data if you select Auto SAVE on Image Label in the General tab of the Preferences window.

During image analysis, starts and stops data playback.

Trackball. Roll the ball with your hand to:

- Move a pointer or cursor around the screen
- Move forward or backward in a cine loop

Reviewing a cine loop on the Vevo Imaging Workstation

When you are playing a cine loop on the Vevo Imaging Workstation these are the controls you use.

Creating cine loops

To create a cine loop:

- While you are acquiring image data, press Scan/Freeze to pause your data acquisition. This creates a temporary cine loop that you can review to determine if you want to save it as an image.
Chapter 28: Working with cine loops

- Press Cine Store after you have acquired your image or at any time while you are acquiring image data. This stores the buffered cine loop frames as an image that appears in your Study Browser.

- Pause an acquired cine loop, drag the left or right cine loop range bracket to isolate a range of image frames within the original cine loop and then press Cine Store to store the range of image frames as a cine loop.

Creating a cine loop subset from a full cine loop

You can use the start and end range brackets to create a cine loop subset 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 subset from a full cine loop:

1. From the Study Browser, open a cine loop.
2. Drag the start bracket and then click to define the start of the subset range.
3. Drag the end bracket and then click to define the end of the subset range.
4. Use the cine loop review controls to view the cine loop subset.
5. If you want to store the cine loop subset, press Cine Store.

This sets the playback range in the stored data. The playback range can be changed and then stored again. The original data in 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 the system recorded along with the image data.

The system displays this physiological data in three areas of the Mode window. The following illustration and table describes the features of each area.

Physiological data elements when you are analyzing saved image data
### Before you begin

Ensure that you select the desired physiological inputs in the **Physiological Enable** section of the General tab in the Preferences window.

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

1. Press **Physio Settings**.
2. In the **Physiological Display** section:
   - To show or hide the entire graph, select or clear the **View Physiology** check box.
   - To show or hide individual traces in the graph, select or clear the check boxes for the required traces.

The system shows only the traces you selected.
Measurement basics

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

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Complete procedure for adding a generic measurement ............................... 166
Protocol measurements .................................................................................... 167
Adding protocol measurements ....................................................................... 168
Measurement units ............................................................................................. 169

Measurement panel workspace

The measurement panel is the workspace you use when you add measurements to a stored image or an image that you have acquired but not yet stored.

To view the measurement panel:

1. Open a stored image from the Study Browser or pause an image acquisition.
2. Click (Workstation) or press Measure (control panel).
The measurement panel appears on the left side of the window.

**Measurement panel workspace**

The following illustration and table describes the information and features in the measurement panel.

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td><strong>Generic measurement tools.</strong> Each imaging Mode provides a unique set of tools. Click the tool and then apply the measurement on the ultrasound imaging area.</td>
</tr>
<tr>
<td>②</td>
<td><strong>Measurement package.</strong> Select the appropriate measurement package from the drop-down box and then expand a protocol to access the measurements you want to apply.</td>
</tr>
<tr>
<td>③</td>
<td><strong>Protocols list.</strong> Displays the list of protocols related to the selected measurement package.</td>
</tr>
<tr>
<td>④</td>
<td><strong>Protocols list item.</strong> Click the protocol to expand the list and display the list of measurements within that protocol.</td>
</tr>
</tbody>
</table>
Chapter 29: Measurement basics

### Area Description

| 5 | Protocol measurement item. A measurement for a specific protocol. Each protocol measurement uses one of the generic measurement tools that are displayed for the active imaging Mode. Click the measurement item and then apply the measurement on the ultrasound imaging area. |

| 6 | Measurement values list. Displays the measurements that have been applied to the image. The index # identifies the measurement on the image if the **Show Values and Labels** option is selected in the Measurement tab of the Preferences window. |

### Related information

- Creating custom measurement packages (page 80)
- Modifying and deleting custom measurement packages (page 81)

### Generic measurements

Generic measurements can be applied 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.

![Depth generic measurement.](image)

### Complete procedure for adding a generic measurement

- **To add a typical measurement:**

  1. While you view a saved image from the Study Browser or an image that is acquired but not stored during an image acquisition session, press **Measure** and toggle to view the measurement tools panel.
2. Click the measurement button 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.

For example, for a linear distance measurement, click 📏. The button remains selected until the measurement is completed.

While you apply the measurement, you can look in the measured values list area at the bottom of the left panel to see a magnified view of your cursor area.

3. Click to apply your caliper points.

For example, for a linear distance measurement, click on your image to place the initial caliper, then trackball to the location where you want to end your measurement and then click to place the end caliper. This completes your measurement.

4. If you selected the Show Values and Labels option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement in the format `<Measurement name> #`, where # is the sequential number of that type of generic measurements in the series.

5. If you want to rename the label and you have selected Show Values and Labels in the Measurement tab of the Preferences window, type a new name while the label text is selected, and then click outside the label to commit the label.

6. If you have selected Show Values and Labels in the Measurement tab of the Preferences window and you want to move the measurement or move the label, select either item and then drag and drop it.

---

**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 applies one of the generic measurement tools that are provided for the imaging Mode, and then labels the measurement with its unique name.

![Splenic Artery Diam measurement for the Spleen protocol within the Abdominal measurement package.](image)
Adding protocol measurements

Protocol measurements are labeled uniquely for a specific measurement protocol.

To access the protocol measurement tools and measurements list

- If you are in an image acquisition session press **Scan/Freeze** to acquire an image and then press **Measure**.
- If you are in the Study Browser, open an image and then press **Measure**.

To place a protocol measurement:

1. In the measurement packages drop-down list click the appropriate package.
2. In the list of protocols, select the appropriate protocol.
3. In the list of measurements, select the measurement you want to add.
The system automatically activates the appropriate measurement tool and highlights the generic button for that tool.

4. On the image, add your measurement. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.

**Next step**

- Reporting your analysis results (page 184)

**Related information**

- Analyzing image data (page 156)
- Protocol measurements (page 167)

**Measurement units**

The system includes the following measurement types and units:

<table>
<thead>
<tr>
<th>Measurement type</th>
<th>Measurement unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length / Distance</td>
<td>millimeters (mm)</td>
</tr>
<tr>
<td>Area</td>
<td>square millimeters (mm²)</td>
</tr>
<tr>
<td>Velocity</td>
<td>millimeters per second (mm/s)</td>
</tr>
<tr>
<td>Acceleration</td>
<td>millimeters per second per second (mm/s²)</td>
</tr>
<tr>
<td>Time</td>
<td>milliseconds (ms)</td>
</tr>
<tr>
<td>Heart rate</td>
<td>beats per minute (BPM)</td>
</tr>
<tr>
<td>Velocity Time Integral (VTI)</td>
<td>centimeters per second integrated over the time interval in seconds (cm)</td>
</tr>
<tr>
<td>Volume</td>
<td>millimeters cubed (mm³)</td>
</tr>
<tr>
<td>RR Interval</td>
<td>milliseconds (ms)</td>
</tr>
<tr>
<td>Pressure gradient</td>
<td>millimeters of Mercury (mmHg)</td>
</tr>
<tr>
<td>Temperature</td>
<td>degrees Celsius</td>
</tr>
</tbody>
</table>

**Note:** If the unit value includes more than four digits before the decimal point, the unit of measure changes in order that the value will have less than four digits before the decimal point.
Chapter 30

Working with measurements

This chapter shows you how to complete measurement tasks that are used for many measurements in many imaging Modes.

In this chapter

Modifying the properties of a measurement ................................................................. 170
Modifying points on a contour measurement ............................................................. 171
Modifying contour measurements ............................................................................. 172
Adding embryo measurements .................................................................................. 172
M-Mode measurement chains .................................................................................... 173
Copying measurements on Contrast Mode images .................................................... 174
Deleting measurements .............................................................................................. 174

Modifying the properties of a measurement

The properties of a measurement are initially defined by the settings you configure in the Measurement Display Options preferences (page 85) on the Measurement tab in the Preferences window. You can override these settings for individual measurements.

To modify the properties of an individual measurement:

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

2. Modify the properties as required and click **OK**.

**Related information**

- *Measurement Display Options preferences* (page 85)
- *Measurement Parameters preferences* (page 84)

**Modifying points on a contour measurement**

- **To modify points on a contour:**
  - **To move a point**, drag it to a new position, then click again to commit the point
  - **To add a point**, click the contour, move the cursor to a new position, then click again to commit the new point
  - **To delete a point**, right-click the point and select **Delete Point**
Modifying contour measurements

To modify a contour:

- **To move the contour** (all the caliper points as a group) click the center point of the trace, trackball to the new position, then click again to commit the contour.
- **To resize the contour**, click the contour, trackball 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 select **Delete**.

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. The Vevo software 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, the system labels this **Crown Rump Length:Emb:LE3**.

You can disable the suffix by selecting **Show Embryo Index** in the Measurement Display Options (page 85) preferences in the Measurement tab of the Preferences window.

To add an embryo measurement:

1. Ensure that the Study Information (page 50) window specifies that the animal is pregnant.
2. From the Study Browser, open the image that includes the embryo image data.
3. Click **Measure** (Workstation) or press **Measure** (control panel).
4. In the measurement packages list select **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.

---

**M-Mode measurement chains**

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

![M-Mode image displaying the measurement chains beginning with RVID;d and IVS;s](image)

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. The image is stored as each of the measurements is completed.

- **To complete an M-Mode chained measurement:**
  1. In the measurement packages list select **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.

    The system displays and labels the measurement if the **Show Values and Labels** option is selected in the Measurement tab of the Preferences window.
  4. Click the bottom point of the first measurement. The system 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. The system measures and labels the second measurement and stores the image.

6. Click the remaining bottom points of the next measurements in the chain.
   The system measures and labels each measurement until the final measurement is completed.

### Copying measurements on Contrast Mode images

On Contrast Mode images you can copy contrast region measurements and cardiac region measurements.

**To copy a Contrast Mode contour measurement:**

1. Right-click a measurement, and select *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.

**Related information**

- *Modifying a contour measurement* (page 172)

### Deleting measurements

**To delete a measurement:**

- Right-click a measurement, and select *Delete*.
- Select a measurement in the list of measured values and press `DEL`.
Chapter 31

Working with annotations

Annotations are text labels that you can add to any ultrasound image.
When you store an image or cine loop, the system includes any annotations as part of the image or cine loop.

Note: The system does not include annotations when you export M-Mode, PW Doppler Mode, or PW Tissue Doppler Mode images. However, if the annotations are in the B-Mode scout window, they are exported.

This chapter describes how to work with annotations when you are analyzing an acquired ultrasound image in an image Mode window.

In this chapter
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Predefined annotations...............................................................176
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Annotation workspace

The following illustration and table describes the information and features you use when you add an annotation to the ultrasound image area.
Chapter 31: Working with annotations

Area Description

1. **Predefined annotation.** A default or custom annotation. To add a predefined annotation right-click on the image > select a package category > select an annotation.

2. **Anchor line.** Appears when you drag the annotation text. Visually links the annotation text to the caliper point on the image where you added the annotation.

3. **Generic Text annotation - modified.** An annotation that you type in manually on the image. To add a generic annotation right-click on the image > select **Generic Text** > type your custom annotation.

   You can also modify the properties of any annotation (page 181).

4. **List of annotation categories.** 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-click on the image.

5. **Annotation text list.** A unique list of predefined annotations that are set for a package category. To display this list right-click on the image > select a package category.

6. **Measurement label.** For detailed information see *Adding annotations* (page 180).

---

**Predefined annotations**

The system 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 (page 88).
- Predefined annotations are not available in 3D-Mode.

This section lists the default predefined annotations that are available.

**Abdominal Package annotations**

<table>
<thead>
<tr>
<th>Category</th>
<th>Annotation text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic</td>
<td>Annotation text</td>
</tr>
</tbody>
</table>
### Chapter 31: Working with annotations

<table>
<thead>
<tr>
<th>Category</th>
<th>Annotation text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kidney</td>
<td>Cortex</td>
</tr>
<tr>
<td></td>
<td>Medulla</td>
</tr>
<tr>
<td></td>
<td>Hilum</td>
</tr>
<tr>
<td></td>
<td>Renal Vein</td>
</tr>
<tr>
<td></td>
<td>Renal Artery</td>
</tr>
<tr>
<td></td>
<td>Left Kidney</td>
</tr>
<tr>
<td></td>
<td>Right Kidney</td>
</tr>
<tr>
<td>Liver</td>
<td>Hepatic Artery</td>
</tr>
<tr>
<td></td>
<td>Hepatic Vein</td>
</tr>
<tr>
<td></td>
<td>Portal Vein</td>
</tr>
<tr>
<td></td>
<td>Lobe</td>
</tr>
<tr>
<td></td>
<td>Right Lobe</td>
</tr>
<tr>
<td></td>
<td>Left Lobe</td>
</tr>
<tr>
<td></td>
<td>Liver</td>
</tr>
<tr>
<td>Other Abdominal</td>
<td>Adrenal Gland</td>
</tr>
<tr>
<td></td>
<td>Intestines</td>
</tr>
<tr>
<td></td>
<td>Bladder</td>
</tr>
<tr>
<td>Reproductive Group</td>
<td>Ovary</td>
</tr>
<tr>
<td></td>
<td>Uterus</td>
</tr>
<tr>
<td></td>
<td>Uterine Horn</td>
</tr>
<tr>
<td></td>
<td>Testicle</td>
</tr>
<tr>
<td></td>
<td>Seminal Vesicle</td>
</tr>
<tr>
<td></td>
<td>Prostate</td>
</tr>
<tr>
<td>Physiological</td>
<td>Inspiration</td>
</tr>
<tr>
<td></td>
<td>Expiration</td>
</tr>
<tr>
<td></td>
<td>Electrical Systole</td>
</tr>
<tr>
<td></td>
<td>Electrical Diastole</td>
</tr>
<tr>
<td></td>
<td>Mechanical Systole</td>
</tr>
<tr>
<td></td>
<td>Mechanical Diastole</td>
</tr>
<tr>
<td></td>
<td>Max dP/dT</td>
</tr>
</tbody>
</table>

### Cardiac Package annotations

<table>
<thead>
<tr>
<th>Category</th>
<th>Annotation text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic Text</td>
<td>Annotation text</td>
</tr>
</tbody>
</table>
## Chapter 31: Working with annotations

<table>
<thead>
<tr>
<th>Category</th>
<th>Annotation text</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cardiology</strong></td>
<td>Left Ventricle</td>
</tr>
<tr>
<td></td>
<td>LV PW</td>
</tr>
<tr>
<td></td>
<td>Right Ventricle</td>
</tr>
<tr>
<td></td>
<td>RV AW</td>
</tr>
<tr>
<td></td>
<td>Left Atrium</td>
</tr>
<tr>
<td></td>
<td>Right Atrium</td>
</tr>
<tr>
<td></td>
<td>Intra-Ventricular Septum</td>
</tr>
<tr>
<td></td>
<td>Infarct</td>
</tr>
<tr>
<td></td>
<td>Respiratory Motion</td>
</tr>
<tr>
<td></td>
<td>Coronary Artery</td>
</tr>
<tr>
<td></td>
<td>Aortic Valve</td>
</tr>
<tr>
<td></td>
<td>Mitral Valve</td>
</tr>
<tr>
<td></td>
<td>Tricuspid Valve</td>
</tr>
<tr>
<td></td>
<td>Pulmonary Artery</td>
</tr>
<tr>
<td></td>
<td>Pulmonary Valve</td>
</tr>
<tr>
<td><strong>Physiological</strong></td>
<td>Inspiration</td>
</tr>
<tr>
<td></td>
<td>Expiration</td>
</tr>
<tr>
<td></td>
<td>Electrical Systole</td>
</tr>
<tr>
<td></td>
<td>Electrical Diastole</td>
</tr>
<tr>
<td></td>
<td>Mechanical Systole</td>
</tr>
<tr>
<td></td>
<td>Mechanical Diastole</td>
</tr>
<tr>
<td></td>
<td>Max dP/dT</td>
</tr>
</tbody>
</table>

### Embryology Package annotations

<table>
<thead>
<tr>
<th>Category</th>
<th>Annotation text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic text</td>
<td>Annotation text</td>
</tr>
</tbody>
</table>

---

*VisualSonics Vevo 2100 Imaging System Operator Manual Rev 1.1*
### Chapter 31: Working with annotations

**Embryology**
- Placenta
- Umbilical Cord
- Embryo
- 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
- 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 annotations

<table>
<thead>
<tr>
<th>Category</th>
<th>Annotation text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic Text</td>
<td>Annotation text</td>
</tr>
</tbody>
</table>
Chapter 31: Working with annotations

### Category 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 annotations

<table>
<thead>
<tr>
<th>Category</th>
<th>Annotation text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic Text</td>
<td>Annotation text</td>
</tr>
</tbody>
</table>

| 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.
Chapter 31: Working with annotations

To add a custom annotation:

Method 1
1. Right-click on the ultrasound image.
2. Select Generic Text.
   The system adds an editable text field.
3. Type your custom annotation and press ENTER.
4. If you want to move the annotation, drag the annotation. The label moves and maintains a line to the initial point where you added the annotation.

Method 2 (Vevo 2100 Imaging System)
1. Press Cursor to toggle the cursor off.
2. Press Annotate.
   The system adds an editable text field.
3. Type your custom annotation and press ENTER.

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:
- To move the annotation label and line, select anywhere in the middle of the line, drag the label and line to the new position, then click to commit the move.
- To move the annotation label only, drag it to the new position, then click to commit the move.
- To move the origin of the annotation line, drag the caliper point to the new position, then click to commit the move.
To delete an annotation:
Right-click the annotation and select Delete.

To show/hide annotations:
1. From the Study Browser (page 49) click Prefs and then click the Annotations tab.
2. In the Annotations Display section, select or deselect the Show Annotations check box.

To modify the properties of an annotation:
1. Right-click the annotation and select Properties.
   The Annotation Properties box appears.

2. Modify the properties as described in the following table.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Label</td>
<td>Annotation text. Type in new text.</td>
</tr>
<tr>
<td>Line Style</td>
<td>Select from a plain line or three arrow-head lines.</td>
</tr>
<tr>
<td>Line Thickness</td>
<td>Modifies the thickness of the anchor line. Select from Thin, Medium, Heavy.</td>
</tr>
<tr>
<td>Color</td>
<td>In the drop-down box select one of 25 colors.</td>
</tr>
<tr>
<td>Font</td>
<td>Select from the available fonts on your system.</td>
</tr>
<tr>
<td>Font Size</td>
<td>Select a font size between 8-48 points.</td>
</tr>
<tr>
<td>Range</td>
<td>Specifies the range of frames in the cine loop that display the annotation. Only available if you de-select the Loop check box.</td>
</tr>
<tr>
<td>Loop</td>
<td>Applies the annotation to the entire cine loop or to a specific frame range in the loop.</td>
</tr>
<tr>
<td>Show Anchor Line</td>
<td>Select or de-select the check box to show or hide the anchor line between the annotation text and the initial caliper point.</td>
</tr>
<tr>
<td>Reset</td>
<td>Click to return all properties to the default values.</td>
</tr>
</tbody>
</table>

3. Click OK.
To modify the list of predefined annotations:

1. From the **Study Browser** (page 49) click **Prefs** and then click the **Annotations** tab.

2. Add, reorder or delete package categories and category annotations as detailed in *Setting the Annotation tab preferences* (page 88).
Chapter 32

Reporting your analysis results

This chapter describes how to work with the measurements, calculations and annotations that you add to the image data.

In this chapter

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Reviewing the image that contains a report measurement ...........................................185
Exporting an image analysis report ..............................................................................185
Exporting an analysis report .........................................................................................188

Creating an analysis report

An analysis report is the collection of measurements and calculations for a collection of series or studies.

You cannot create an analysis report for an individual cine loop or image frame. If you select an image row in the Study Browser and try to create an analysis report for it, the system builds a report for the entire series that includes that one image.

Analysis report guidelines

- You can create analysis reports for studies or individual series.
- You cannot create a report for the measurements and calculations for an individual image.
- When you select a study for a report, the report includes all measurements for all series in the study.
- When you select multiple studies for a report, the report includes all measurements in all the studies you selected.

To report your analysis results:

1. Open the Study Browser.
2. Select the images, series or studies that contain the measurements you want to compile into a report.

   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:
   - Press Select to select one row
Chapter 32: Reporting your analysis results

- Press **CTRL** + **Select** to select a collection of individual rows
- Press **Select** + **SHIFT** + scroll + **Select** to select a range of rows

3. Click **Report**.
   The system compiles your selections into a single report.

Reviewing the image that contains a report measurement

- **To review the image that contains a report measurement:**
  1. In the analysis report, select a measurement row.
     In the right column the system 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 **Load**, or double-click the measurement. or double-click the thumbnail.
     The system displays the image that contains the selected measurement.

Exporting an image analysis report

You can export report files that list all measurements and calculations as well as the physiological data for any combination of studies, series and images.

You cannot create an analysis report for an individual cine loop or image frame. If you select an image row in the Study Browser and try to create an analysis report for it, the system builds a report for the entire series that includes that one image.
The system exports your analysis report as a CSV file which you can load into third party tools such as spreadsheet software so you can complete additional statistical analysis.

The system supports three ways to export your analysis report:

- Export your report from the **Study Browser**
- Export your report from the **Analysis Browser**
- Export your report from the **Mode** window

**Before you begin**

Ensure that the Vevo 2100 Imaging System is connected through the appropriate ports on the rear panel of the system to a data storage location on your network or to an external storage device.

**To export your analysis report from the Study Browser**

1. Press **Study Management**.
   
The **Study Browser** appears.

2. Select the studies, series and images you want to include in your export.
   
   - All the measurements for the entire series will be reported, not just the measurements for the selected images
   
   - 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 element rows you want to include in your report
   
   - Press **Select** to select one row
   
   - Press **CTRL + Select** to select a collection of individual rows
   
   - Press **Select + SHIFT + scroll + Select** to select a range of rows

3. Press **Export**.
   
The **Export Report** window appears.

4. In the folder browser, browse to the location where you want to export your data and select the folder.

5. If you need to create a new folder to contain the image frames you are exporting:
   
   a. Click **New Folder**.

   b. Type the name of the new folder and click **OK**.
Chapter 32: Reporting your analysis results

The system adds a new folder inside the selected folder in the folder browser window.

6. In the Export Type section click Report.
7. (Optional) In the Options section type a unique name to replace the default time stamp.
8. Click OK.

The system exports your report to the folder you selected and returns you to the Study Browser.

To export your analysis report from the Analysis Browser:

1. From the Study Browser, select the studies, series and images you want to include in your export.
   All the measurements for the entire series will be reported, not just the measurements for the selected images.
2. Click Analysis.
   The Analysis Browser appears and displays a preview of the report.
3. Press Export.
   The Export Report window appears.
4. In the folder browser, browse to the location where you want to export your data and select the folder.
5. In the Export Type section click Report.
6. In the Options section, in the Save As box, type the name of your report.
7. Click OK.

To export your analysis report from the Mode window:

1. Open a saved image or acquire a new image.
   The Mode window displays the image.
2. Add any measurements or annotations to the image.
3. Press Export.
   The Export Report window appears.
4. In the folder browser, browse to the location where you want to export your data and select the folder.
5. In the Export Type section click Report.
6. In the Options section, in the Save As box, type the name of your report.
7. Click OK.
8. The system exports the analysis report for the image you are viewing.

---

### Exporting an analysis report

You can export measurements and calculations as a CSV file that you can import into a spreadsheet or a database for further analysis.

**Before you begin**

Ensure that the Vevo 2100 Imaging System is connected through the appropriate ports on the rear panel of the system to a data storage location on your network or to an external storage device.

**To export an analysis report:**

1. Create the analysis report (page 184).
2. Click **Export**.
   
   The **Export Report** window appears.
3. In the folder browser, browse to the location where you want to export your report and select the folder.
4. If you need to create a new folder to contain the cine loops you are exporting:
   a. Click **New Folder**.
   b. Type the name of the new folder and click **OK**.
      
      The system adds a new folder inside the selected folder in the folder browser window.
   c. Select the new folder.
5. (Optional) In the **Options** section type a unique name to replace the default time stamp.
6. Click **OK**.

The system exports all the measurements in the report as a CSV file to the folder you selected.
B-Mode imaging and 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.

B-Mode is also used:

- In other imaging modes as the background orientation image over which the active mode data is applied
- 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

Related information

- Mode window workspace (page 44)
- Acquiring B-Mode images (page 190)
- Analyzing B-Mode images (page 202)

In This Section

Acquiring B-Mode images .................................................................190
Analyzing B-Mode images ...............................................................202
Acquiring B-Mode images

This chapter shows you how to acquire B-Mode images.

**WARNING**: High levels of ultrasound energy can damage tissue. Do not touch the transducer when acoustic power could be generated.

In this chapter

- Typical B-Mode image acquisition session ......................................................... 190
- B-Mode window workspace ................................................................................. 192
- Control panel controls for B-Mode ...................................................................... 194
- B-Mode acquisition settings ............................................................................... 198
- Adding focal zones ............................................................................................. 199
- Visualizing injections with a needle guide overlay .............................................. 199

Typical B-Mode image acquisition session

**Before you begin**

If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 109).
- Prepare your animal on the animal platform. For detailed information refer to the operator manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 113).

**To acquire a B-Mode image:**

1. Press B-Mode.
   
   The **B-Mode** imaging window appears and the system begins storing cine loop data in the acquisition buffer.

2. Position the transducer and locate your region of interest.

3. If the image orientation looks backward to you, click the image orientation icon or (on the control panel press **Invert**) to flip the image view horizontally.
The icon indicates the position of the orientation ridge of your transducer in relation to your image.

4. Adjust the **Image Width** control to remove image content outside the region of interest to optimize the image data for analysis.

5. Press **Presets** to cycle through the available presets and then select an appropriate set of optimized image acquisition settings.

6. On the control panel, adjust the B-Mode controls (page 194) to refine your image acquisition settings if required.

7. Press the **Scan/Freeze** toggle control to stop the data acquisition so you can review the data in the acquisition buffer.

8. Roll the trackball side to side to scroll through the cine loop.

9. If you are satisfied with the cine loop or an individual image frame, store your image data.
   - To save a cine loop press **Cine Store**.
   - To save and label a cine loop, press **Image Label**.
   - To save the displayed image frame press **Frame Store**.

10. Press **Scan/Freeze** toggle control to resume scanning.

11. Save images as required.

12. Press **Close**. The system closes the series you are working on and displays the **Study Information** window.

13. Complete the required fields to define your study and click **OK**.

   The **Study Browser** appears.

You have successfully acquired B-Mode image data.

**Next step**

- *Adding generic B-Mode measurements* (page 202)
- *Adding protocol measurements* (page 168)
B-Mode window workspace

The B-Mode window is the workspace you use whenever you view image data in B-Mode. The following illustration and table describes the information and features in the B-Mode window.

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 * Image area export zone. When you export a stored image and configure your export to send only the <strong>Image Area</strong>, this is the area of the window that the system exports, along with header information.</td>
<td></td>
</tr>
<tr>
<td>2 * Micro-ultrasound image. Displays the B-Mode data that the transducer acquires. When you review an image, this is the workspace where you use the image measurement tools to apply your measurements.</td>
<td></td>
</tr>
<tr>
<td>3 * Image scale. Indicates in <em>mm</em> the distance from the face of the transducer.</td>
<td></td>
</tr>
</tbody>
</table>
### Area Description

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Focal depth indicator.</td>
<td>When you acquire data, use the <strong>Focal Zones</strong> control on the control panel to add up to three focal zones.</td>
</tr>
<tr>
<td>2. Transducer orientation indicator.</td>
<td>The line in this icon corresponds to the orientation ridge on the transducer and indicates the orientation of the probe relative to the image.</td>
</tr>
<tr>
<td>3. Dynamic range bar.</td>
<td>Indicates the input signal strength that is mapped into the gray scale of the display. When you acquire data, use the <strong>Dynamic Range</strong> control on the control panel to change the range.</td>
</tr>
<tr>
<td>4. Physiological data trace window.</td>
<td>Displays your animal's heart rate, temperature, respiration rate and blood pressure data. During data acquisition this information comes from the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station. During an image review you can add time and ECG amplitude measurements in this window.</td>
</tr>
<tr>
<td>5. Live physiological data values.</td>
<td>Displays the recorded numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature.</td>
</tr>
<tr>
<td>6. Cine loop range control.</td>
<td>Displays the length of the cine loop range. The triangular white marker identifies the individual frame number within the cine loop. You can drag the left and right vertical markers to display only the image frames in that range.</td>
</tr>
<tr>
<td>7. Live physiological display.</td>
<td>If the animal is connected to the physiology controller, data appears here in real time during image acquisition and can display the numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature. This area also displays the <strong>image data storage capacity progress bar</strong> so you can see when you should start to back up your image data to free up space on the system. Live physiological data is only active when you enable the inputs in the General tab of the Preferences window.</td>
</tr>
<tr>
<td>8. Screen keys display</td>
<td>Displays the updated parameter and system information when you make adjustments on the control panel.</td>
</tr>
<tr>
<td>9. Displays control options in the mode that you apply during image acquisition when you press the <strong>Screen Keys</strong> dial.</td>
<td></td>
</tr>
<tr>
<td>10. Left panel.</td>
<td>Displays a unique set of controls and information sections depending on the control key you press:</td>
</tr>
<tr>
<td>Press <strong>Mode Settings</strong> to set the panel to display the Mode settings. This is the default panel when you open a Mode window.</td>
<td></td>
</tr>
<tr>
<td>Press <strong>Measure</strong> to set the panel to display the measurement tools. These tools are not available when you are acquiring or reviewing images.</td>
<td></td>
</tr>
<tr>
<td>Press <strong>Physio Settings</strong> to set the panel to display the options for a) viewing and manipulating physiological data input from the Advanced Physiological Monitoring Unit and b) manipulating the Respiration Gating and ECG Trigger controls.</td>
<td></td>
</tr>
</tbody>
</table>

For complete information on how each panel works, see *Left panel workspace* (page 47).
Control panel controls for B-Mode

When you are acquiring B-Mode image data, these are the controls you use to optimize the image you see on the screen.

1. **Image Width**
   
   Adjusts the physical width of the area the transducer is imaging. Push up to increase the width. Pull down to decrease the width.
   
   **Tip:** The closer you can reasonably narrow the width of your image around your target structure, the higher the system sets the acquisition frame rate. This is especially helpful when you are studying cardiac tissue movement.

2. **Display Map**
   
   Cycles you through a predefined set of optimization maps that you can apply either while you are acquiring or reviewing image data.
   
   Push up or pull down to cycle through the available maps for the active imaging mode.
Chapter 33: Acquiring B-Mode images

3. **Image Depth**

   Adjusts how deep in *mm* you want to display the ultrasound signal. Pull down to increase the depth. Push up to decrease the depth. The available depth is transducer dependent.

4. **Focus Depth**

   Adjusts the depth of the B-Mode focal zone or focal zones on your image. When you have more than one focal zone this control moves the depth of all the focal zones as a group. Push up to decrease the depth. Pull down to increase.

5. **Focal Zones**

   This control adjusts the number and configuration of focal zones on your B-Mode based image.

   Focal zones enhance the resolution across your image, while slightly reducing the acquisition frame rate. The system always displays at least one focal zone, and you can apply a maximum of two additional zones depending on the transducer. When you add focal zones the system maximizes the resolution for a larger area of your image, and reduces the acquisition frame rate.

   **To use this rocker switch control:**

   1. Push the rocker switch forward to cycle through the following focal zone application sequence:
      - Single zone
      - Two zones, narrow
      - Two zone, wide
      - Three zones, narrow
      - Three zones, wide

   2. Pull the rocker switch back to cycle back through the focal zone options in reverse.
Presets

Active during image acquisition in all modes except 3D-Mode. This rocker switch cycles you through all the preset groups of acquisition parameters for the active imaging Mode. The list of presets include the transducer-specific presets as well as any custom presets that other operators added to the system.

All presets are both mode dependent, transducer dependent and application dependent.

Transmit Power

Adjusts the power of the ultrasound signal transmission.

Turn clockwise to increase power. Turn counterclockwise to decrease power. Between 1% and 10% power the control adjusts power in increments of 1%. Between 10% to 100% power the control adjusts in increments of 10%.

Depth Offset

Available during all acquisition sessions for all modes that are based on B-Mode or include a B-Mode scout window. Adjusts, in 1mm increments, the distance from the face of the transducer at which the system begins to display the ultrasound image.

To use this rocker switch control:

- Pull down to remove a 1mm strip of image data from the top. For example, if your transducer is set to acquire data from 2mm to 12mm, when you pull the control down once, the display will only show the data between 3mm and 12mm. The minimum depth varies by transducer.
- Push up to add a 1mm strip of image data to the top.

Line Density

Adjusts the resolution of your image by adjusting how many lines of image data the transducer acquires over your image area. Push up to increase the line density. Pull down to decrease.

The higher you set your line density, the lower the system sets the acquisition frame rate. Because of this trade off, you might find that higher line density is most useful for examining features in tissues that don't move very much such as liver, spleen, pancreas, and prostrate.

For cardiology applications, you will tend to keep the line density lower so you can increase the frame rate to measure more tissue movements over the time span of a complete cardiac cycle.
Persist
Applies a pixel averaging algorithm to the most recently acquired frames to produce a more uniform view of the faster moving areas in the image data.

To use this rocker switch control:
Push up or down to cycle through the persistence levels. In the bottom-left corner of the screen the status bar briefly displays the name of the persistence label as you select.

In B-Mode: Reduces distracting artifacting such as shimmering effects. Levels: Off, Low, Med, High. This is most useful when you are imaging uniform tissues such as the liver, kidney and prostate.

Dynamic Range
Adjusts the input signal strength that is mapped into the spectral display. Range: 5-100dB.
- Push up to increase the range by 5dB and lower contrast. Higher dynamic ranges are often used in cardiac imaging.
- Pull down to decrease the range by 5dB and increase contrast. Lower dynamic ranges are often used in abdominal imaging.

B-Mode
Activates B-Mode acquisition and begins displaying the acquired B-Mode data in the B-Mode window.

2D Gain
Adjusts the strength of the ultrasound signal when it returns to the face of the transducer. Range values for the control are specific to each individual transducer.

Turn clockwise to add gain and brighten your entire image. Turn counterclockwise to reduce gain and darken your image.
B-Mode acquisition settings

To view the B-Mode acquisition settings:
Press **Mode Settings**.

The B-Mode acquisition settings panel displays the following parameters, in addition to labeling the current transducer application and preset:

### Transmit

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>The ultrasound frequency, measured in MHz. Adjust with the <strong>Frequency</strong> control.</td>
</tr>
<tr>
<td>Power</td>
<td>The transmission power level of the ultrasound signal, displayed as a percentage of the maximum power. Adjust with the <strong>Transmit Power</strong> control.</td>
</tr>
</tbody>
</table>

### Acquisition

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain</td>
<td>The strength of the ultrasound signal in dB increments when it returns to the face of the transducer. Adjust with the <strong>2D Gain</strong> control.</td>
</tr>
<tr>
<td>Frame Rate</td>
<td>The number of image frames per second that the system is acquiring.</td>
</tr>
<tr>
<td>Depth</td>
<td>The distance, measured in mm, from the face of the transducer. Adjust with the <strong>Image Depth</strong> control.</td>
</tr>
<tr>
<td>Width</td>
<td>The width of the acquired image area, measured in mm. Adjust with the <strong>Image Width</strong> control.</td>
</tr>
</tbody>
</table>

### Display

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Range</td>
<td>The contrast of your image, measured in dB. Adjust with the <strong>Dynamic Range</strong> control.</td>
</tr>
<tr>
<td>Persistence</td>
<td>The state of the Persistence feature: Off, Low, Med, High, Max. Adjust with the <strong>Persist</strong> control.</td>
</tr>
<tr>
<td>Line Density</td>
<td>The line density level. One of four settings: Quarter, Third, Half, Full. Adjust with the <strong>Line Density</strong> control.</td>
</tr>
<tr>
<td>Display Map</td>
<td>The selected predefined display map from the predefined set of maps. Adjust with the <strong>Display Map</strong> control.</td>
</tr>
</tbody>
</table>
Adding focal zones

Focal zones enhance the resolution across your image, while slightly reducing the acquisition frame rate. The system always displays at least one focal zone, and you can apply a maximum of two additional zones depending on the transducer. When you add focal zones the system maximizes the resolution for a larger area of your image, and reduces the acquisition frame rate.

To add a focal zone:

1. Press **Focal Zones** to add one or two additional focal zones to the initial focal zone.
   - Push once to add a second focal zone at the standard spread
   - Push twice to add the second focal zone at the minimum spread
   - Push three times to add a third focal zone and set the zones at the standard spread
   - Push four times to add the third focal zone and set the zones at the minimum spread
   - Push one more time to return to a single focal zone

2. Press **Focus Depth** down or up to increase or decrease the depth of all focal zones.

Visualizing injections with a needle guide overlay

When you are injecting an animal the needle guide overlay feature helps you visualize the alignment of your needle with your injection target.

To ensure that your needle appears in the image area, you must submerge the needle in water (for externalized targets) or insert it in the anatomy of the animal.

Before you begin

If you intend to save a cine loop of your injection, make sure that you have set your B-Mode cine loop size to a sufficient length to capture the event.

To perform a typical image-guided needle injection:

2. With the injection target below focus or out of the plane, using the *Vevo 2100 Imaging Station* physically extend the needle into the image, toward the expected target location. Bring the needle tip as close to the focal depth as possible.

3. Turn the **Screen Keys** dial to highlight the **Needle Guide Overlay** option that is displayed at the bottom left corner of the window.

4. Turn **Screen Keys** to activate the **Needle Guide Overlay** feature.

5. Turn **Screen Keys** again to display the caliper cursor.

6. Position the caliper cursor on the tip of the needle (where it appears on the screen), then click to apply the first caliper.

7. Trackball to the location where the needle enters the edge of the image window.
   
   As you move the cursor, the system applies a green dashed overlay line that follows your cursor.

8. Click to apply the second caliper.

   The system applies the caliper and extends the needle guide overlay through both calipers and across the B-Mode image area.

9. To toggle the needle guide overlay on and off, press **Screen Keys**.

10. Using the *Vevo 2100 Imaging Station* physically retract the needle. Ensure that the needle moves along the needle guide overlay.

11. Bring the target into the image plane and line up the target with the needle guide that indicates the needle tip.

12. Physically bring the needle into the image plane.

13. Advance the needle tip to the tissue target and start your guided injection.

14. When the needle tip is within the target area inject the sample.
15. To save a cine loop of the injection event, press Cine Store.
16. Physically retract the needle using the Vevo 2100 Imaging Station.

Related information
- Cine Loop Size preferences (page 71)
- Typical B-Mode image acquisition (page 190)
- Saving a cine loop (page 122)
Chapter 34

Analyzing B-Mode images

This chapter shows you how to analyze B-Mode images that are saved to a study.

In this chapter

Adding generic B-Mode measurements .......................................................... 202
Adding protocol measurements ...................................................................... 208
Creating pressure-volume loop measurements in B-Mode ......................... 210
Strain rate step 1: Adding the LV wall trace .................................................... 213
Strain rate step 2: Analyzing the data ............................................................. 217

Adding generic B-Mode measurements

B-Mode provides seven generic measurement tools. Use these tools when you
want to add measurements that aren't part of a measurement protocol.

Before you begin

If you want to display the measurement labels and values that you add, select the
Show Values and Labels option in the Measurement tab of the Preferences
window.

To access the generic measurement tools for B-Mode:

- If you are acquiring B-Mode image data, press Scan/Freeze and then press
  Measure.
- If you are in the Study Browser, open an image and then press Measure.
The system displays the measurement tools at the top of the left panel.

  Hover over a tool to see the description label.

Linear distance measurement

Linear distance is measured in mm.
To place a linear distance measurement:

1. Click the linear distance measurement button.
2. Click on your image to place the initial caliper.
3. Trackball to the location where you want to end your measurement and then click to place the end caliper. If you selected the Show Values and Labels option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.
4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

Related information

- Complete procedure for adding a measurement (page 166)

Traced distance measurement

Traced distance is measured in \( \text{mm} \).

To place a traced distance measurement:

1. Click the traced distance measurement button.
2. Click on your image to place the initial caliper.
3. Trackball along the contour of your target tissue and then right-click to place the final caliper of your trace. If you selected the Show Values and Labels option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.
4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

Related information

- Complete procedure for adding a measurement (page 166)

2D Area measurement

2D Area is measured in \( \text{mm}^2 \).

To place a 2D area measurement:

1. Click the 2D area measurement button.
2. Click on your image to place the initial caliper.
3. Trackball along the contour of your target tissue and then right-click to place your last caliper.

If the position of the trackball 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. This feature applies to 2D area measurements in B-Mode, 3D-Mode, and Contrast Mode as well as for 3D-Mode volume contours.

4. The system adds the final line segment to connect your last caliper with your first. If you selected the Show Values and Labels option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.

5. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**

- Complete procedure for adding a measurement (page 166)

### Angle measurement

Angles report interior angle values and are therefore always less than 180 degrees. Angles are measured in deg.

**To place an angle measurement:**

1. Click the angle measurement button.

2. Click on your image to place the initial caliper. This is the outside end of the first ray of your angle.

3. Trackball to where you want to position the vertex of your angle and then click to place the caliper. This completes the first ray.

4. Trackball to the position where you want to end the second ray and then click to place the final caliper. If you selected the Show Values and Labels option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.

5. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**

- Complete procedure for adding a measurement (page 166)
LV Area long axis measurement

Use the LV wall trace measurement to trace the endocardial wall through multiple cardiac cycles, semi-automatically or manually.

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 semi-automatically:

1. While you view a saved image from the Study Browser or an image that is acquired but not stored during an image acquisition session, press Measure and toggle to view the measurement tools panel.

2. Click the LV area long axis measurement button. The system highlights the button until you complete your measurement.

3. 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.

   ![Image of LV area long axis measurement](image1)

   *If you selected the short axis view for analysis, the system does not insert an annulus line*

4. Click a point toward the apex on the interior wall. This creates the basic curve.

   ![Image of LV area long axis measurement](image2)

5. Continuing to click along the wall to create a contour that traces the area of the wall.

   ![Image of LV area long axis measurement](image3)
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. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement **B-Mode LV Area #**, where # is a sequential number.

6. If you want to rename the label and you have selected **Show Values and Labels** in the Measurement tab of the Preferences window, type a new name while the label text is selected, and then click outside the label to commit the label.

7. If you have selected **Show Values and Labels** in the Measurement tab of the Preferences window and you want to move the measurement or move the label, select either item and then drag and drop it.

8. Move to another frame in the cine loop and place another LV area long axis measurement.

9. Right-click the contour and select **Replicate Forward** or **Replicate Reverse** with additional options to define how many cycles: either 2 or 3. The system automatically traces the wall forward or backward through the frames.

10. Modify the contour or points on the contour if required and then select **Replicate Forward** again to complete the automatic wall trace.

11. Press **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.

**Next step**

- **Reporting your analysis results** (page 184)

**Related information**

- **Analyzing image data** (page 156)
Modifying points on an LV area trace

To modify points on a contour:

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

Modifying the LV area trace

To modify a contour:

- **To move the contour** (all the caliper points as a group) click the center point of the trace, trackball to the new position, then click again to commit the contour.
- **To resize the contour**, click the contour, trackball 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 select **Delete**.

LV Area short axis measurement

To place an LV area short axis measurement:

1. While you view a saved image from the Study Browser or an image that is acquired but not stored during an image acquisition session, press **Measure** and toggle to view the measurement tools panel.
2. Click the LV area short axis measurement button 🕯. The system highlights the button until you complete your measurement.
3. Click to place a point along the myocardial wall in the center of the wall.
4. Continue to click and add additional points around the wall. The loop contour forms to the points that you add.
5. Right-click the final point on the contour to complete the measurement. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.
6. If you want to rename the label and you have selected **Show Values and Labels** in the Measurement tab of the Preferences window, type a new name while the label text is selected, and then click outside the label to commit the label.
Chapter 34: Analyzing B-Mode images

7. If you have selected Show Values and Labels in the Measurement tab of the Preferences window and you want to move the measurement or move the label, select either item and then drag and drop it.

8. Right-click the contour and select Replicate Forward or Replicate Reverse and select the number of cycles. The system automatically traces the wall forward or backward through the frames.

9. Press 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.

**Next step**

- Reporting your analysis results (page 184)

**Related information**

- Analyzing image data (page 156)

**Time Interval measurement**

Time interval is measured in ms.

**To place a time interval measurement:**

1. Click the time interval measurement button . The system highlights the button until you complete your measurement.

2. In the physiology data trace window below the image mode data, click to place the initial caliper.

3. Trackball to the location where you want to place your end caliper and then click to place the caliper.

4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**

- Complete procedure for adding a measurement (page 166)

**Adding protocol measurements**

Protocol measurements are labeled uniquely for a specific measurement protocol.
Chapter 34: Analyzing B-Mode images

To access the protocol measurement tools and measurements list

- If you are in an image acquisition session press **Scan/Freeze** to acquire an image and then press **Measure**.
- If you are in the Study Browser, open an image and then press **Measure**.

To place a protocol measurement:

1. In the measurement packages drop-down list click the appropriate package.

2. In the list of protocols, select the appropriate protocol.

3. In the list of measurements, select the measurement you want to add.

The system automatically activates the appropriate measurement tool and highlights the generic button for that tool.

4. On the image, add your measurement. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.

Next step

- **Reporting your analysis results** (page 184)
Lens radius measurement

The lens radius measurement is only available in the Ophthalmology measurement package for B-Mode images. Lens radius is measured in \( \text{mm} \).

To place a lens radius measurement:

1. Open an existing eye image or begin acquiring an eye ultrasound image and then press \( \text{Scan/Freeze} \).
2. Press \( \text{Measure} \).
3. In the drop-down list of measurement packages select \( \text{Ophthalmology} \).
4. In the list of measurements click \( \text{Lens Radius} \).
5. Click on your image to place the initial caliper at one end of the radius.
6. Trackball along the contour of the lens to the center of your radius and then click to place the center caliper.
7. Trackball 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.
8. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

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 both B-Mode and M-Mode images that are accompanied by a continuous blood pressure trace. These traces are typically acquired from a blood pressure catheter.

To obtain PV loops from a B-Mode image:

1. Create a B-Mode cine loop of the heart in a long-axis orientation.
2. Complete a B-Mode LV Area measurement (page 205) that includes at least two cardiac cycles.
3. Right-click the measurement and select **PV Curve**.

   ![Image of PV Curve](image)

   **Note:** The PV Curve menu command is not available if the image does not include blood pressure data.

4. The system calculates the pressure-volumes of the cardiac cycles and plots them as a graph on the Pressure Volume Relationship window.

   ![Image of Pressure Volume Relationship](image)

**Pressure-Volume relationship graphs**

When you have generated pressure-volume graph data, you can use the tools on the Pressure Volume Relationship window to:

- Display the end systolic PV points
- Display the end diastolic points
- 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
Chapter 34: Analyzing B-Mode images

**ESPVR check box**

Check this box to display the end systolic PV points.

*If the graph displays a single loop, the system plots a green dot on the curve at the End Systolic point.*

*If the graph displays multiple loops, the system plots a best-fit line through the End Systolic points.*

**EDPVR check box**

Check this box to display the end diastolic points.

*If the graph displays a single loop, the system plots a red dot on the curve at the End Diastolic point.*

*If the graph displays multiple loops, the system plots a best-fit line 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.

When the Average option is cleared, the graph plots the cardiac cycle.

**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 as one of three file formats:

- **CSV file.** Can be imported into a spreadsheet or database.
- **BMP file.** Exports the graph data as a bitmap image.
- **TIFF file.** Exports the graph data as a vector based image.

**Strain rate step 1: Adding the LV wall trace**

You measure strain rate using the system’s VevoStrain™ application. Included within the Vevo 2100 Imaging System, this tool produces velocity strain and time-to-peak analyses on myocardial wall images.

**To create the LV wall trace:**

1. From the Study Browser, select the B-Mode cine loop you want to analyze and then click Vevo Strain.
The system processes the cine loop and then displays the cine loop in the VevoStrain workspace.

2. In the B-Mode panel (area 1 as shown below):
   a. Use the playback controls below the B-Mode scout window to display the image frame you want to work with.
   b. Click above the LV wall, trackball across the chamber to beyond the opposite wall at whatever angle you prefer, and then right-click to set the AM-Mode cross-section.
   c. Select the Reverse check box if you want to switch the grayscale contrast values for the background you will work with in the VevoStrain analysis window.

3. In the EKG panel (area 2):
   a. On the left side drag the single red slider to the position where you want the data period to begin.
   b. On the right side drag the double red slider to the end of your data period. In the example above, the period includes three R waves.
Chapter 34: Analyzing B-Mode images

4. On the AM-Mode image (area ③):
   a. Click on the R wave where for the first cardiac cycle. The system applies a vertical blue line.
   b. Click on the other R waves to add the remainder of your cardiac cycles. The system applies a second blue line and connects the two lines with a green line.
      For the best results, create your selection period between one respiration cycle and the next.
   c. If you want to change the position of a line, click it to delete it, and then click again at the new position.

5. In the upper-right corner click **Next**.
   The cine loop appears in the VevoStrain LV wall trace workspace.

6. At the top of the screen, select the appropriate strain measurement.

7. In the right panel:
   a. Select the type of trace you will create (Short Axis, Long Axis, Free Curve).
   b. Select whether you want the system to calculate the average heart cycle.
   c. Select if you want the system to simultaneously trace both the Endocardium as well as the Epicardium. (If you do select this option, use the control to expand or contract the automatic outer wall trace to fit the outer wall.)

8. Click to add points along the inner wall, and right-click to complete the trace.
If you want to delete the trace and start again, delete the old trace from the History and select a new trace.

If you want to return to the AM-Mode view to select a new cardiac period, click the Sequence button below, create the new period and then click **Next** again.

9. Click the Start Analysis button.

10. VevoStrain builds the dynamic LV wall trace for all frames in the cine loop and graphs the results in the analysis workspace.

**Next:**
- Strain rate step 2: Analyzing the data (page 217)
Strain rate step 2: Analyzing the data

Before you begin

- You must complete the procedure in *Strain rate step 1: Adding the LV wall trace* (page 213).

VevoStrain analysis window workspace

The following illustration and table describes the information and features in the VevoStrain analysis window workspace.

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>LV wall trace on B-Mode cine loop.</strong> Features the automatic endocardial 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 the position.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Derivative distribution graph.</strong> For the long axis, the graph displays the volume and volume derivative. For the short axis, displays the area and area derivative.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Graph type options.</strong> Includes Velocity, Displacement, Strain, Strain Rate.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Graph.</strong> Velocity distribution along the radial axis.</td>
</tr>
</tbody>
</table>
### Area Description

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td><strong>Graph.</strong> Parametric distribution for the radial axis.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Graph.</strong> Velocity distribution along the longitudinal axis.</td>
</tr>
<tr>
<td>7</td>
<td><strong>Graph.</strong> Parametric distribution along the longitudinal axis.</td>
</tr>
</tbody>
</table>

**Analysis tools group.** Includes:

- Row 1 (top row): Time to Peak Analysis, New Trace, Edit Trace.
- Row 2: Export AVI, Export Picture, Export Data, Sequence/M-Mode Selection. You can export modalities from the VevoStrain™ package, independently from the Vevo 2100 Imaging System, in TIFF and JPEG image formats, AVI formats for cine loops - compressed and uncompressed, and data export to TXT format.
- Row 4: Reset Graphs Display, Zoom In/Out, Toggle Filtered/Unfiltered Plots, Bkg M-Mode Display
- Row 5: Delete Selected Contour.

---

**Visualizing wall trace tendencies in VevoStrain**

### Before you begin

- You must complete the procedure in *Strain rate step 1: Adding the LV wall trace* (page 213).

Every point used for calculations is displayed with an associated vector. As you play back the cine loop you can visualize the directional tendencies for different parts of the cardiac contour in different points of the cardiac cycle.

### To view the directional tendencies of the LV wall trace:

1. Click the contour/vector/orbit line/B-Mode button. Toggle the button as illustrated in the following table.
2. To modify the size of the vector use the Decrease Vector Size, Reset Vector Size or Increase Vector size buttons on row three of the analysis tools group.
Displaying individual curves for specific points on the trace in VevoStrain

Before you begin

- You must complete the procedure in *Strain rate step 1: Adding the LV wall trace* (page 213).

By default, the system displays all the curves for the individual points along the trace.

To display the curve for a specific point on the trace:

1. Click on the contour to create a point.

2. The graph displays the curve for the individual point.

3. If required, add more points onto the trace.
4. The system applies unique colors to the additional points on the trace and the corresponding curves on the graph.

Analyzing time-to-peak in VevoStrain

Before you begin

- You must complete the procedure in Strain rate step 1: Adding the LV wall trace (page 213).

Time-to-peak analysis displays the synchronicity and phase for different segments of the heart. The display for the segments varies depending on the view of the heart: long/short axis or apical.

To view the time-to-peak analysis:

Click the Time-to-Peak button.

The time-to-peak window for your selected cardiac period appears.
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Time-to-peak window for short axis wall data

Features

- Time-to-peak is calculated as the time from the reference axis, 0.000, to the maximum peak (negative or positive), for each of the segments of the heart in the specific view.
- Low time-to-peak comes displayed in blue and high in red.
- The phase measures the synchronicity located between regions of the heart for a selected time interval. As a method of analysis, the phase in this case is defined as the first fundamental Fourier harmonic, each one of the curves is compared to the average curve, and expressed in time delay and percentage of heartbeats.
- Each of the heart sectors is represented by a corresponding graph and a designated color. You can display all the curves simultaneously or select them separately.
- The parameters time-to-peak and phase are quantified on the color wheel keys displayed to the left of the charts. The minimum and maximum range is calculated based on the contour that you trace on the B-Mode image.
- You can apply time-to-peak analysis to Velocity, Displacement, Strain and Strain Rate.
- In the right panel, turn all curves or individual curves on or off.
Viewing strain data in 3D in VevoStrain

Before you begin

- You must complete the procedure in *Strain rate step 1: Adding the LV wall trace* (page 213).

To view strain data in 3D:

1. From the VevoStrain analysis window, click the 3d button that is located to the left of the parametric distribution graph.

2. The system displays the strain rate data in three dimensions.

3. Modify your view of the data.
   - Drag the image to rotate the image on any axis
   - Move the **Zoom** slider as needed

4. If you want to save the image, click the Export Picture button located above the Zoom slider.
Section 9

M-Mode imaging and analysis

M-Mode is used primarily to measure the movement of structures in the heart such as valves, chambers, and walls.

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Chapter 35

Acquiring M-Mode images

This chapter shows you how to acquire M-Mode images.

WARNING: High levels of ultrasound energy can damage tissue. Do not touch the transducer when acoustic power could be generated.

In this chapter
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M-Mode window workspace ...................................................................................... 227
Control panel controls for M-Mode .......................................................................... 229
M-Mode acquisition settings ..................................................................................... 233
Setting the M-Mode region of interest ..................................................................... 234

Typical M-Mode image acquisition session

Before you begin
If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 109).
- Prepare your animal on the animal platform. For detailed information refer to the operator manual for your Vevo Imaging Station.
- For blood pressure setup, see Blood Pressure section (page 113).

To acquire an M-Mode image:

1. Start imaging in B-Mode and position the transducer to situate your region of interest in the center of the image area.
2. Adjust the Image Width control to remove image content outside the region of interest to optimize the image data for analysis.
The system begins acquiring B-Mode image data and displays the yellow M-Mode sample gate overlay on the B-Mode image.

4. Press **Update** or press **M-Mode** again.

The dual-window **M-Mode** image area workspace appears. The M-Mode window is on the bottom, the B-Mode scout window is on the top.

The system begins storing cine loop data in the acquisition buffer, and live acquisition data appears in both windows.

5. (Optional) To display a larger B-Mode window so you can guide the position of your transducer more precisely:
   a. Press **Update** to display the full B-Mode window.
   b. When you have positioned your transducer, press **Update** again to return to the dual-window workspace.

6. Press **Presets** to cycle through the available presets and then select an appropriate set of optimized image acquisition settings.

7. On the control panel, adjust the M-Mode controls (page 229) to refine your image acquisition settings if required.

8. Press the **Scan/Freeze** toggle control to stop the data acquisition so you can review the data in the acquisition buffer.

9. Roll the trackball side to side to scroll through the cine loop.

10. If you are satisfied with the cine loop or an individual image frame, store your image data.
    - To save a cine loop press **Cine Store**.
    - To save and label a cine loop, press **Image Label**.

11. Press **Scan/Freeze** toggle control to resume scanning.

12. Save images as required.

13. Press **Close**. The system closes the series you are working on and displays the **Study Information** window.

14. Complete the required fields to define your study and click **OK**.

    The **Study Browser** appears.

You have successfully acquired M-Mode image data.

**Next step**

- *Adding generic M-Mode measurements* (page 235)
- *Adding protocol measurements* (page 168)
M-Mode window workspace

The M-Mode window is the workspace you use whenever you view image data in M-Mode. The following illustration and table describes the information and features in the M-Mode window.

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M-Mode Image area export zone. When you export a stored image and configure your export to send only the Image Area, this is the area of the window that the system exports, along with header information.</td>
</tr>
<tr>
<td>2</td>
<td>B-Mode scout window. Shows you precisely where the region of interest is. The region of interest is located between the yellow wireframe brackets set. Use this window to reposition your transducer and the wireframe brackets set so you can acquire the most useful data.</td>
</tr>
<tr>
<td>3</td>
<td>Image scale. Indicates in mm the distance from the face of the transducer.</td>
</tr>
</tbody>
</table>
Chapter 35: Acquiring M-Mode images

### Area Description

1. **Sample gate overlay in B-Mode scout window.** Shows you precisely where the region of interest is. The region of interest is located between the yellow wireframe brackets set. Use this window to reposition your transducer and the wireframe brackets set so you can acquire the most useful data.

2. **M-Mode image data.** Displays the cardiac cross-section image 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 your measurements.

3. **Image scale.** Indicates in mm the distance from the face of the transducer.

4. **Region of interest image window.** Displays the sample gate 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.

5. **Physiological data trace window.** Displays your animal's heart rate, temperature, respiration rate and blood pressure data. During data acquisition this information comes from the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station.

6. **Cine loop time scale.** In milliseconds. Use the **Sweep Speed** rocker switch to adjust the range of the scale so you can place more or less cine loop data into the window.

7. **Live physiological display.** If the animal is connected to the physiology controller, data appears here in real time during image acquisition and can display the numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature. This area also displays the **image data storage capacity progress bar** so you can see when you should start to back up your image data to free up space on the system. Live physiological data is only active when you enable the inputs in the General tab of the Preferences window.

8. **Screen keys display**

   - Displays the updated parameter and system information when you make adjustments on the control panel.
   - Displays control options in the mode that you apply during image acquisition when you press the **Screen Keys** dial. When you display the B-Mode image with the M-Mode overlay, press to place a needle guide within the image.

9. **Left panel.** Displays a unique set of controls and information sections depending on the control key you press:

   - Press **Mode Settings** to set the panel to display the Mode settings. This is the default panel when you open a Mode window.
   - Press **Measure** to set the panel to display the measurement tools. These tools are not available when you are acquiring or reviewing images.
   - Press **Physio Settings** to set the panel to display the options for a) viewing and manipulating physiological data input from the Advanced Physiological Monitoring Unit and b) manipulating the Respiration Gating and ECG Trigger controls.

For complete information on how each panel works, see **Left panel workspace** (page 47).
Control panel controls for M-Mode

When you are acquiring M-Mode image data, these are the controls you use to optimize the M-Mode image data you see in the lower window of the image area.

**To use this key control:**

1. Press **M-Mode** to begin displaying the M-Mode sample volume overlay on the full-window B-Mode acquisition data.

2. Press **M-Mode** again (or press **Update**) to display the live M-Mode data in the lower window and the live B-Mode data with the sample volume overlay data in the scout window.
Chapter 35: Acquiring M-Mode images

2 Transmit Power

Adjusts the power of the ultrasound signal transmission.

Turn clockwise to increase power. Turn counterclockwise to decrease power. Between 1% and 10% power the control adjusts power in increments of 1%. Between 10% to 100% power the control adjusts in increments of 10%.

3 Frequency

Adjusts the transmit frequency of the transducer between the higher and lower frequency levels that are supported by the specific transducer. When you increase the frequency you can improve detail at the focus depth but the system tends to lose detail at deeper tissues.

Push forward to increase the frequency. Pull back to decrease the frequency.

4 Focal Zones

This control adjusts the number and configuration of focal zones on your B-Mode based image.

Focal zones enhance the resolution across your image, while slightly reducing the acquisition frame rate. The system always displays at least one focal zone, and you can apply a maximum of two additional zones depending on the transducer. When you add focal zones the system maximizes the resolution for a larger area of your image, and reduces the acquisition frame rate.

To use this rocker switch control:

1. Push the rocker switch forward to cycle through the following focal zone application sequence:
   - Single zone
   - Two zones, narrow
   - Two zone, wide
   - Three zones, narrow
   - Three zones, wide

2. Pull the rocker switch back to cycle back through the focal zone options in reverse.
**Invert**

Flips the image.

**In M-Mode:** In the dual window view, press to flip the B-Mode scout image left/right.

---

**Display Map**

Cycles you through a predefined set of optimization maps that you can apply either while you are acquiring or reviewing image data.

Push up or pull down to cycle through the available maps for the active imaging mode.

---

**Dynamic Range**

Adjusts the input signal strength that is mapped into the spectral display. Range: 5-100dB.

- Push up to increase the range by 5dB and lower contrast. Higher dynamic ranges are often used in cardiac imaging.
- Pull down to decrease the range by 5dB and increase contrast. Lower dynamic ranges are often used in abdominal imaging.

**In M-Mode:** applies to the images in both the M-Mode window as well as the B-Mode scout window.

---

**2D Gain**

Adjusts the strength of the ultrasound signal when it returns to the face of the transducer. Range values for the control are specific to each individual transducer.

- Turn clockwise to add gain and brighten your entire image. Turn counterclockwise to reduce gain and darken your image.
- **In M-Mode:** Applies to the images in both the M-Mode window as well as the B-Mode scout window.
Function 1: display control
Alternates the display from the dual view (B-Mode scout window on top, Mode image window on the bottom) to the B-Mode image plus overlay so you can position your sample gate more precisely.

To use this toggle control:
1. Press to view the dual view.
2. Press again to display the B-Mode window and overlay.

Function 2: right-click button
When the manual directs you to right-click, press Update.

SV/Gate
Push up to increase. Pull back to decrease.

In M-Mode: This control adjusts the size of the sample gate, measured in mm. The control adjusts the distance of the vertical line between the two yellow calipers.

In the dual window view, the system displays the M-Mode sample gate image data. Current data is on the right side, trailing data extends to the left.

Sweep Speed
Adjusts the cine loop playback speed parameter so that you can stretch out or compress the cine loop data in the review window. Push up to increase the speed and compress the cine loop image. Pull down to decrease the speed and expand the cine loop image.

When you are reviewing the cine loop you can also use the Cine Loop Review control to adjust the sweep speed.

In M-Mode: Set the sweep speed parameter in a range from 200 Hz to 4000 Hz in increments of 100 Hz. The system displays the updated values in the status bar in the lower left area of the screen.

In cardiac applications you might want to decrease the M-Mode sweep speed so you can view more wall movements over more cardiac cycles in the window, or increase the speed so you can view more wall detail over one cycle.
# M-Mode acquisition settings

## To view the M-Mode acquisition settings:

Press **Mode Settings**. The left panel displays the following parameters, in addition to labeling the current transducer application and preset:

### Transmit

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>The ultrasound frequency, measured in MHz. Adjust with the <strong>Frequency</strong> control.</td>
</tr>
<tr>
<td>Power</td>
<td>The transmission power level of the ultrasound signal, displayed as a percentage of the maximum power. Adjust with the <strong>Transmit Power</strong> control.</td>
</tr>
</tbody>
</table>

### Acquisition

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain</td>
<td>The strength of the ultrasound signal in dB increments when it returns to the face of the transducer. Adjust with the <strong>2D Gain</strong> control.</td>
</tr>
</tbody>
</table>

### Display

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Range</td>
<td>The contrast of your image, measured in dB. Adjust with the <strong>Dynamic Range</strong> control.</td>
</tr>
<tr>
<td>Display Map</td>
<td>The selected predefined display map from the predefined set of maps. Adjust with the <strong>Display Map</strong> control.</td>
</tr>
<tr>
<td>Sweep Speed</td>
<td>The cine loop playback speed, measured in Hz in a range from 200 to 4000 Hz. Adjust with the <strong>Sweep Speed</strong> control.</td>
</tr>
</tbody>
</table>

### Gate

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>The distance, measured in mm, from the face of the transducer. Adjust with the <strong>Image Depth</strong> control.</td>
</tr>
<tr>
<td>Length</td>
<td>The length, measured in mm, of the gate. Adjust with the <strong>SV/Gate</strong> control.</td>
</tr>
</tbody>
</table>
Setting the M-Mode region of interest

In M-Mode, the region of interest is the image data that the transducer acquires along the vertical line between the brackets of the yellow wireframe in the B-Mode image. This line is called the sample gate.

To set your M-Mode sample gate:

1. Begin acquiring data in M-Mode and position your transducer to display your region of interest in the center of the B-Mode scout window.

2. Watching the B-Mode scout window, trackball to move the yellow wireframe to your region of interest.

3. Adjust the SV/Gate control forward or back to increase or decrease the length of the gate.

   After you change the position or distance of the gate:
   a. The system pauses briefly to reset.
   b. The system starts acquiring data again.

   **Note:** If the mode settings are not displayed in the left panel press Mode Settings.

The mode settings panel displays the following Gate parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>The distance in mm from the face of the transducer to the center of the gate.</td>
</tr>
<tr>
<td>Length</td>
<td>The length in mm of the gate.</td>
</tr>
</tbody>
</table>
Chapter 36

Analyzing M-Mode images

This chapter shows you how to analyze M-Mode images.

In this chapter
Adding generic M-Mode measurements .................................................................235
Adding protocol measurements ..............................................................................239
Creating pressure-volume loop measurements in M-Mode .................................242

Adding generic M-Mode measurements

M-Mode provides five generic measurement tools. Use these tools when you want to add measurements that aren't part of a measurement protocol.

Before you begin
If you want to display the measurement labels and values that you add, select the Show Values and Labels option in the Measurement tab of the Preferences window.

To access the generic measurement tools for M-Mode:

- If you are acquiring M-Mode image data, press Scan/Freeze and then press Measure.
- If you are in the Study Browser, open an image and then press Measure. The system displays the measurement tools at the top of the left panel.

Hover over a tool to see the description label.

Depth interval measurement

Depth interval is measured in mm.
To place a depth interval measurement:

1. Click the depth interval measurement button. The system highlights the button until you complete your measurement.
2. Click on your image to place the initial caliper.
3. Trackball to the location where you want to end your measurement and then click to place the end caliper.
4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

Related information
- Complete procedure for adding a measurement (page 166)

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 the velocity measurement button.
2. Click on your image to place the initial caliper.
3. Trackball to the location where you want to end your measurement and then click to place the end caliper.
4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

Related information
- Complete procedure for adding a measurement (page 166)

Heart rate measurement

Use the heart rate measurement tool 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 the heart rate measurement button.
2. Click on your image to place the initial caliper at a specific point in the cardiac cycle.
3. Trackball 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. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**

- Complete procedure for adding a measurement (page 166)

**M-Mode LV wall trace measurements**

Use the LV trace measurement tool 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 the LV Area button \( \mathcal{O} \). The system highlights the button until you complete your measurement.

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:
   a. 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.
   b. 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.
   c. Right-click to complete the trace.

4. On the lower wall:
   a. Add caliper points the same way.
   b. Right-click to complete the trace.
   c. Right-click a second time to complete the measurement and display the measurements.

5. Work with your trace as required:
   - Modify the trace (page 238)
Refine the trace (page 238)

To trace the outer LV walls as well as the inner LV walls:

Use the same peak and valley caliper points tracing method, 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 display the measurements.

Modifying the trace

You can modify the caliper points on your trace after you complete the trace.

To move a caliper point:

1. Position the cursor over the point until the point becomes a pink cross.
2. Drag the point to a new position, then click again to set the new position.

To add a point:

1. Position your cursor where you want to place a new point.
2. Click twice.

To delete an individual point:

1. Position the cursor over the point until the point becomes a pink cross.
2. Right-click and select **Delete Point**. If more than one point is located within the five-pixel radius, the system deletes the point that is closest point to the cursor.

Refining the trace

After you complete a trace, you can use the system's Refine feature to automatically adds points along a tissue layer to contour the trace more precisely to the wall.

To refine one trace line in your LV trace:

1. Right-click on the line and select **Refine Current**.
2. The system automatically adds points along the tissue layer.

3. Depending on the placement of the initial points, the Refine feature might produce less than optimal results. To return to the initial trace, right-click the trace and select **Undo Last Action**.

**To refine all the trace lines in your LV trace:**

1. Right-click on any of the lines on your trace and select **Refine All**.

2. The system refines the contours of all the lines in your trace.
   - If you created a two-line trace of the internal LV wall, the system refines the contours along the upper and lower wall
   - If you created a four-line trace of the LV walls, the system refines the contours along the the two outer walls and the two inner walls

3. To return to the initial trace, right-click the trace and select **Undo Last Action**.

**Time Interval measurement**

Time interval is measured in **ms**.

**To place a time interval measurement:**

1. Click the time interval measurement button . The system highlights the button until you complete your measurement.

2. In the image mode data, click to place the initial caliper.

3. Trackball to the location where you want to place your end caliper and then click to place the caliper.

4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**

- Complete procedure for adding a measurement (page 166)

**Adding protocol measurements**

Protocol measurements are labeled uniquely for a specific measurement protocol.

**To access the protocol measurement tools and measurements list**

- If you are in an image acquisition session press **Scan/Freeze** to acquire an image and then press **Measure**.
If you are in the Study Browser, open an image and then press **Measure**.

**To place a protocol measurement:**

1. In the measurement packages drop-down list click the appropriate package.

2. In the list of protocols, select the appropriate protocol.

3. In the list of measurements, select the measurement you want to add.

   The system automatically activates the appropriate measurement tool and highlights the generic button for that tool.

4. On the image, add your measurement. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.

**Next step**

- **Reporting your analysis results** (page 184)

**Related information**

- **Analyzing image data** (page 156)
- **Protocol measurements** (page 167)
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 the system 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.
   
   The system labels 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 system commits the measurement value for the first measurement.
   
   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 system measures and labels the second measurement.
5. Click the remaining bottom points of the next measurements in the chain. The system measures and labels each measurement 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. Press `ESC` to cancel the chain but keep the completed measurements.
To see the label for any measurement you must either:

- Complete the remaining measurements in the chain
- Complete another measurement
- Return to the Study Browser and open the image

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 both B-Mode and M-Mode images that are accompanied by a continuous blood pressure trace. These traces are typically acquired from a blood pressure catheter.

This section describes how to obtain PV loops from M-Mode images.

To obtain PV loops from an M-Mode image:

1. Create an M-Mode cine loop of the heart in a long-axis orientation.
2. Complete an M-Mode LV Area wall trace measurement (page 237) that includes at least two cardiac cycles.
3. Right-click the measurement and select **PV Curve**.

**Note:** The PV Curve menu command is not available if the image does not include blood pressure data.
4. The system calculates the pressure-volumes of the cardiac cycles and plots them as a graph on the Pressure Volume Relationship window.

Pressure-Volume relationship graphs

When you have generated pressure-volume graph data, you can use the tools on the Pressure Volume Relationship window to:

- Display the end systolic PV points
- Display the end diastolic points
- 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 PV points.

If the graph displays a single loop, the system plots a green dot on the curve at the End Systolic point.

If the graph displays multiple loops, the system plots a best-fit line through the End Systolic points.

**EDPVR check box**

Check this box to display 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.

### 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 as one of three file formats:

- CSV file. Can be imported into a spreadsheet or database.
- BMP file. Exports the graph data as a bitmap image.
- TIFF file. Exports the graph data as a vector based image.
PW Doppler Mode imaging and analysis

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 system speakers.

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Chapter 37

Acquiring PW Doppler Mode and PW Tissue Doppler Mode images

This chapter shows you how to acquire PW Doppler Mode images.

**WARNING:** High levels of ultrasound energy can damage tissue. Do not touch the transducer when acoustic power could be generated.

In this chapter

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Setting the PW Doppler Mode sample volume in a distance blockout zone.............258
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**Typical PW Doppler Mode image acquisition session**

**Before you begin**

If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 109).
- Prepare your animal on the animal platform. For detailed information refer to the operator manual for your Vevo Imaging Station.
- For blood pressure setup, see Blood Pressure section (page 113).

**To acquire a PW Doppler Mode image:**

1. In B-Mode, position the transducer to situate your region of interest in the center of the image area.
2. Set the PW Doppler sample volume (page 257).
3. Adjust the **Image Width** control to remove image content outside the region of interest to optimize the image data for analysis.

4. Press **PW**.
   
   The system displays the yellow sample volume overlay on the B-Mode image.

5. Press **PW** again.
   
   The dual-window **PW Doppler Mode** workspace appears. The PW Doppler Mode window is on the bottom, the B-Mode scout window is on the top.

6. The system begins storing cine loop data in the acquisition buffer.

7. Press **Presets** to cycle through the available presets and then select an appropriate set of optimized image acquisition settings.

8. On the control panel, adjust the PW Doppler Mode controls (page 251) to refine your image acquisition settings if required.

9. Press the **Scan/Freeze** toggle control to stop the data acquisition so you can review the data in the acquisition buffer.

10. Roll the trackball side to side to scroll through the cine loop.

11. If you are satisfied with the cine loop, store your image data.
   
   a. To save a cine loop press **Cine Store**.
   
   b. To name the image you just stored, press **Image Label**.

12. Press **Scan/Freeze** toggle control to resume scanning.

13. Save images as required.

14. Press **Close**. The system closes the series you are working on and displays the **Study Information** window.

15. Complete the required fields to define your study and click **OK**.

   The **Study Browser** appears.

You have successfully acquired PW Doppler Mode image data.

**Next step**

- *Adding generic PW Doppler Mode measurements (page 262)*
- *Adding protocol measurements (page 168)*

**PW Doppler Mode window workspace**

The PW Doppler Mode window is the workspace you use whenever you view image data in PW Doppler Mode. The following illustration and table describes the information and features in the PW Doppler Mode window.
### Area Description

1. **PW Doppler Mode Image area export zone.** When you export a stored image and configure your export to send only the **Image Area**, this is the area of the window that the system exports, along with header information.

2. **B-Mode scout window.** Shows you precisely where the region of interest is. The region of interest is located between the yellow wireframe brackets set. Use this window to reposition your transducer and the wireframe brackets set so you can acquire the most useful data.

3. **Image scale.** Indicates in mm the distance from the face of the transducer.
### Blockout zones

In PW Doppler Mode, the system 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 the system does not sufficiently process the signal data.

The system assigns a blue bar to these zones, as shown in the following diagram.

If you set the sample volume in a blockout zone the system will move it out of the blockout zone and as close as possible to your target location.

### Sample volume

This region of interest is the image data that the transducer acquires along the vertical line between the brackets of the yellow wireframe in the B-Mode image.

### Scout window B-Mode sample gate

Displays a smaller scale version of the complete B-Mode image, along with the volume brackets. If you want to change the relative size of the scout window and the spectrum data, see the Mode Screen Layout section in the General tab of the Preferences window.

### PW Doppler Mode data

Displays the spectral display of the velocity data.

### Scale indicator

Indicates the velocity of blood flow. You can set it to Velocity or Frequency in the General tab of the Preferences window.

### 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.

### 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).

---

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Blockout zones</strong>. In PW Doppler Mode, the system 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.</td>
</tr>
<tr>
<td>2.</td>
<td>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 the system does not sufficiently process the signal data.</td>
</tr>
<tr>
<td>3.</td>
<td>The system assigns a blue bar to these zones, as shown in the following diagram.</td>
</tr>
<tr>
<td>4.</td>
<td>If you set the sample volume in a blockout zone the system will move it out of the blockout zone and as close as possible to your target location.</td>
</tr>
<tr>
<td>5.</td>
<td><strong>Sample volume</strong>. This region of interest is the image data that the transducer acquires along the vertical line between the brackets of the yellow wireframe in the B-Mode image.</td>
</tr>
<tr>
<td>6.</td>
<td><strong>Scout window B-Mode sample gate</strong>. Displays a smaller scale version of the complete B-Mode image, along with the volume brackets. If you want to change the relative size of the scout window and the spectrum data, see the Mode Screen Layout section in the General tab of the Preferences window.</td>
</tr>
<tr>
<td>7.</td>
<td><strong>PW Doppler Mode data</strong>. Displays the spectral display of the velocity data.</td>
</tr>
<tr>
<td>8.</td>
<td><strong>Scale indicator</strong>. Indicates the velocity of blood flow. You can set it to Velocity or Frequency in the General tab of the Preferences window.</td>
</tr>
<tr>
<td>9.</td>
<td><strong>Region of interest image window</strong>. 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.</td>
</tr>
<tr>
<td>10.</td>
<td><strong>Baseline</strong>. 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).</td>
</tr>
</tbody>
</table>
Chapter 37: Acquiring PW Doppler Mode and PW Tissue Doppler Mode images

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Physiological data trace window. Displays your animal's heart rate, temperature, respiration rate and blood pressure data. During data acquisition this information comes from the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station.</td>
</tr>
<tr>
<td>12</td>
<td>Cine loop time scale. In milliseconds. Use the <strong>Sweep Speed</strong> rocker switch to adjust the range of the scale so you can place more or less cine loop data into the window.</td>
</tr>
<tr>
<td>13</td>
<td>Live physiological display. If the animal is connected to the physiology controller, data appears here in real time during image acquisition and can display the numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature. This area also displays the <strong>image data storage capacity progress bar</strong> so you can see when you should start to back up your image data to free up space on the system. Live physiological data is only active when you enable the inputs in the General tab of the Preferences window.</td>
</tr>
</tbody>
</table>
| 14   | Left panel. Displays a unique set of controls and information sections depending on the control key you press:  
  - Press **Mode Settings** to set the panel to display the Mode settings. This is the default panel when you open a Mode window.  
  - Press **Measure** to set the panel to display the measurement tools. These tools are not available when you are acquiring or reviewing images.  
  - Press **Physio Settings** to set the panel to display the options for a) viewing and manipulating physiological data input from the Advanced Physiological Monitoring Unit and b) manipulating the Respiration Gating and ECG Trigger controls. |

For complete information on how each panel works, see *Left panel workspace* (page 47).
Control panel controls for PW Doppler Mode

When you are acquiring PW Doppler Mode image data, these are the controls you use to optimize the image you see on the screen.

<table>
<thead>
<tr>
<th>Transmitter Power</th>
<th>Adjusts the power of the ultrasound signal transmission.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Turn clockwise to increase power. Turn counterclockwise to decrease power. Between 1% and 10% power the control adjusts power in increments of 1%. Between 10% to 100% power the control adjusts in increments of 10%.</td>
</tr>
</tbody>
</table>
Chapter 37: Acquiring PW Doppler Mode and PW Tissue Doppler Mode images

**Volume**

Adjusts the speaker volume for the PW Doppler Mode and PW Tissue Doppler Mode audio data that the system acquires along with the spectral data.

**To use this dial control:**

- Turn clockwise to increase the volume.
- Turn counterclockwise to decrease the volume.

**Active during:** PW Doppler Mode and PW Tissue Doppler Mode image acquisition and review sessions.

**Frequency**

Adjusts the transmit frequency of the transducer between the higher and lower frequency levels that are supported by the specific transducer. When you increase the frequency you can improve detail at the focus depth but the system tends to lose detail at deeper tissues.

Push forward to increase the frequency. Pull back to decrease the frequency.

**Invert**

Flips the image.

**In PW Doppler Mode and PW Tissue Doppler Mode in the dual window view:** Press to flip the spectrum window vertically.

**Dynamic Range**

Adjusts the input signal strength that is mapped into the spectral display. Range: 5-100dB.

- Push up to increase the range by 5dB and lower contrast. Higher dynamic ranges are often used in cardiac imaging.
- Pull down to decrease the range by 5dB and increase contrast. Lower dynamic ranges are often used in abdominal imaging.

**In PW Doppler Mode and PW Tissue Doppler Mode:** Applies to the spectral display in the lower, spectral image data, window. Does not apply to the B-Mode scout window.
**Doppler Gain**

Adjusts the frequency shift in increments of 1.0 dB. Turn clockwise to add gain and brighten the Doppler data. Turn counterclockwise to reduce gain and darken the data.

**Active during:** PW Doppler Mode, PW Tissue Doppler Mode, Color Doppler Mode, Power Doppler Mode image acquisition sessions.

Unless the system is in simultaneous (duplex) mode, the B-Mode image remains constant with only a change displayed within the PW Doppler spectrum.

**Baseline**

Adjusts the vertical position of the horizontal zero frequency line (the *baseline*) that divides the image data coming toward the transducer face from the image data moving away from the transducer face. Push up to raise the line. Pull down to lower the line.

**Beam Angle**

Helps you generate flow direction information when the orientation of your target vessel is perpendicular or almost perpendicular to your ultrasound beam.

This control applies a graduated series of transmission and reception delays to the ultrasound sound signals of each crystal in the transducer. These carefully calibrated sequences can effectively *steer* the ultrasound beam in order to detect minute frequency shifts.

In PW Doppler Mode and PW Tissue Doppler Mode, the current beam angle setting is displayed in the top-left corner of the B-Mode scout image.

In Power Doppler Mode and Color Doppler Mode, this changes the color box.

**Active during** Color Doppler Mode, Power Doppler Mode, PW Doppler Mode, PW Tissue Doppler Mode imaging sessions.

**To use this rocker switch control:**

Push up or pull down the control depending on the orientation of your transducer to steer the beam angle.
Chapter 37: Acquiring PW Doppler Mode and PW Tissue Doppler Mode images

**Simul**

This toggle control sets the system to acquire live data simultaneously in both the B-Mode scout window as well as the PW Doppler image window.

In the dual window view, use this feature when you want to adjust your sample volume in the B-Mode scout window while you view the waveform data in the PW Doppler Mode window.

**To use this toggle control:**

1. Press to activate the simultaneous state.
   
   A black vertical strip scans across the spectrum from left to right.

2. To eliminate this striping, press the toggle again to freeze the scout window and return to PW Doppler image data only.

**Active during:** M-Mode, PW Doppler Mode and PW Tissue Doppler Mode image acquisition sessions.

**Sweep Speed**

Adjusts the cine loop playback speed parameter so that you can stretch out or compress the cine loop data in the review window. Push up to increase the speed and compress the cine loop image. Pull down to decrease the speed and expand the cine loop image.

When you are reviewing the cine loop you can also use the **Cine Loop Review** control to adjust the sweep speed.

**In PW Doppler Mode and PW Tissue Doppler Mode:** Set the sweep speed parameter in a range from 0.25 seconds at 4000 Hz to 5.1 seconds at 200 Hz. In some cases, if your imaging window is large and the **Velocity** is set high, the minimum speed may be greater. The system displays the updated values in the status bar in the lower left area of the screen.

**Wall Filter**

Filters out signals that correspond to low velocity axial motion. Typically these include vessel wall movement, cardiac wall movement and tissue movement caused by respiration. Push up to filter out more. Pull down to filter out less.

**In PW Doppler Mode:** Use this control to filter out the display of low velocity signal artifacting that appears as a horizontal black band along either side of the white baseline. Push up to reduce the lower velocity signals and bring the waveform of the spectral data closer to the baseline. Pull down to display more low velocity signals.
SV/Gate

Push up to increase. Pull back to decrease.

**In PW Doppler Mode:** This control adjusts the distance in mm of the vertical line between the two yellow calipers of the *sample volume*.

In the dual window view, the system displays the spectral data that the system acquires along this line. Current data is on the right side, trailing data extends to the left.

Doppler Angle

Adjusts the angle correction in 5-degree increments 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.

When the system receives the return signal, it applies an algorithm to the signal data to correct for the delta. This produces usable PW Doppler Mode data.

**To use this dial control:**

1. Turn the dial to align the dashed yellow line with the direction of the vascular flow in your sample volume region.
   
   The system always displays the value of the resulting angle as a positive value between 0 degrees and 80 degrees, regardless of which side of the vertical line you align the dashed line.
   
   For angles between 60 degrees and 80 degrees, the system applies the color blue to the dashed line. This indicates that the angle is too great to correct.

2. Reposition your transducer and/or the animal to bring the angle of the vessel as parallel as you can to the vertical yellow line that represents the transducer beam.
Chapter 37: Acquiring PW Doppler Mode and PW Tissue Doppler Mode images

---

**Velocity**

Adjusts the PRF (pulse repetition frequency). The higher you set the PRF, the lower the signal resolution. **In PW Doppler Mode**: Adjust the range of the scale of the Y axis on the Power Doppler Mode image window by adjusting the pulse rate frequency of the ultrasound signal. Use this control when the spectral waveform is either too compressed or too expanded for your purposes.

**Note:** In the General tab of the Preferences window you can set the **PW Doppler Scale (Y axis)** to display either velocity or frequency.

Turn the dial clockwise to compress the waveform by increasing the range of the scale. Turn counterclockwise to expand the waveform by decreasing the range of the scale.

---

**PW**

Activates PW Doppler Mode acquisition. Press to begin displaying the yellow PW Doppler Mode sample volume, press **Update** to display the live PW Doppler Mode spectral data in the lower window and the live B-Mode data in the scout window, then press **Simul**.

---

**PW Doppler Mode acquisition settings**

To view the PW Doppler Mode acquisition settings:

Press **Mode Settings**.

The PW Doppler Mode acquisition settings panel displays the following parameters, in addition to labeling the current transducer application and preset:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>The ultrasound frequency, measured in MHz. Adjust with the <strong>Frequency</strong> control.</td>
</tr>
<tr>
<td>Power</td>
<td>The transmission power level of the ultrasound signal, displayed as a percentage of the maximum power. Adjust with the <strong>Transmit Power</strong> control.</td>
</tr>
<tr>
<td>PRF</td>
<td>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. Adjust with the <strong>Velocity</strong> control.</td>
</tr>
</tbody>
</table>
### Acquisition

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doppler Gain</td>
<td>The PW Doppler frequency, measured in dB. Adjust with the Doppler Gain control.</td>
</tr>
<tr>
<td>Beam Angle</td>
<td>The number of degrees of steer to the ultrasound beam so you generate flow direction information when the orientation of your target vessel is perpendicular or almost perpendicular to your ultrasound beam. Adjust with the Beam Angle control.</td>
</tr>
<tr>
<td>Wall Filter</td>
<td>The level of low velocity signals, measured in Hz, filtered out of the spectral display. Adjust with the Wall Filter control.</td>
</tr>
<tr>
<td>Simultaneous</td>
<td>The state (On or Off) of the simultaneous display of live acquisition data in both the B-Mode scout window and the PW Doppler Mode image window. Adjust with the Simul control.</td>
</tr>
</tbody>
</table>

### Display

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Range</td>
<td>The contrast of your image, measured in dB. Adjust with the Dynamic Range control.</td>
</tr>
<tr>
<td>Display Map</td>
<td>The selected predefined display map from the predefined set of maps. Adjust with the Display Map control.</td>
</tr>
</tbody>
</table>

### Doppler SV

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>The distance, measured in mm, from the face of the transducer. Adjust with the Image Depth control.</td>
</tr>
<tr>
<td>Size</td>
<td>The length, measured in mm, of the sample volume. Adjust with the SV/Gate control.</td>
</tr>
<tr>
<td>Angle</td>
<td>The angle correction, measured in degrees, between the vertical line of the ultrasound pulse from the face of the transducer and the direction of vascular flow, as indicated by the dashed yellow line. This angle always displays a positive value between 0° and 80°, regardless of which side of the vertical line it is positioned on. Adjust with the Doppler Angle control.</td>
</tr>
</tbody>
</table>

---

### Setting the PW Doppler Mode sample volume

In PW Doppler Mode, the region of interest is the image data that the transducer acquires along the vertical line between the brackets of the yellow wireframe in the B-Mode image. This line is called the sample volume (SV).
Chapter 37: Acquiring PW Doppler Mode and PW Tissue Doppler Mode images

To set your PW Doppler SV:

1. Begin acquiring data in Power Doppler Mode and position your transducer to display your region of interest in the center of the B-Mode scout window.

2. If the PW Doppler Mode acquisition settings (page 256) are not displayed in the left panel press Mode Settings.

3. Watching the B-Mode scout window, trackball to move the yellow wireframe as close as possible to your region of interest.

4. Adjust the SV/Gate rocker switch forward or back to increase or decrease the size of the SV.

   After you change the position or size of the SV:

   a. The system pauses briefly to reset the SV and update the Doppler SV parameter values in the mode settings panel.

   b. The system restarts the acquisition.

5. If your target vessel is at or near perpendicular to the transducer face, adjust the Beam Angle to steer the beam to reduce the Doppler angle to a usable degree.

6. Adjust the Doppler Angle dial to align the dashed yellow line as parallel as you can to the axis of the vessel in the SV.

   In the mode settings panel and in the upper left corner of the B-Mode scout window, the system displays the updated angle degree value.

To update your PW Doppler SV:

1. Press Simul to activate live image acquisition in the B-Mode scout window.

2. In the scout window, trackball to the new location, adjust the SV/Gate and Doppler Angle controls to set the sample volume.

3. Press Simul to return the scout window to a static image.

Setting the PW Doppler Mode sample volume in a distance blockout zone

You cannot place an SV in a distance blockout zone because the frequency setting is too high to produce useful detail at that depth.

However, if you try to set the SV in the blockout zone, the system automatically lowers the frequency setting until there is enough detail to support the SV.
Tip: If your transducer supports beam angle adjustments, adjust the Beam Angle to steer the beam to reduce the angle enough that the SV is no longer in the blockout zone.

Exporting PW Doppler Mode cine loop audio

The system acquires PW Doppler Mode data as both visual and audio data. You can export this data as a cine loop as either an integrated audiovisual file using the AVI file format, or as audio-only using the WAV file format.

- To export a PW Doppler Mode cine loop as an audiovisual file:
  Complete the export procedure detailed in Exporting cine loops from the Study Browser (page 139) and in the File Type box select the appropriate AVI file format.

- To export a PW Doppler Mode cine loop as an audio file only:
  Complete the export procedure detailed in Exporting cine loops from the Study Browser (page 139) and in the File Type box select Windows Audio Wave File.

Related information

- Exporting images to DICOM from the Study Browser (page 145)
Chapter 38

Acquiring PW Tissue Doppler Mode images

PW Tissue Doppler Mode uses PW Doppler ultrasound to measure the velocity function of myocardial tissue, typically during the diastolic phase of the cardiac cycle.

This chapter shows you how to acquire PW Tissue Doppler Mode images.

**WARNING:** High levels of ultrasound energy can damage tissue. Do not touch the transducer when acoustic power could be generated.

In this chapter

Typical PW Tissue Doppler Mode image acquisition session ............................................... 260
Analyzing PW Tissue Doppler Mode images ........................................................................ 261

**Typical PW Tissue Doppler Mode image acquisition session**

You acquire PW Tissue Doppler Mode images exactly the same way as you acquire PW Doppler Mode images. The only difference is that the Vevo 2100 Imaging System processes the data in a slightly different way.

In PW Doppler Mode the system requires higher frequency signals to display the fast-moving vascular flows. In PW Tissue Doppler, the system filters out higher frequency signals so it can more accurately display the lower frequency signals that define slower moving myocardial tissue.

**To acquire a PW Tissue Doppler Mode image:**

Follow the acquisition procedure defined in *Typical PW Doppler Mode image acquisition session* (page 246).

- Press Tissue instead of PW when you begin the acquisition.
- Set your sample volume as defined in *Setting the PW Doppler sample volume* (page 257).
Analyzing PW Tissue Doppler Mode images

You analyze PW Tissue Doppler Mode images using the same tools that you use to analyze PW Doppler Mode images.

For complete information, see Analyzing PW Doppler Mode images (page 262).
Chapter 39

Analyzing PW Doppler Mode and PW Tissue Doppler Mode images

This chapter shows you how to analyze PW Doppler Mode and PW Tissue Doppler Mode images that are saved to a study.

In this chapter
Adding generic PW Doppler Mode measurements........................................................262
Applying automatic traces to the frequency waveform.................................................267
Adding protocol measurements........................................................................................270

Adding generic PW Doppler Mode measurements

PW Doppler Mode provides seven generic measurement tools. Use these tools when you want to add measurements that aren't part of a measurement protocol.

Before you begin
If you want to display the measurement labels and values that you add, select the Show Values and Labels option in the Measurement tab of the Preferences window.

To access the generic measurement tools for PW Doppler Mode:

- If you are acquiring PW Doppler Mode image data, press Scan/Freeze and then press Measure.
- If you are in the Study Browser, open an image and then press Measure.
  The system displays the measurement tools at the top of the left panel.

  Hover over a tool to see the description label.

Acceleration measurement

Use the acceleration measurement tool to determine the acceleration of heart tissue movement. Acceleration is measured in mm/s².
To place an acceleration measurement:

1. While you view a saved image from the Study Browser or an image that is acquired but not stored during an image acquisition session, press Measure and toggle to view the measurement tools panel.

2. Click the Acceleration measurement button \[\text{\textcopyright}^\text{\textcopyright}\]. The system highlights the button until you complete your measurement.

3. Click on your image to place the initial caliper.

4. Trackball to the location where you want to end your measurement and then click to place the end caliper.

   If you selected the Show Values and Labels option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement Acceleration \#\#, where \# is a sequential number.

5. If you want to rename the label and you have selected Show Values and Labels in the Measurement tab of the Preferences window, type a new name while the label text is selected, and then click outside the label to commit the label.

6. If you have selected Show Values and Labels in the Measurement tab of the Preferences window and you want to move the measurement or move the label, select either item and then drag and drop it.

Next step

- Reporting your analysis results (page 184)

Related information

- Analyzing image data (page 156)

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. While you view a saved image from the Study Browser or an image that is acquired but not stored during an image acquisition session, press Measure and toggle to view the measurement tools panel.

2. Click the VTI button \[\text{\textcopyright}^\text{\textcopyright}\]. The system highlights the button until you complete your measurement.
3. Click on your image to place the initial caliper at a specific point on the waveform.

4. Trackball 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.

5. Right-click to place your final caliper at the end of the last cardiac cycle. If you selected the Show Values and Labels option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement VTI #, where # is a sequential number.

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 and you have selected Show Values and Labels in the Measurement tab of the Preferences window, type a new name while the label text is selected, and then click outside the label to commit the label.

8. If you have selected Show Values and Labels in the Measurement tab of the Preferences window and you want to move the measurement or move the label, select either item and then drag and drop it.

Next step

- Reporting your analysis results (page 184)

Related information

- Analyzing image data (page 156)
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 your frequency waveform before you apply the VTI measurement.

To place a VTI measurement with automatic frequency trace:

1. While you view a saved image from the Study Browser or an image that is acquired but not stored during an image acquisition session, press Measure and toggle to view the measurement tools panel.
2. Select the appropriate auto trace option in the Peak or Mean drop-down boxes as described in Applying automatic traces to the frequency waveform (page 267).

   **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 button . The system highlights the button until you complete your measurement.
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.
7. The system plots individual caliper points along the range. If you selected the Show Values and Labels option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement VTI #, where # is a sequential number.
8. If you want to rename the label and you have selected Show Values and Labels in the Measurement tab of the Preferences window, type a new name while the label text is selected, and then click outside the label to commit the label.
9. If you have selected Show Values and Labels in the Measurement tab of the Preferences window and you want to move the measurement or move the label, select either item and then drag and drop it.

Next step

- Reporting your analysis results (page 184)
Heart rate measurement

Use the heart rate measurement tool 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 the heart rate measurement button.
2. Click on your image to place the initial caliper at a specific point in the cardiac cycle.
3. Trackball 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. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

Single point measurement

Use the linear distance measurement tool to place a caliper dot on the image. A single 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. While you view a saved image from the Study Browser or an image that is acquired but not stored during an image acquisition session, press Measure and toggle to view the measurement tools panel.
2. Click the single point measurement button. The system highlights the button until you complete your measurement.
3. Click on your image to place the single caliper dot. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement **Doppler Point #**, where # is a sequential number.

4. If you want to rename the label and you have selected **Show Values and Labels** in the Measurement tab of the Preferences window, type a new name while the label text is selected, and then click outside the label to commit the label.

5. If you have selected **Show Values and Labels** in the Measurement tab of the Preferences window and you want to move the measurement or move the label, select either item and then drag and drop it.

**Next step**
- *Reporting your analysis results* (page 184)

**Related information**
- *Analyzing image data* (page 156)

**Time Interval measurement**

Time interval is measured in ms.

**To place a time interval measurement:**

1. Click the time interval measurement button —. The system highlights the button until you complete your measurement.

2. In the spectrum window or the physiology data trace window click to place the initial caliper.

3. Trackball to the location where you want to place your end caliper and then click to place the caliper.

4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**
- *Complete procedure for adding a measurement* (page 166)

**Applying automatic traces to the frequency waveform**

You can set the system to apply a range of peak and mean frequency traces to your PW Doppler spectral data.
You can apply these traces in real-time to the data in your cine loop acquisition buffer or to an acquired cine loop.

**To apply an automatic trace of the frequency waveform:**

1. While you view a saved image from the Study Browser or an image that is acquired but not stored during an image acquisition session, press **Measure** and toggle to view the measurement tools panel.

2. Select the appropriate auto trace option in the **Peak** or **Mean** frequency drop-down boxes as described in the following tables.

3. To adjust the VTI threshold for a trace, press **[** to increase and **]** to decrease.

**Peak**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>The system does not apply a trace.</td>
</tr>
<tr>
<td>+</td>
<td>Applies a blue trace to all positive peak frequency signal traces (flow moving toward the transducer face) along the entire cine loop.</td>
</tr>
<tr>
<td>-</td>
<td>Applies a pink trace to all negative peak frequency signal traces along the entire cine loop.</td>
</tr>
<tr>
<td>+ / -</td>
<td>Applies both the positive as well as the negative peak frequency traces.</td>
</tr>
</tbody>
</table>
### Option Description

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>auto</td>
<td>Applies a green trace to the largest velocity values, positive and negative, along the entire cine loop.</td>
</tr>
</tbody>
</table>

### Mean

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>The system does not apply a trace.</td>
</tr>
<tr>
<td>+</td>
<td>Applies a blue trace to all positive mean frequency signal traces along the entire cine loop.</td>
</tr>
<tr>
<td>-</td>
<td>Applies a purple trace to all negative mean frequency signal traces along the entire cine loop.</td>
</tr>
<tr>
<td>+ / -</td>
<td>Applies both the positive as well as the negative mean frequency traces.</td>
</tr>
</tbody>
</table>

**Related information**

- *VTI measurement with automatic frequency trace* (page 265)
Adding protocol measurements

Protocol measurements are labeled uniquely for a specific measurement protocol.

- **To access the protocol measurement tools and measurements list**
  - If you are in an image acquisition session press `Scan/Freeze` to acquire an image and then press `Measure`.
  - If you are in the Study Browser, open an image and then press `Measure`.

- **To place a protocol measurement:**
  1. In the measurement packages drop-down list click the appropriate package.
  2. In the list of protocols, select the appropriate protocol.
  3. In the list of measurements, select the measurement you want to add.
The system automatically activates the appropriate measurement tool and highlights the generic button for that tool.

4. On the image, add your measurement. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.

**Next step**
- *Reporting your analysis results* (page 184)

**Related information**
- *Analyzing image data* (page 156)
- *Protocol measurements* (page 167)
3D-Mode imaging and analysis

3D-Mode provides tools you can use to:

- Create and manipulate three-dimensional renderings
- Make volumetric measurements of objects viewed with high-resolution ultrasound

In This Section

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How 3D-Mode works

3D-Mode acquires a series of 2-dimensional “slices” and assembles 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 imaging can be used in B-Mode, Power Doppler Mode and Contrast Mode imaging procedures.

3D-Mode hardware setup

The transducer is mounted on a Vevo Imaging Station equipped with a 3D motor stage.

The transducer connects to a clamp connected to the bottom of the 3D motor stage. The 3D motor stage connects to the mount on the Vevo Imaging Station.

3D-Mode image acquisition

Based on operator-defined parameters, the 3D motor stage travels a set distance across the target object in a series of minute steps. The 3D motor stage, with the
attached transducer, travels in a direction perpendicular to the imaging orientation.

At each step, the transducer acquires a two-dimensional slice of the B-Mode, Power Doppler Mode, or Contrast Mode image.

Each two-dimensional B-Mode, Power Doppler Mode, or Contrast Mode image slice is assembled with the other slices of acquired data and rendered by the Vevo software into a three-dimensional data set.

**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
Acquiring 3D-Mode images

This chapter shows you how to acquire 3D-Mode images.

WARNING: High levels of ultrasound energy can damage tissue. Do not touch the transducer when acoustic power could be generated.

In this chapter
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3D-Mode window workspace .......................................................................................... 279
Control panel controls for 3D-Mode ................................................................................. 281
Setting up for a 3D-Mode image acquisition ................................................................. 282
Recording a 3D-Mode analysis session ............................................................................ 286

Typical 3D-Mode image acquisition session

Before you begin

Prepare your animal on the animal platform. For detailed information refer to the Vevo Imaging Station Operator Manual.

To acquire a 3D-Mode image:

1. From B-Mode, Power Doppler Mode, Contrast Mode or the Study Browser press 3D to activate the 3D-Mode acquisition process.

   The system freezes the image acquisition and displays the 3D Motor Stage initialization option box.

2. Click Yes. The system:
Chapter 41: Acquiring 3D-Mode images

a. Initializes the motor stage.

b. Confirms the initialization and prompts you to start the 3D slices acquisition.

3. Click OK. The system returns to the base image acquisition Mode.

4. Activate the base imaging Mode for the type of 3D-Mode image you want to acquire:
   - Press B-Mode to acquire a B-Mode only 3D image. The system begins to acquire B-Mode image data.
   - Press Power to acquire Power Doppler Mode 3D image data over each B-Mode image slice. The system begins to acquire Power Doppler Mode image data.

5. Locate the object of interest and center it as closely as possible relative to the transducer using the platform controls on the Vevo Imaging Station.

   **WARNING:** Ensure that the lateral movement of the 3D motor stage cannot injure the subject and damage the transducer.

6. Press 3D.
The system displays the **3D Acquisition Setup** box.

![3D Acquisition Setup](image)

7. Set up your 3D-Mode image slices parameters as described in the following table.

<table>
<thead>
<tr>
<th>3D parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scan Distance</td>
<td>Sets the distance (in millimeters) that the 3D motor stage will travel during the entire 3D image acquisition. Scan distance ranges between 0.5 mm and 38 mm.</td>
</tr>
<tr>
<td>Step Size</td>
<td>Sets the distance that the 3D motor stage travels between each B-Mode slice. Step sizes range between 0.03 mm and 0.5 mm.</td>
</tr>
<tr>
<td>- Smaller step size produces more image slices which generates a more detailed 3D image, typically useful for detailed evaluations of structures</td>
<td></td>
</tr>
<tr>
<td>- Higher step size produces fewer image slices which generates a less detailed 3D image, but typically suitable for quick evaluations of structure volumes</td>
<td></td>
</tr>
<tr>
<td>Scan Frames</td>
<td>Read-only display of the total number of 3D frames the system will acquire. The number of frames equals the Scan Distance value divided by the Step Size value.</td>
</tr>
</tbody>
</table>

8. Press **Scan**.

The system acquires the specified number of frames across the specified scan distance and displays the progress at the bottom of the image area.

![Scan frame progress](image)
When the 3D motor stage finishes acquiring the 3D slices:

- The system positions the transducer at the center of its range.
- The system assembles the 3D image data set and displays the data in the four-pane view.

9. Press Cine Store or Frame Store to save the 3D image data.

10. Press Close. The system closes the series you are working on and displays the Study Information window.

11. Complete the required fields to define your study and click OK.

   The Study Browser appears.

You have successfully acquired a 3D-Mode image.

Related information

- Typical Power 3D-Mode image acquisition session (page 323)
- Typical Contrast 3D-Mode image acquisition session (page 341)
3D-Mode window workspace

The 3D-Mode window is the workspace you use whenever you visualize acquired image data in 3D-Mode. The following illustration and table describes the information and features in the 3D-Mode window.

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Image data area</td>
<td>Includes the view panes area and the visualization options tool bar.</td>
</tr>
<tr>
<td><strong>2</strong> View panes area</td>
<td>The system defaults to four view panes (Quad Pane view), but you can select Dual Pane view or Single Pane 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 the system exports.</td>
</tr>
<tr>
<td><strong>3</strong> Active pane yellow border</td>
<td>When you select a view pane, the system applies a yellow border to that pane.</td>
</tr>
</tbody>
</table>
### Chapter 41: Acquiring 3D-Mode images

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active pane menu drop-down icon.</strong></td>
<td>When you are in the cube view, 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 the available commands:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire-frame</td>
<td>Turns the image outline on/off</td>
</tr>
<tr>
<td>Orientation</td>
<td>Turns the orientation marker points on/off</td>
</tr>
<tr>
<td>Restore</td>
<td>Resets the original view of the 3D image including size, orientation, brightness and zoom values.</td>
</tr>
</tbody>
</table>

| **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: |

<table>
<thead>
<tr>
<th>Command</th>
<th>Step size</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;</td>
<td>1 slice</td>
</tr>
<tr>
<td>Shift + &gt;</td>
<td>5 slices</td>
</tr>
<tr>
<td>Ctrl + &gt;</td>
<td>10 slices</td>
</tr>
</tbody>
</table>

| **Unique image view.** | Each pane displays a unique view of the 3D image. When you click a different view icon in the image analysis tool bar to change the view, the system visualizes the same slice from a different perspective. |

| **Visualization options tool bar.** | 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 image analysis tools (page 288). |

| **Live physiological display.** | If the animal is connected to the physiology controller, data appears here in real time during image acquisition and can display the numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature. This area also displays the image data storage capacity progress bar so you can see when you should start to back up your image data to free up space on the system. Live physiological data is only active when you enable the inputs in the General tab of the Preferences window. |
Chapter 41: Acquiring 3D-Mode images

### Area Description

**Image management panel.** Press the appropriate control to display the image management panel you want to work with.

- Press **Mode Settings** to toggle between the acquisition Mode settings and the 3D-Mode analysis tools.

The 3D-Mode tools each provide a unique set of commands and controls for each tool. These appear beneath the tool buttons. Click the tool button to work with the commands and controls.

- Press **Measure** to display the measurement tools for 3D-Mode.

### Control panel controls for 3D-Mode

Because the image acquisition process in 3D-Mode is automated, you optimize your settings before you run your 3D-Mode scan.

**To optimize your 3D-Mode image:**

- If you are acquiring a 3D-Mode image:
  a. Start B-Mode and use the control panel controls for B-Mode (page 194) to optimize your image.
  b. Press **3D** to set up the automated image acquisition.
If you are acquiring a Power 3D-Mode image:
   a. Start Power Doppler Mode.
   b. Use the Control panel controls for Power Doppler Mode (page 327) to optimize your image.
   c. Press \textbf{3D} to set up the automated image acquisition.

If you are acquiring a Contrast 3D-Mode image:
   a. Start Contrast Mode.
   b. Use the Control panel controls for Contrast Mode (page 345) to optimize your image.
   c. Press \textbf{3D} to set up the automated image acquisition.

\textbf{Related information}
- \textit{Typical Power 3D-Mode image acquisition session} (page 323)
- \textit{Typical Contrast 3D-Mode image acquisition session} (page 341)

\textbf{Setting up for a 3D-Mode image acquisition}

This section describes how to set up your 3D motor stage and your transducer for a 3D-Mode image acquisition session.

\textbf{Connecting the 3D motor stage to the Vevo Imaging Station}

The 3D motor stage features a Quick Release post on the top to connect to the Vevo Imaging Station, and a Quick Release mount on the bottom to affix the transducer clamp.
To connect the 3D motor stage to the Vevo Imaging Station:

1. Insert the quick release post into the quick release mount located on the Imaging Station arm.

2. Carefully line up the holes on the post with the pins on the quick release mount.

3. Finger tighten the knob on the quick release mount.

4. Connect the 3D motor cable to the 3D Motor connector on the rear panel of the Vevo 2100 Imaging System.

Connecting the transducer to the 3D motor stage

When you use the Vevo Imaging Station, you must secure the transducer within the transducer clamp.

To connect the transducer to the 3D motor stage:

1. Insert the Quick Release post on the transducer clamp into the Quick Release mount on the 3D motor stage unit so that the pins on the mount fit into the holes on the Quick Release post.

2. Tighten the Quick Release mount until it is finger tight.
3. Lift the latch to open the clamp and then place the collar of the transducer in the clamp.
4. Close the moving arm of the clamp and then pull the latch down to the 45° notch. This transducer rotation lock setting holds the transducer but provides enough freedom for your to rotate it.

5. To set the transducer to any of the at the desired 90-degree angle in the clamp turn the transducer until you feel the collar snap into position.

6. Close the clamp and push the latch down until it locks into place as shown in the following illustration.
Orienting the transducer

As shown in the following illustration, the long axis of the 3D motor stage must be aligned in the direction that the transducer travels during data acquisition.

During the 3D data acquisition, the motor stage moves the transducer. Ensure that the animal under the transducer is flat in relation to the 3D scan direction to prevent unintended contact with the surface of the subject as the 3D motor stage moves the transducer.

**WARNING:** The 3D motor stage could cause a hazard to fingers during a 3D scan as the motor stage moves. Ensure that fingers are kept away from the 3D motor stage during a 3D scan.

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. While you analyze your 3D-Mode image, to view the 3D-Mode tools set in the left panel:
If you are on the Vevo 2100 Imaging System, press **Mode Settings**.

If you are on the Vevo Imaging Workstation, click **3D Settings**.

2. Click **Record** and then click **Start Recording**.

3. In the **Save As** box:
   a. Browse to the directory where you want to save the recording.
   b. If you want to create a new folder for the recording, click **New Folder** and add the new folder.
   c. If you want to change the file name, in the **Save As** field, type a unique file name.
   d. In the **File Type** box select the appropriate AVI compression type.
   e. If the **OK** button is grayed out, the system has detected that the file name already exists in the selected folder. If you want to overwrite this file click **Overwrite Existing File**.
   f. Click **OK**.

The system begins recording the activity occurring in the selected view pane.

4. Use the other 3D tools to analyze your 3D images.

5. When you are done your analyses click **Stop Recording**.

The system saves the recording to the location you specified.
Chapter 42

Analyzing 3D-Mode images

This chapter shows you how to analyze 3D-Mode images that are saved to a study.

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3D-Mode visualization tools

When you are in the cube view, the 3D-Mode image analysis tool bar 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

The image analysis tool bar includes the following tools:

<table>
<thead>
<tr>
<th>Tool</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Single Pane" /></td>
<td>Click to display one 3D image view across the entire image area.</td>
<td><img src="example" alt="Example Image" /></td>
</tr>
<tr>
<td><img src="image" alt="Dual Pane" /></td>
<td>Click to display two 3D image views across the image area.</td>
<td><img src="example" alt="Example Image" /></td>
</tr>
<tr>
<td><img src="image" alt="Quad Pane" /></td>
<td>Click to display four image views across the image area.</td>
<td><img src="example" alt="Example Image" /></td>
</tr>
</tbody>
</table>
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**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**
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.

As you trackball over a plane on the cube, the plane becomes “active” and the wire-frame for that plane is displayed in green.

**Right-click commands**
Right-click a pane to display the following commands:

<table>
<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>
<tr>
<td>Delete 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>

**Cross View**
Click to display three single, slidable image slice views presented on the x, y, and z planes. Each plane presents its own color outline:
- Blue = x-y plane on the z axis
- Green = y-z plane on the x axis
- Red = x-z plane on the y axis

**Transverse View**
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.

**Sagittal View**
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.
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**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 operator-generated volumes to the acquired data.

**Toggle Overlay**
Click to cycle through the three overlay states:
- Overlay + B-Mode
- Overlay
- B-Mode

---

**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 trackball 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 trackball cursor in the image pane.
2. While pressing the Shift key, left-click and drag in any direction.
3. Left-click to stop the panning.
Rendering a 3D image

Use the Render tool in 3D-Mode to display the full 3D image. You can only use this tool when you are viewing your 3D image in the Cube view.

To render an image:

1. While you analyze your 3D-Mode image, to view the 3D-Mode tools set in the left panel:
   - If you are on the Vevo 2100 Imaging System, press Mode Settings.
   - If you are on the Vevo Imaging Workstation, click 3D Settings.

2. Click Render.

3. Select from the four modes as described in the following table:

<table>
<thead>
<tr>
<th>Render mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texture Mapping</td>
<td>Texture Mapping mode displays the surface texture of the 3D image. Texture mapping mode is the default rendering mode for 3D acquisition.</td>
</tr>
</tbody>
</table>

To apply texture mapping to a 3D image:

Under Mode, click Texture Mapping. The Cube view displays data on the surface of each plane of the 3D image.
Chapter 42: Analyzing 3D-Mode images

<table>
<thead>
<tr>
<th>Render mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Render</td>
<td>Render mode displays the full 3D image in the Cube view.</td>
</tr>
</tbody>
</table>

To render a 3D image:

Under Mode, click Render.

- The Cube view traces each line of the data, perpendicular to the display for the full image.
- The left panel adds the Opacity & Luminance section for B-Mode image data under the Mode section.

![Opacity & Luminance](image)

Use the light-red Opacity curve to adjust the levels of transparency in the image. Use the light-blue Luminance to artificially adjust the light/dark contrast of the image.

To adjust opacity and luminance of a rendered image:

- Left-click and drag a point along the curves and then left-click to lock the point to a new setting.
- Click Reset to return both curves to their default settings.

For Contrast 3D-Mode and Power 3D-Mode:

The system adds an overlay opacity and luminance tool that applies to the overlay data component of the image. The tools work in the same way as the B-Mode opacity and luminance tools.

![Overlay Opacity & Luminance](image)

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.

To apply MIP (Max) to a 3D image:

Under Mode, click MIP (Max).
Chapter 42: Analyzing 3D-Mode images

<table>
<thead>
<tr>
<th>Render mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIP (Min)</td>
<td>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.</td>
</tr>
</tbody>
</table>

To apply MIP (Min) to a 3D image:
Under Mode, click MIP (Min).

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 your 3D image in the Cube view.

To sculpt an image:

1. While you analyze your 3D-Mode image, to view the 3D-Mode tools set in the left panel:
   - If you are on the Vevo 2100 Imaging System, press **Mode Settings**.
   - If you are on the Vevo Imaging Workstation, click **3D Settings**.

2. Click **Sculpting**.
3. Select from the three available modes as described in the following table:
Chapter 42: Analyzing 3D-Mode images

Sculpting 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 the tool can shave the target and then use the tool on the image in Cube view.

To shave a 3D image dataset:
1. Under Mode, click Shave.
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, the system shaves a hole completely through the image.
3. Step through the image slices to find the plane from which shaving should start.
4. Trackball in the target area.
5. Drag the cursor.
6. Release the trackball button to complete the shaving procedure.

Scalpel (Inside) | Scalpel (Inside) mode functions like a cookie cutter. Select a depth, then outline an area within which to remove data.

To scalpel inside a 3D image:
1. Under Mode, click Scalpel (Inside).
2. Under Depth, set the slider to the required depth.
3. Position the trackball cursor over the image.
4. Drag the trackball cursor to create the outline of the area to be scalpeled.
5. Release the trackball button.
   The outlined area is removed from the image.

Image before scalpelng | Image after scalpelng (inside)
Scultping mode | Description
--- | ---
Scalpel (Outside) | Scalpel (Outside) mode functions like a cookie cutter, much the same way as Scalpel (Inside). Select a depth, then outline an area outside of which to remove data.

To scalpel outside a 3D image:
1. Under Mode, click **Scalpel (Outside)**.
2. Under Depth, set the slider to the required depth.
3. Trackball over the image.
4. Drag to create the outline of the area to be scalpelled.
5. Release the trackball button.

Data outside the outlined area is removed from the image.

Creating 3D volume measurements

In Cube view, the 3D-Mode 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 3D volumes in 3D-Mode, Power 3D-Mode, and Contrast 3D-Mode using Parallel or Rotational Segmentation.

Typically, rotational segmentation should be used when the volume resembles a spherical shape. Otherwise, use parallel segmentation.

For parallel segmentation, the system can perform manual, semi-automated or automated segmentation of the volume. Rotational segmentation does not support manual segmentation.

- When you segment the volume manually (in parallel segmentation only) you manually draw each contour of the volume.
- When you segment the volume semi-automatically the system draws multiple contours.
- When you segment the volume automatically the system draws multiple contours.
Rotational segmentation

To create a volume measurement using rotational segmentation:

1. While you analyze your 3D-Mode image, to view the 3D-Mode tools set in the left panel:
   - If you are on the Vevo 2100 Imaging System, press **Mode Settings**.
   - If you are on the Vevo Imaging Workstation, click **3D Settings**.

2. Click **Volume**.

3. Ensure that the 3D data is displayed in the Cube view.

4. In the Volume area:
   a. Select **Rotational**.
   b. If you want to assign a custom color to the contours of the volume click **Color**, select the appropriate color from the Color dialog, and then click **OK**.
   c. Click **Start**.

5. To create the first contour, start in the Cube view and then complete the following procedures:
   a. In the active pane use the `< >` tools to step to a slice that is not one of the outer slices of the cube.
   b. Click **Start**.
Chapter 42: Analyzing 3D-Mode images

The system prompts you to set a Rotational Axis. You can set the axis of rotation by clicking once at one end of the axis of rotation and then clicking at the other end.

The axis of rotation should run through entire volume region as shown in the following illustration:

![Set Rotational Axis...](Image)

c. Click to create a point on the circumference of a contour.

d. Trace the contour. The system adds points as you trace.

e. 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 3D Volume 1 -- 001 if this is the first contour of the first volume measurement on the image. The contour color changes from blue to the specified color.

If the position of the trackball cursor is within five pixels of the previous caliper when you right-click, the previously placed caliper is considered to be the last caliper for the measurement. This applies to 3D-Mode polygon measurements and for 3D-Mode volume contours.

f. 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.

The Refine function achieves the best results when the contour is drawn just outside the boundary of the anatomical structure.

![Initial contour](Image) ![Refined contour](Image)
6. Select the preferred rotational segmentation parameters in the Segmentation section of the Volume tool.

   - Set the desired Method of segmentation: Auto or Semi.
   - Set the Angle of rotation. The angle represents the degrees separating each contour. The default value is 18 degrees.
   - Set the Direction of rotation: Clockwise or Counterclockwise, relative to the axis of rotation.
   - If Semi was selected as the method of segmentation, select the Step Num value. This specifies the number of contours the system creates.

7. Click Proceed to draw subsequent contours.

   - If you select the Method Auto the system creates a sufficient number of contours to complete a full rotation around the volume. This completes the segmentation procedure and the volume calculation is displayed in the lower left corner of the cube view.
   - If you select the Method Semi the system creates the number of contours specified in the Step Num setting. Repeat the previous steps until you segment the full volume. Click Finish to complete the segmentation. The volume calculation is displayed in the lower left corner of the cube view.

Parallel segmentation

To create a volume using parallel segmentation:

1. While you analyze your 3D-Mode image, to view the 3D-Mode tools set in the left panel:
   - If you are on the Vevo 2100 Imaging System, press Mode Settings.
   - If you are on the Vevo Imaging Workstation, click 3D Settings.
2. Click **Volume**.

3. Ensure that the 3D data is displayed in the Cube view.

4. In the Volume area:
   a. Select **Parallel**.

   ![Volume Menu](image)

   b. If you want to assign a color to the contours of the volume click **Color**, select the appropriate color from the Color dialog, and then click **OK**.

   c. Click **Start**.

5. To create the first contour, start in the Cube view and then complete the following procedures:
   a. Click to create a point on the circumference of a contour.

   b. Position the cursor to a second point along the intended contour, and then click to set the second point.

   c. Continue creating points, and then right-click the last point, or left-click near the first point to complete the contour.

   The contour is displayed in the Contour List as **3D Volume 1 -- 001** if this is the first contour of the first volume measurement on the image. The contour color changes from blue to the specified color.

   If the position of the trackball cursor is within five pixels of the previous caliper when you right-click, the previously placed caliper is considered to be the last caliper for the measurement. This applies to 3D-Mode polygon measurements and for 3D-Mode volume contours.

   d. 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.

   The Refine function achieves the best results when the contour is drawn just outside the boundary of the anatomical structure.
Chapter 42: Analyzing 3D-Mode images

Initial contour  
Refined contour

6. You can draw subsequent contours can be drawn manually or semi-automatically. Select the preferred parallel segmentation parameters in the Segmentation area of the Volume tool.

   ![Segmentation](image)

   a. Set the Step Size. The default step size is the scan step size.
   b. Set the Direction of segmentation: Inward, Outward, or Both.
   c. Set whether you are going to use manual or semi-automatic segmentation.
      - To use manual segmentation set the Step Num to 1
      - To use semi-automatic segmentation, set the Step Num to a value of two or more.

      When you use semi-automatic segmentation, the system generates the contours automatically. Each contour is refined before the next contour is drawn.
   d. To generate additional contours, click **Proceed**. If you use manual segmentation the system draws and refines the next contour. If you use semi-automatic segmentation the system creates the number of contours you specified in the Step Num field.

   The Contour List displays the second contour as 3D Volume 1 -- 002.

7. Repeat the previous step as necessary until the desired number of contours have been defined, and then click **Finish**.

   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.

**Editing a volume contour**

After you create a volume you can edit one or more of the contours.

- **To modify a contour:**
  
  1. Select the contour in the Contour List.
  2. 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. Click **Refine** to use the edge detection feature to fit the contour in line with the new point.

**To move a contour:**

1. Click between the caliper points on the contour. This selects the entire contour.
2. Drag the contour to the new location.

**Displaying a volume measurement as a 3D object**

**To display a volume measurement as a 3D object:**

1. On the visualization tools tool bar, click the Surface View icon.

   ![Surface View Icon]

   The system compiles a 3D representation of the volume in the Surface view, and then displays the measured volume as a red wire mesh overlay on the three planes.

2. Use the rotate, pan and zoom tools to modify the view of the object.

**Adding generic 3D-Mode measurements**

3D-Mode provides two generic measurement tools. Use these tools when you want to add measurements that aren't part of a measurement protocol.

**Before you begin**

If you want to display the measurement labels and values that you add, select the **Show Values and Labels** option in the Measurement tab of the Preferences window.

**To access the generic measurement tools for 3D-Mode:**

- If you are acquiring 3D-Mode image data, press **Scan/Freeze** and then press **Measure**.
- If you are in the Study Browser, open an image and then press **Measure**.
Chapter 42: Analyzing 3D-Mode images

The system displays the measurement tools at the top of the left panel.

Hover over a tool to see the description label.

Linear distance measurement

Linear distance is measured in \textit{mm}.

\textbf{To place a linear distance measurement:}

1. Click the linear distance measurement button \textbullet.
2. Click on your image to place the initial caliper.
3. Trackball to the location where you want to end your measurement and then click to place the end caliper. If you selected the \textit{Show Values and Labels} option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.
4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

Related information

\begin{itemize}
  \item \textit{Complete procedure for adding a measurement} (page 166)
\end{itemize}

2D Area measurement

2D Area is measured in \textit{mm}^2.

\textbf{To place a 2D area measurement:}

1. Click the 2D area measurement button \textbullet.
2. Click on your image to place the initial caliper.
3. Trackball along the contour of your target tissue and then right-click to place your last caliper.

   If the position of the trackball 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. This feature applies to 2D area measurements in B-Mode, 3D-Mode, and Contrast Mode as well as for 3D-Mode volume contours.

4. The system adds the final line segment to connect your last caliper with your first. If you selected the \textit{Show Values and Labels} option in the Measurements
tab of the Preferences window, the system displays the measurement value and editable label for the measurement.

5. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**

- Complete procedure for adding a measurement (page 166)
Color Doppler Mode imaging and analysis

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

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Chapter 43

**Acquiring Color Doppler Mode images**

This chapter shows you how to acquire Color Doppler Mode images.

**WARNING:** High levels of ultrasound energy can damage tissue. Do not touch the transducer when acoustic power could be generated.

In this chapter

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Control panel controls for Color Doppler Mode.............................................................309
Color Doppler Mode acquisition settings ....................................................................313

**Typical Color Doppler Mode image acquisition session**

**Before you begin**

If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 109).
- Prepare your animal on the animal platform. For detailed information refer to the operator manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 113).

To acquire a Color Doppler Mode image:

1. Press Color. In the image area:
   - The system begins storing cine loop data in the acquisition buffer
   - The system displays the region-of-interest (ROI) box overlay on the B-Mode background image
   - If your transducer is positioned almost parallel over a vessel, the system displays color data in the ROI box

2. To change the size and proportion of the color ROI box:
   a. Press Update. The color ROI box becomes a dashed-line box.
b. Trackball up or down to change the height of the box, or left and right to change the width of the box.

c. Press Update to return to the solid-lined color ROI box.

3. To change the position of the box, trackball to move the color ROI box.

4. Press Presets to cycle through the available presets and then select an appropriate set of optimized image acquisition settings.

5. On the control panel, adjust the Color Doppler Mode controls (page 309) to refine your image acquisition settings if required.

6. Press the Scan/Freeze toggle control to stop the data acquisition so you can review the data in the acquisition buffer.

7. Roll the trackball side to side to scroll through the cine loop.

8. If you are satisfied with the cine loop or an individual image frame, store your image data.

   - To save a cine loop press Cine Store.
   - To save and label a cine loop, press Image Label.
   - To save the displayed image frame press Frame Store.

9. Press Scan/Freeze toggle control to resume scanning.

10. Save images as required.

11. Press Close. The system closes the series you are working on and displays the Study Information window.

12. Complete the required fields to define your study and click OK.

   The Study Browser appears.

You have successfully acquired Color Doppler Mode image data.

Next step

- Adding generic Color Doppler Mode measurements (page 315)
Chapter 43: Acquiring Color Doppler Mode images

Color Doppler Mode window workspace

The Color Doppler Mode window is the workspace you use whenever you view image data in Color Doppler Mode. The following illustration and table describes the information and features in the Color Doppler Mode window.

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Image area export zone.</strong> When you export a stored image and configure your export to send only the <strong>Image Area</strong>, this is the area of the window that the system exports, along with header information.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Image scale.</strong> Indicates in mm the distance from the face of the transducer.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Focus depth.</strong> Indicates the distance from the face of the transducer where the system maximizes image resolutions.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Micro-ultrasound image.</strong> Displays the B-Mode data that the transducer acquires. When you review an image, this is the workspace where you use the image measurement tools to apply your measurements.</td>
</tr>
</tbody>
</table>
### Area Description

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td><strong>Region of interest color box overlay.</strong> The system applies the Color Doppler Mode based colors only to the image data within this box.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Vascular flow moving toward the transducer.</strong> Displayed in red colors.</td>
</tr>
<tr>
<td>7</td>
<td><strong>Vascular flow moving away from the transducer.</strong> Displayed in blue colors.</td>
</tr>
</tbody>
</table>
| 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 from, 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.** Tracks the priority level when you adjust the Priority control. This control adjusts the priority relationship between the overlay data and the background B-Mode data so you can eliminate false readings. For more information see Priority (page 415). |
| 10   | **Physiological data trace window.** Displays your animal's heart rate, temperature, respiration rate and blood pressure data. During data acquisition this information comes from the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station. |
| 11   | **Cine loop range control.** Displays the length of the cine loop range. The triangular white marker identifies the individual frame number within the cine loop. You can drag the left and right vertical markers to display only the image frames in that range. |
| 12   | **Live physiological display.** If the animal is connected to the physiology controller, data appears here in real time during image acquisition and can display the numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature. This area also displays the **image data storage capacity progress bar** so you can see when you should start to back up your image data to free up space on the system. Live physiological data is only active when you enable the inputs in the General tab of the Preferences window. |
| 13   | **Screen keys display**  

- Displays the updated parameter and system information when you make adjustments on the control panel.  
- Displays control options in the mode that you apply during image acquisition when you press the Screen Keys dial.  

In Color Doppler Mode, press the dial to cycle through three image states: Color box overlay + B-Mode, B-Mode only, Color box only. |
Chapter 43: Acquiring Color Doppler Mode images

Area Description

Left panel. Displays a unique set of controls and information sections depending on the control key you press:

- Press **Mode Settings** to set the panel to display the Mode settings. This is the default panel when you open a Mode window.
- Press **Measure** to set the panel to display the measurement tools. These tools are not available when you are acquiring or reviewing images.
- Press **Physio Settings** to set the panel to display the options for a) viewing and manipulating physiological data input from the Advanced Physiological Monitoring Unit and b) manipulating the Respiration Gating and ECG Trigger controls.

For complete information on how each panel works, see *Left panel workspace* (page 47).

Control panel controls for Color Doppler Mode

The following table describes the primary controls you use to optimize the image you see on the screen and reduce color artifacting when you are acquiring Color Doppler Mode image data.
Chapter 43: Acquiring Color Doppler Mode images

1. **Frequency**

Adjusts the transmit frequency of the transducer between the higher and lower frequency levels that are supported by the specific transducer. When you increase the frequency you can improve detail at the focus depth but the system tends to lose detail at deeper tissues.

Push forward to increase the frequency. Pull back to decrease the frequency.

2. **Screen Keys**

Press the dial to cycle through three image states: Color box overlay + B-Mode, B-Mode only, Color box only.

3. **Display Map**

Cycles you through a predefined set of optimization maps that you can apply either while you are acquiring or reviewing image data.

Push up or pull down to cycle through the available maps for the active imaging mode.

4. **Transmit Power**

Adjusts the power of the ultrasound signal transmission.

Turn clockwise to increase power. Turn counterclockwise to decrease power. Between 1% and 10% power the control adjusts power in increments of 1%. Between 10% to 100% power the control adjusts in increments of 10%.

5. **Persist**

Applies a pixel averaging algorithm to the most recently acquired frames to produce a more uniform view of the faster moving areas in the image data.

**To use this rocker switch control:**

Push up or down to cycle through the persistence levels. In the bottom-left corner of the screen the status bar briefly displays the name of the persistence label as you select. In **Color Doppler Mode and Power Doppler Mode**: Applies to the color signal data only. It does not apply to the B-Mode background data. Levels: Off, Low, Med, High, Max. Helpful when you are studying abdominal organ tissue such as liver, kidney and pancreas.
Activates Color Doppler Mode acquisition and begins displaying the color box overlay over the B-Mode background image.

**Doppler Gain**

Adjusts the frequency shift in increments of 1.0 dB. Turn clockwise to add gain and brighten the Doppler data. Turn counterclockwise to reduce gain and darken the data.

**Active during:** PW Doppler Mode, PW Tissue Doppler Mode, Color Doppler Mode, Power Doppler Mode image acquisition sessions.

**Velocity**

Adjusts the PRF (pulse repetition frequency). The higher you set the PRF, the lower the signal resolution.

**SV/Gate**

Push up to increase. Pull back to decrease.

**In Color Doppler Mode:** Adjusts the size of the multiple *sample volumes* that span the depth of the region of interest, indexed in a range from 1-6.

- Set your gate to 1 for the best axial resolution.
- Set your gate to 6 for the best sensitivity.

**Wall Filter**

Filters out signals that correspond to low velocity axial motion. Typically these include vessel wall movement, cardiac wall movement and tissue movement caused by respiration. Push up to filter out more. Pull down to filter out less. **In Color Doppler Mode and Power Doppler Mode:** Set as low as you can so that you don't lose any flow, but higher than any motion that creates low frequency artifacting.
Chapter 43: Acquiring Color Doppler Mode images

**Beam Angle**

Helps you generate flow direction information when the orientation of your target vessel is perpendicular or almost perpendicular to your ultrasound beam.

This control applies a graduated series of transmission and reception delays to the ultrasound sound signals of each crystal in the transducer. These carefully calibrated sequences can effectively steer the ultrasound beam in order to detect minute frequency shifts.

In PW Doppler Mode and PW Tissue Doppler Mode, the current beam angle setting is displayed in the top-left corner of the B-Mode scout image.

In Power Doppler Mode and Color Doppler Mode, this changes the color box.

Active during Color Doppler Mode, Power Doppler Mode, PW Doppler Mode, PW Tissue Doppler Mode imaging sessions.

**To use this rocker switch control:**

Push up or pull down the control depending on the orientation of your transducer to steer the beam angle.

---

**Priority**

Determines the threshold point on the gray scale above which the system does not apply color data. The red marker along the left side of the gray scale indicates the threshold point.

Push up to assign more priority to the color data. Pull down to assign less priority to the color data and more priority to the threshold on the B-Mode grayscale bar.

Useful when you suspect, for example, that color data is covering over the actual contour of a vessel wall. In this case you would lower the priority until the overlay data matches the actual tissue contour and properties.

---

**Baseline**

Adjusts the vertical position of the horizontal zero frequency line (the baseline) that divides the image data coming toward the transducer face from the image data moving away from the transducer face. Push up to raise the line. Pull down to lower the line.
Sensitivity

Adjusts the signal-to-noise ratio so that you can:

- Better identify weak-signal targets in the near field that are difficult to distinguish because they are very small
- Better identify large targets in the far field that are difficult to distinguish because the signal is so attenuated at depth.

The higher you set the sensitivity level, the lower the system sets the frame rate. Push up to increase sensitivity. Pull down to decrease.

Color Doppler Mode acquisition settings

To view the Color Doppler Mode acquisition settings:

Press **Mode Settings**.

The Color Doppler Mode acquisition settings panel displays the following parameters, in addition to labeling the current transducer application and preset:

### Transmit

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>The ultrasound power level of the ultrasound signal, displayed as a percentage of the maximum power. Adjust with the <strong>Transmit Power</strong> control.</td>
</tr>
<tr>
<td>Power</td>
<td>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. Adjust with the <strong>Velocity</strong> control.</td>
</tr>
<tr>
<td>Gate</td>
<td>Number of transmit cycles in the ultrasound pulse. Adjust the value with the <strong>Sensitivity</strong> control. The range of values depends on the transducer. Higher gate values deliver more detail sensitivity, but lower image resolution.</td>
</tr>
</tbody>
</table>

### Acquisition

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doppler Gain</td>
<td>The PW Doppler frequency, measured in dB. Adjust with the <strong>Doppler Gain</strong> control.</td>
</tr>
<tr>
<td>2D Gain</td>
<td>The strength of the ultrasound signal when it returns to the face of the transducer. Range values vary by transducer. Adjust with the <strong>2D Gain</strong> control.</td>
</tr>
<tr>
<td>Frame Rate</td>
<td>The number of image frames per second that the system is acquiring.</td>
</tr>
</tbody>
</table>
### Chapter 43: Acquiring Color Doppler Mode images

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>The width of the acquired image area, measured in mm. Adjust with the Image Width control.</td>
</tr>
<tr>
<td>Beam Angle</td>
<td>The number of degrees of steer to the ultrasound beam so you generate flow direction information when the orientation of your target vessel is perpendicular or almost perpendicular to your ultrasound beam. Adjust with the Beam Angle control.</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>The signal resolution level. Adjust with the Sensitivity control.</td>
</tr>
</tbody>
</table>

### Display

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistence</td>
<td>The state of the Persistence feature: Off, Low, Med, High, Max. Adjust with the Persist control.</td>
</tr>
<tr>
<td>Line Density</td>
<td>The line density level. One of four settings: Quarter, Third, Half, Full. Adjust with the Line Density control.</td>
</tr>
<tr>
<td>Display Map</td>
<td>The selected predefined display map from the predefined set of maps. Adjust with the Display Map control.</td>
</tr>
<tr>
<td>Wall Filter</td>
<td>The level of low velocity signals, measured in Hz, filtered out of the spectral display. Adjust with the Wall Filter control.</td>
</tr>
<tr>
<td>Priority</td>
<td>The threshold level on the B-Mode gray scale, displayed as a percentage, above which the system does not apply color data. Adjust with the Priority control.</td>
</tr>
</tbody>
</table>
Chapter 44

Analyzing Color Doppler Mode images

This chapter shows you how to analyze Color Doppler Mode images that are saved to a study.

In this chapter

Adding generic Color Doppler Mode measurements ....................................................315
Adding protocol measurements........................................................................................318

Adding generic Color Doppler Mode measurements

Color Doppler Mode provides seven generic measurement tools. Use these tools when you want to add measurements that aren't part of a measurement protocol.

Before you begin

If you want to display the measurement labels and values that you add, select the Show Values and Labels option in the Measurement tab of the Preferences window.

To access the generic measurement tools for Color Doppler Mode:

- If you are acquiring Color Doppler Mode image data, press Scan/Freeze and then press Measure.
- If you are in the Study Browser, open an image and then press Measure. The system displays the measurement tools at the top of the left panel.

Hover over a tool to see the description label.

Linear distance measurement

Linear distance is measured in mm.

To place a linear distance measurement:

1. Click the linear distance measurement button .
2. Click on your image to place the initial caliper.

3. Trackball to the location where you want to end your measurement and then click to place the end caliper. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.

4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**

- *Complete procedure for adding a measurement* (page 166)

### Traced distance measurement

Traced distance is measured in *mm*.

**To place a traced distance measurement:**

1. Click the traced distance measurement button.
2. Click on your image to place the initial caliper.
3. Trackball along the contour of your target tissue and then right-click to place the final caliper of your trace. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.
4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**

- *Complete procedure for adding a measurement* (page 166)

### 2D Area measurement

2D Area is measured in *mm²*.

**To place a 2D area measurement:**

1. Click the 2D area measurement button.
2. Click on your image to place the initial caliper.
3. Trackball along the contour of your target tissue and then right-click to place your last caliper.

If the position of the trackball 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. This feature
applies to 2D area measurements in B-Mode, 3D-Mode, and Contrast Mode as well as for 3D-Mode volume contours.

4. The system adds the final line segment to connect your last caliper with your first. If you selected the Show Values and Labels option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.

5. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**
- Complete procedure for adding a measurement (page 166)

### Angle measurement

Angles report interior angle values and are therefore always less than 180 degrees. Angles are measured in deg.

#### To place an angle measurement:

1. Click the angle measurement button.
2. Click on your image to place the initial caliper. This is the outside end of the first ray of your angle.
3. Trackball to where you want to position the vertex of your angle and then click to place the caliper. This completes the first ray.
4. Trackball to the position where you want to end the second ray and then click to place the final caliper. If you selected the Show Values and Labels option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.
5. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**
- Complete procedure for adding a measurement (page 166)

### Time Interval measurement

Time interval is measured in ms.

#### To place a time interval measurement:

1. Click the time interval measurement button. The system highlights the button until you complete your measurement.
2. In the physiology data trace window below the image mode data, click to place the initial caliper.

3. Trackball to the location where you want to place your end caliper and then click to place the caliper. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.

4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**
- *Complete procedure for adding a measurement* (page 166)

---

**Adding protocol measurements**

Protocol measurements are labeled uniquely for a specific measurement protocol.

- **To access the protocol measurement tools and measurements list**
  - If you are in an image acquisition session press `Scan/Freeze` to acquire an image and then press `Measure`.
  - If you are in the Study Browser, open an image and then press `Measure`.

- **To place a protocol measurement:**
  1. In the measurement packages drop-down list click the appropriate package.
  2. In the list of protocols, select the appropriate protocol.
3. In the list of measurements, select the measurement you want to add.

The system automatically activates the appropriate measurement tool and highlights the generic button for that tool.

4. On the image, add your measurement. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.

---

**Next step**

- *Reporting your analysis results* (page 184)

**Related information**

- *Analyzing image data* (page 156)
- *Protocol measurements* (page 167)
Power Doppler Mode imaging and analysis

Power Doppler Mode displays the energy from the returning Doppler signal and assigns a color range to the energy generated by moving blood flow. Power Doppler.

In This Section

Acquiring Power Doppler Mode images ................................................................. 321
Analyzing Power Doppler Mode images .............................................................. 333
Chapter 45

Acquiring Power Doppler Mode images

This chapter shows you how to acquire Power Doppler Mode images.

**WARNING:** High levels of ultrasound energy can damage tissue. Do not touch the transducer when acoustic power could be generated.

In this chapter

Typical Power Doppler Mode image acquisition session .............................................. 321
Typical Power 3D-Mode image acquisition session ....................................................... 323
Power Doppler Mode window workspace...................................................................... 325
Control panel controls for Power Doppler Mode ........................................................... 327
Power Doppler Mode acquisition settings....................................................................... 331

---

**Typical Power Doppler Mode image acquisition session**

**Before you begin**

If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 109).
- Prepare your animal on the animal platform. For detailed information refer to the operator manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 113).

**To acquire a Power Doppler Mode image:**

1. Press **Power**. In the image area:
   - The system begins storing cine loop data in the acquisition buffer
   - The system displays the region-of-interest (ROI) box overlay on the B-Mode background image
   - If your transducer is positioned over a vessel, the system displays color data in the ROI box

2. To change the size and proportion of the color ROI box:
a. Press Update. The color ROI box becomes a dashed-line box.
b. Trackball up or down to change the height of the box, or left and right to change the width of the box.
c. Press Update to return to the solid-lined color ROI box.

3. To change the position of the box, trackball to move the color ROI box.

4. Adjust the Image Width control to remove image content outside the region of interest to optimize the image data for analysis.

5. Press Presets to cycle through the available presets and then select an appropriate set of optimized image acquisition settings.

6. If you need to refine your settings, on the control panel adjust the Power Doppler Mode controls (page 327).

7. Press the Scan/Freeze toggle control to stop the data acquisition so you can review the data in the acquisition buffer.

8. Roll the trackball side to side to scroll through the cine loop.

9. If you are satisfied with the cine loop or an individual image frame, store your image data.
   - To save a cine loop press Cine Store.
   - To save and label a cine loop, press Image Label.
   - To save the displayed image frame press Frame Store.

10. Press Scan/Freeze toggle control to resume scanning.

11. Save images as required.

12. Press Close. The system closes the series you are working on and displays the Study Information window.

13. Complete the required fields to define your study and click OK. The Study Browser appears.

You have successfully acquired Power Doppler Mode image data.

Next step

- Adding generic Power Doppler Mode measurements (page 333)
- Adding protocol measurements (page 168)

Segmentation in Power 3D-Mode

The segmentation feature is the only 3D image analysis tool in the system that can quantify vasculature.
To segment a volume in Power 3D-Mode:

1. Acquire your Power 3D-Mode image.
2. Follow the same procedures for segmenting a volume in 3D-Mode:
   - Create a volume using rotational segmentation (page 296)
   - Create a volume using parallel segmentation (page 298)

The system displays a Percent Vascularity (PV) value below the image. This PV value quantifies the relative percentage of flow or other movement.

3. If you modify the volume click PV Recalc to update the PV value.

Typical Power 3D-Mode image acquisition session

Power 3D-Mode adds Power Doppler Mode data during a 3D-Mode scan so you can reconstruct a volume that integrates the Power Doppler Mode color data with the surrounding B-Mode 3D volume.

To acquire a Power 3D-Mode image:

1. Set up for a 3D-Mode image acquisition session (page 282).
2. Follow the typical steps for a Power Doppler Mode image acquisition (page 321).
3. When you are satisfied with your Power Doppler Mode image, press 3D.
4. Follow the typical steps for a 3D-Mode image acquisition (page 275).
The system acquires the Power 3D-Mode image slices and then displays the data in the 3D-Mode workspace.

Related information

- 3D-Mode visualization tools (page 288)
- Typical 3D-Mode image acquisition session (page 275)
- Typical Contrast 3D-Mode image acquisition session (page 341)
**Power Doppler Mode window workspace**

The Power Doppler Mode window is the workspace you use whenever you view image data in Power Doppler Mode. The following illustration and table describes the information and features in the Power Doppler Mode window.

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Image area export zone.</strong> When you export a stored image and configure your export to send only the <strong>Image Area</strong>, this is the area of the window that the system exports, along with header information.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Image scale.</strong> Indicates in mm the distance from the face of the transducer.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Focus depth.</strong> Indicates the distance from the face of the transducer where the system maximizes image resolutions. When you reposition the ROI power box, the system automatically resets the focal depth to the vertical center of the box.</td>
</tr>
</tbody>
</table>
Chapter 45: Acquiring Power Doppler Mode images

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro-ultrasound image</td>
<td>Displays the B-Mode data that the transducer acquires. When you review an image, this is the workspace where you use the image measurement tools to apply your measurements.</td>
</tr>
<tr>
<td>Power box overlay</td>
<td>The system applies the Power Doppler Mode based colors only to the image data within this region-of-interest box.</td>
</tr>
<tr>
<td>Gray scale and power scale</td>
<td>The right column of the scale is the power scale. The darker colors indicate lower frequency signals. The lighter colors indicate higher frequency signals. The left column of the scale is the gray scale for the B-Mode background image.</td>
</tr>
<tr>
<td>Physiological data trace window</td>
<td>Displays your animal's heart rate, temperature, respiration rate and blood pressure data. During data acquisition this information comes from the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station.</td>
</tr>
<tr>
<td>Cine loop range control</td>
<td>Displays the length of the cine loop range. The triangular white marker identifies the individual frame number within the cine loop. You can drag the left and right vertical markers to display only the image frames in that range.</td>
</tr>
<tr>
<td>Live physiological display</td>
<td>If the animal is connected to the physiology controller, data appears here in real time during image acquisition and can display the numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature. This area also displays the image data storage capacity progress bar so you can see when you should start to back up your image data to free up space on the system. Live physiological data is only active when you enable the inputs in the General tab of the Preferences window.</td>
</tr>
<tr>
<td>Screen keys display</td>
<td>Displays the updated parameter and system information when you make adjustments on the control panel. Displays control options in the mode that you apply during image acquisition when you press the Screen Keys dial.</td>
</tr>
<tr>
<td>Left panel</td>
<td>Displays a unique set of controls and information sections depending on the control key you press: Press <strong>Mode Settings</strong> to set the panel to display the Mode settings. This is the default panel when you open a Mode window. Press <strong>Measure</strong> to set the panel to display the measurement tools. These tools are not available when you are acquiring or reviewing images. Press <strong>Physio Settings</strong> to set the panel to display the options for a) viewing and manipulating physiological data input from the Advanced Physiological Monitoring Unit and b) manipulating the Respiration Gating and ECG Trigger controls. For complete information on how each panel works, see Left panel workspace (page 47).</td>
</tr>
</tbody>
</table>
Control panel controls for Power Doppler Mode

When you are acquiring Power Doppler Mode image data, these are the controls you use to optimize the image you see on the screen.

1. **Frequency**
   
   Adjusts the transmit frequency of the transducer between the higher and lower frequency levels that are supported by the specific transducer. When you increase the frequency you can improve detail at the focus depth but the system tends to lose detail at deeper tissues.
   
   Push forward to increase the frequency. Pull back to decrease the frequency.

2. **Display Map**
   
   Cycles you through a predefined set of optimization maps that you can apply either while you are acquiring or reviewing image data.
   
   Push up or pull down to cycle through the available maps for the active imaging mode.
Chapter 45: Acquiring Power Doppler Mode images

**Transmit Power**

Adjusts the power of the ultrasound signal transmission. Turn clockwise to increase power. Turn counterclockwise to decrease power. Between 1% and 10% power the control adjusts power in increments of 1%. Between 10% to 100% power the control adjusts in increments of 10%.

**Line Density**

Adjusts the resolution of your image by adjusting how many lines of image data the transducer acquires over your image area. Push up to increase the line density. Pull down to decrease.

The higher you set your line density, the lower the system sets the acquisition frame rate. Because of this trade off, you might find that higher line density is most useful for examining features in tissues that don't move very much such as liver, spleen, pancreas, and prostate.

For cardiology applications, you will tend to keep the line density lower so you can increase the frame rate to measure more tissue movements over the time span of a complete cardiac cycle.

**Persist**

Applies a pixel averaging algorithm to the most recently acquired frames to produce a more uniform view of the faster moving areas in the image data.

**To use this rocker switch control:**

Push up or down to cycle through the persistence levels. In the bottom-left corner of the screen the status bar briefly displays the name of the persistence label as you select.

**Dynamic Range**

Adjusts the input signal strength that is mapped into the spectral display. Range: 5-100dB.

- Push up to increase the range by 5dB and lower contrast. Higher dynamic ranges are often used in cardiac imaging.
- Pull down to decrease the range by 5dB and increase contrast. Lower dynamic ranges are often used in abdominal imaging.
Doppler Gain  
Adjusts the frequency shift in increments of 1.0 dB. Turn clockwise to add gain and brighten the Doppler data. Turn counterclockwise to reduce gain and darken the data. 
**Active during:** PW Doppler Mode, PW Tissue Doppler Mode, Color Doppler Mode, Power Doppler Mode image acquisition sessions.

Power  
Activates Power Doppler Mode acquisition and begins displaying the power box overlay over the B-Mode background image.

Velocity  
Adjusts the PRF (pulse repetition frequency).

SV/Gate  
Push up to increase. Pull back to decrease. **In Power Doppler Mode:** Adjusts the size of the gate, indexed in a range from 1-6.
- Set your gate to 1 for the best axial resolution.
- Set your gate to 6 for the best sensitivity.

Wall Filter  
Filters out signals that correspond to low velocity axial motion. Typically these include vessel wall movement, cardiac wall movement and tissue movement caused by respiration. Push up to filter out more. Pull down to filter out less.
Beam Angle

Helps you generate flow direction information when the orientation of your target vessel is perpendicular or almost perpendicular to your ultrasound beam.

This control applies a graduated series of transmission and reception delays to the ultrasound sound signals of each crystal in the transducer. These carefully calibrated sequences can effectively steer the ultrasound beam in order to detect minute frequency shifts.

In PW Doppler Mode and PW Tissue Doppler Mode, the current beam angle setting is displayed in the top-left corner of the B-Mode scout image.

In Power Doppler Mode and Color Doppler Mode, this changes the color box.

Active during Color Doppler Mode, Power Doppler Mode, PW Doppler Mode, PW Tissue Doppler Mode imaging sessions.

**To use this rocker switch control:**

Push up or pull down the control depending on the orientation of your transducer to steer the beam angle.

Priority

Determines the threshold point on the gray scale above which the system does not apply color data. The red marker along the left side of the gray scale indicates the threshold point.

Push up to assign more priority to the color data. Pull down to assign less priority to the color data and more priority to the threshold on the B-Mode grayscale bar.

Useful when you suspect, for example, that color data is covering over the actual contour of a vessel wall. In this case you would lower the priority until the overlay data matches the actual tissue contour and properties.

Sensitivity

Adjusts the signal-to-noise ratio so that you can:

- Better identify weak-signal targets in the near field that are difficult to distinguish because they are very small
- Better identify large targets in the far field that are difficult to distinguish because the signal is so attenuated at depth.

The higher you set the sensitivity level, the lower the system sets the frame rate. Push up to increase sensitivity. Pull down to decrease.
To view the Power Doppler Mode acquisition settings:

Press **Mode Settings**.

The Power Doppler Mode acquisition settings panel displays the following parameters, in addition to labeling the current transducer application and preset:

### Transmit

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<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>The ultrasound frequency, measured in MHz. Adjust with the <strong>Frequency</strong> control.</td>
</tr>
<tr>
<td>Power</td>
<td>The transmission power level of the ultrasound signal, displayed as a percentage of the maximum power. Adjust with the <strong>Transmit Power</strong> control.</td>
</tr>
<tr>
<td>PRF</td>
<td>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. Adjust with the <strong>Velocity</strong> control.</td>
</tr>
<tr>
<td>Gate</td>
<td>Number of transmit cycles in the ultrasound pulse. Adjust the value with the <strong>Sensitivity</strong> control. The range of values depends on the transducer. Higher gate values deliver more detail sensitivity, but lower image resolution.</td>
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</tbody>
</table>

### Acquisition

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<td>Doppler Gain</td>
<td>The strength of the ultrasound signal in dB increments when it returns to the face of the transducer. Adjust with the <strong>Doppler Gain</strong> control.</td>
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<td>The strength of the ultrasound signal when it returns to the face of the transducer. Range values vary by transducer. Adjust with the <strong>2D Gain</strong> control.</td>
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<td>Frame Rate</td>
<td>The number of image frames per second that the system is acquiring.</td>
</tr>
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<td>Width</td>
<td>The width of the acquired image area, measured in mm. Adjust with the <strong>Image Width</strong> control.</td>
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<td>The number of degrees of steer to the ultrasound beam so you generate flow direction information when the orientation of your target vessel is perpendicular or almost perpendicular to your ultrasound beam. Adjust with the <strong>Beam Angle</strong> control.</td>
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<td>The signal resolution level. Adjust with the <strong>Sensitivity</strong> control.</td>
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</tbody>
</table>
## Display

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Range</td>
<td>The contrast of your image, measured in dB. Adjust with the <strong>Dynamic Range</strong> control.</td>
</tr>
<tr>
<td>Persistence</td>
<td>The state of the Persistence feature: Off, Low, Med, High, Max. Adjust with the <strong>Persist</strong> control.</td>
</tr>
<tr>
<td>Line Density</td>
<td>The line density level. One of four settings: Quarter, Third, Half, Full. Adjust with the <strong>Line Density</strong> control.</td>
</tr>
<tr>
<td>Display Map</td>
<td>The selected predefined display map from the predefined set of maps. Adjust with the <strong>Display Map</strong> control.</td>
</tr>
<tr>
<td>Wall Filter</td>
<td>The level of low velocity signals, measured in Hz, filtered out of the spectral display. Adjust with the <strong>Wall Filter</strong> control.</td>
</tr>
<tr>
<td>Priority</td>
<td>The threshold level on the B-Mode gray scale, displayed as a percentage, above which the system does not apply color data. Adjust with the <strong>Priority</strong> control.</td>
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</table>
Chapter 46

Analyzing Power Doppler Mode images

This chapter shows you how to analyze Power Doppler Mode images that are saved to a study.

In this chapter
Adding generic Power Doppler Mode measurements.................................333

Adding generic Power Doppler Mode measurements

Power Doppler Mode provides seven generic measurement tools. Use these tools when you want to add measurements that aren't part of a measurement protocol.

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To access the generic measurement tools for Power Doppler Mode:
- If you are acquiring Power Doppler Mode image data, press Scan/Freeze and then press Measure.
- If you are in the Study Browser, open an image and then press Measure.
  The system displays the measurement tools at the top of the left panel.

  Hover over a tool to see the description label.

Time Interval measurement

Time interval is measured in ms.

To place a time interval measurement:
1. Click the time interval measurement button . The system highlights the button until you complete your measurement.
2. In the physiology data trace window below the image mode data, click to place the initial caliper.

3. Trackball to the location where you want to place your end caliper and then click to place the caliper.

4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**

- Complete procedure for adding a measurement (page 166)

### Linear distance measurement

Linear distance is measured in **mm**.

#### To place a linear distance measurement:

1. Click the linear distance measurement button.
2. Click on your image to place the initial caliper.
3. Trackball to the location where you want to end your measurement and then click to place the end caliper. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.
4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**

- Complete procedure for adding a measurement (page 166)

### Traced distance measurement

Traced distance is measured in **mm**.

#### To place a traced distance measurement:

1. Click the traced distance measurement button.
2. Click on your image to place the initial caliper.
3. Trackball along the contour of your target tissue and then right-click to place the final caliper of your trace. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.
4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.
Related information

- Complete procedure for adding a measurement (page 166)

2D Area measurement

2D Area is measured in \( \text{mm}^2 \).

To place a 2D area measurement:

1. Click the 2D area measurement button \( \square \).
2. Click on your image to place the initial caliper.
3. Trackball along the contour of your target tissue and then right-click to place your last caliper.

   If the position of the trackball 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. This feature applies to 2D area measurements in B-Mode, 3D-Mode, and Contrast Mode as well as for 3D-Mode volume contours.

4. The system adds the final line segment to connect your last caliper with your first. If you selected the Show Values and Labels option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.

5. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

Related information

- Complete procedure for adding a measurement (page 166)

Angle measurement

Angles report interior angle values and are therefore always less than 180 degrees. Angles are measured in \( \text{deg} \).

To place an angle measurement:

1. Click the angle measurement button \( \angle \).
2. Click on your image to place the initial caliper. This is the outside end of the first ray of your angle.
3. Trackball to where you want to position the vertex of your angle and then click to place the caliper. This completes the first ray.
4. Trackball to the position where you want to end the second ray and then click to place the final caliper. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.

5. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**

- Complete procedure for adding a measurement (page 166)
Contrast Mode imaging and analysis

Contrast Mode imaging provides tools to detect and quantify vascular structures and dynamics at the molecular level.

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

- 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

In This Section

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Analyzing Contrast Mode images ............................................................. 352
Chapter 47

Acquiring Contrast Mode images

This chapter shows you how to acquire Contrast Mode images.

WARNING: High levels of ultrasound energy can damage tissue. Do not touch the transducer when acoustic power could be generated.

In this chapter
Typical Contrast Mode image acquisition session..........................................................338
Typical Contrast 3D-Mode image acquisition.................................................................341
Contrast Mode window workspace..................................................................................343
Control panel controls for Contrast Mode.......................................................................345
Contrast Mode acquisition settings...................................................................................347
Contrast agent technology .................................................................................................348
Displaying contrast agents as an overlay.........................................................................348
Adjusting the contrast overlay display ............................................................................350

Typical Contrast Mode image acquisition session

Before you begin
If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 109).
- Prepare your animal on the animal platform. For detailed information refer to the operator manual for your Vevo Imaging Station.
- For blood pressure setup, see Blood Pressure section (page 113).

Inject the contrast agent. Refer to the appropriate VisualSonics Application Protocol document for more information.

To manually create a typical Contrast Mode bolus injection cine loop:

1. Press \text{Contrast} and begin acquiring image data.
2. Position the transducer and locate your region of interest.
3. Acquire 100 to 200 frames of data and then save and label the cine loop as Baseline.
4. Press Pre Trigger and inject the contrast agent. If you selected Auto SAVE on Scan Completion for Contrast Mode in the General tab of the Preferences window the system saves the cine loop when the acquisition ends.

You have created a cine loop of the bolus injection.

To automatically create a contrast agent destruction cine loop:

1. Press Contrast and begin acquiring image data.
2. Position the transducer and locate your region of interest.
3. Inject the contrast agent according to your protocol and then press Image Sequence.

The system completes an automated sequence of actions based on the configuration you define in the Contrast Mode (page 74) section in the General tab of the Preferences window:

a. The system acquires data for a set portion of the default cine loop length as you inject the contrast agent.

b. The transducer transmits a single ultrasound pulse at maximum setting for a short specified period. This destroys the contrast agent in the region of interest.

c. The system acquires data for the remainder of the cine loop.

4. Press Cine Store.
Chapter 47: Acquiring Contrast Mode images

You have successfully acquired the contrast data that the system can work with to isolate the contrast agent ultrasound signal data from the tissue ultrasound signal data.

The contrast overlay data is created by comparing the baseline data acquired before the injection of the contrast agent with the data acquired after the injection. This, in theory, isolates only the signal from the contrast agent.

To create the reference set:

1. If the cine loop is playing, press Cine Loop Review to stop the playback.
2. Use the cine loop range controls under the cine loop bar to bracket a reference period in the cine loop before the burst destruction event.

Note: The reference can be no longer than 500 frames.

3. In the left panel click Create Reference.
   
   A progress bar appears as the system creates the reference data set.

4. Load the cine loop to be processed.

5. Click Process Cine.

   A progress bar appears as the system compares the reference set to the full cine loop to calculate the intensity markers that represent contrast agent.

To manually create a contrast agent destruction cine loop:

1. Press Contrast and begin acquiring image data.
2. Position the transducer and locate your region of interest.
3. Inject the contrast agent according to your protocol and then press Burst.
The transducer transmits a single ultrasound pulse burst at maximum setting for the period defined in the Contrast Mode preferences.

4. Press **Cine Store**.

**Next steps**

- *Displaying contrast agents as an overlay* (page 348)
- *Adjusting the contrast overlay display* (page 350)

**Related information:**

- *Typical B-Mode image acquisition session* (page 190)

---

**Typical Contrast 3D-Mode image acquisition**

Contrast 3D-Mode adds Contrast Mode scan data during a 3D-Mode scan so you can reconstruct a volume that integrates the Contrast Mode data with the surrounding B-Mode 3D volume.

#### To acquire a Contrast 3D-Mode image:

1. Set up for a 3D-Mode image acquisition session (page 282).
2. Press **Contrast**.
3. Complete the 3D motor stage initialization process and 3D acquisition setup process as detailed in *Typical 3D-Mode image acquisition session* (page 275) and click **Scan**.
   
   The system acquires image slices across the motor stage track and combines them into a cine loop. Unlike a typical cine loop which contains slices along the same image plane over time, this cine loop contains a series of individual slices at different locations as the motor stage moves along its track.

4. Inject the microbubbles according to the specified protocol and then press **3D**.
5. Press **Cine Store** to save the Contrast 3D-Mode image data.
6. Press **3D**.
   
   The system acquires image slices at exactly the same step positions.

7. Click **Destroy 3D**.
   
   The system stops acquiring data and runs the destruction level ultrasound burst at each step along the the motor stage track and then returns the motor stage to the initial position.

8. Press **3D** to acquire post-destruction image data.
9. Press \textit{Cine Store}.
10. Click \textit{Create Reference}.
11. Press \textit{Study Management} and then open the first Contrast Mode cine loop you acquired before you ran the destruction sequence.
12. Click \textit{Process Cine}.

   The system generates the green contrast overlay data.
13. Click \textit{Load into 3D}.

   The system generates the Contrast 3D-Mode data and opens the image in the four-pane \textit{Contrast 3D-Mode} window.
14. Review and manipulate the Contrast 3D Mode image data using the standard 3D-Mode image analysis tools (page 288).

\textbf{Related information}

- 3D-Mode visualization tools (page 288)
- Typical Contrast Mode image acquisition session (page 338)
- Typical 3D-Mode image acquisition session (page 275)
- Typical Power 3D-Mode image acquisition session (page 323)
Chapter 47: Acquiring Contrast Mode images

Contrast Mode window workspace

The Contrast Mode window is the workspace you use whenever you view image data in Contrast Mode. The following illustration and table describes the information and features in the Contrast Mode window.

---

### Area Description

1. **Image area export zone.** When you export a stored image and configure your export to send only the Image Area, this is the area of the window that the system exports, along with header information.

2. **Image scale.** Indicates in mm the distance from the face of the transducer.

3. **Focus depth.** Indicates the distance from the face of the transducer where the system maximizes image resolutions.

4. **Micro-ultrasound image.** Displays the B-Mode data that the transducer acquires. When you review an image, this is the workspace where you use the image measurement tools to apply your measurements.
Chapter 47: Acquiring Contrast Mode images

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td><strong>Orientation icon.</strong> Indicates the position of the orientation ridge of your transducer in relation to your image. If the image orientation looks backward to you, click this icon to flip the image view left/right.</td>
</tr>
<tr>
<td>6.</td>
<td><strong>Green scale and gray scale.</strong> The left column of the scale is the green scale. It indicates the dynamic range of the contrast intensity. The right column of the scale is the gray scale for the B-Mode background image.</td>
</tr>
<tr>
<td>7.</td>
<td><strong>Physiological data trace window.</strong> Displays your animal's heart rate, temperature, respiration rate and blood pressure data. During data acquisition this information comes from the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station.</td>
</tr>
<tr>
<td>8.</td>
<td><strong>Cine loop range control.</strong> Displays the length of the cine loop range. The triangular white marker identifies the individual frame number within the cine loop. You can drag the left and right vertical markers to display only the image frames in that range.</td>
</tr>
<tr>
<td>9.</td>
<td><strong>Live physiological data values.</strong> Displays the recorded numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature.</td>
</tr>
<tr>
<td>10.</td>
<td><strong>Live physiological display.</strong> If the animal is connected to the physiology controller, data appears here in real time during image acquisition and can display the numeric values of the animal's heart rate, respiration rate, blood pressure and body temperature. This area also displays the image data storage capacity progress bar so you can see when you should start to back up your image data to free up space on the system. Live physiological data is only active when you enable the inputs in the General tab of the Preferences window.</td>
</tr>
<tr>
<td>11.</td>
<td><strong>Screen keys display</strong></td>
</tr>
<tr>
<td></td>
<td>- Displays the updated parameter and system information when you make adjustments on the control panel.</td>
</tr>
<tr>
<td></td>
<td>- Displays control options in the mode that you apply during image acquisition when you press the Screen Keys dial.</td>
</tr>
<tr>
<td>12.</td>
<td><strong>Left panel.</strong> Displays a unique set of controls and information sections depending on the control key you press:</td>
</tr>
<tr>
<td></td>
<td>- Press <strong>Mode Settings</strong> to set the panel to display the Mode settings. This is the default panel when you open a Mode window.</td>
</tr>
<tr>
<td></td>
<td>- Press <strong>Measure</strong> to set the panel to display the measurement tools. These tools are not available when you are acquiring or reviewing images.</td>
</tr>
<tr>
<td></td>
<td>- Press <strong>Physio Settings</strong> to set the panel to display the options for a) viewing and manipulating physiological data input from the Advanced Physiological Monitoring Unit and b) manipulating the Respiration Gating and ECG Trigger controls.</td>
</tr>
</tbody>
</table>

For complete information on how each panel works, see *Left panel workspace* (page 47). |

| 13. | **Mode settings.** Read-only. |
### Contrast acquisition tools

<table>
<thead>
<tr>
<th>Tool</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create Reference</td>
<td>Processes the data reference set that is defined by the length of the cine range.</td>
</tr>
<tr>
<td>Contrast DR</td>
<td>Displays the intensity level of the green overlay.</td>
</tr>
<tr>
<td>Threshold</td>
<td>Eliminates overlay data that is not relevant to your contrast agent by specifying the level at which the system displays no contrast image data.</td>
</tr>
<tr>
<td>Process Cine</td>
<td>Creates the contrast overlay.</td>
</tr>
</tbody>
</table>

### Control panel controls for Contrast Mode

Contrast Mode imaging is based on B-Mode data.

- Use the control panel controls for B-Mode (page 194) to optimize the B-Mode image while you work with the contrast agent.
- Use the highlighted controls in the following control panel diagram when you are completing a typical Contrast Mode imaging session (page 338).
Chapter 47: Acquiring Contrast Mode images

1. **Burst**

Transmits an ultrasound pulse at maximum setting. This destroys the contrast agent in the region of interest. In the cine loop the system displays a vertical green bar to mark the destruction event.

2. **Pre Trigger**

In Contrast Mode, starts an analysis based on the number of frames defined in the General tab of the Preferences window.

Stores cine loop data for a predefined number of image frames acquired after you press the control, as compared to **Cine Store** which stores data acquired before you press the control. To ensure that the system stores your cine loop, select the **Auto SAVE at Scan Completion** option in the General tab of the Preferences window.

3. **Image Sequence**

In Contrast Mode this control starts a sequence of configurable events. When you press the control:

1. The system begins to store image data for the predefined number of frames in the cine loop, as configured in the **Contrast Mode** preferences (page 74) section of the General tab in the Preferences window.

2. The destruction burst event (page 407) runs automatically:
   - Using a) the transducer that you connect to the front panel of the Vevo 2100 Imaging System, or using b) the external Vevo SoniGene transducer that you connect to the **Parallel** port on the rear panel of the cart
   - At a predefined percentage point of the entire pretrigger cine loop length
   - For a predefined period in tenths of seconds between 0.1 and 1.0 seconds (defaults to 0.5)

3. The system continues to acquire image data for the remainder of the predefined cine loop size, but the image is not automatically stored when the loop is completed unless you select **Auto SAVE on Scan Completion** for **Contrast Mode** in the General tab of the Preferences window.

**To configure the control for Contrast Mode:**

- In the **Cine Loop Size** section (page 71) of the General tab in the Preferences window configure the size of the cine loop.
- In the Contrast Mode preferences section (page 74) of the General tab in the Preferences window configure the parameters for the destruction sequence.
Chapter 47: Acquiring Contrast Mode images

Contrast Mode acquisition settings

To view the Contrast Mode acquisition settings:
Press Mode Settings.

The Contrast Mode acquisition settings panel displays the following parameters, in addition to labeling the current transducer application and preset:

<table>
<thead>
<tr>
<th>Transmit Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>The ultrasound frequency, measured in MHz. Adjust with the Frequency control.</td>
</tr>
<tr>
<td>Power</td>
<td>The transmission power level of the ultrasound signal, displayed as a percentage of the maximum power. Adjust with the Transmit Power control.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acquisition Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain</td>
<td>The strength of the ultrasound signal in dB increments when it returns to the face of the transducer. Adjust with the 2D Gain control.</td>
</tr>
<tr>
<td>Frame Rate</td>
<td>The number of image frames per second that the system is acquiring.</td>
</tr>
<tr>
<td>Depth</td>
<td>The distance, measured in mm, from the face of the transducer. Adjust with the Image Depth control.</td>
</tr>
<tr>
<td>Width</td>
<td>The width of the acquired image area, measured in mm. Adjust with the Image Width control.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Display Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Range</td>
<td>The contrast of your image, measured in dB. Adjust with the Dynamic Range control.</td>
</tr>
<tr>
<td>Persistence</td>
<td>The state of the Persistence feature: Off, Low, Med, High, Max. Adjust with the Persist control.</td>
</tr>
<tr>
<td>Line Density</td>
<td>The line density level. One of four settings: Quarter, Third, Half, Full. Adjust with the Line Density control.</td>
</tr>
<tr>
<td>Display Map</td>
<td>The selected predefined display map from the predefined set of maps. Adjust with the Display Map control.</td>
</tr>
</tbody>
</table>
Contrast Mode imaging requires the use of contrast agents. Contrast agents are gas-filled microbubbles that produce a strong echogenic signal when excited with an ultrasound pulse.

VisualSonics provides a family of contrast agent kits for targeted and non-targeted applications.

Non-targeted contrast agents

Non-targeted contrast agents are injected into the vascular system either via a small bolus or a continuous infusion using a syringe pump.

The contrast agents are free flowing in the vascular system for a period of time until they are either destroyed with a high-powered ultrasound sequence or are cleared through the system via the kidney or the liver.

Targeted contrast agents

Targeted contrast agents are microbubbles similar to those used in untargeted applications, but are conjugated with a ligand that will bind to specific molecular markers.

A targeted contrast agent flows freely through the vascular system until it finds the specific receptor. At this time it binds to the molecular marker on the endothelial surface of the vessel and will no longer flow freely.

An ultrasound image of a region with bound contrast agents displays the strong echogenic signal provided by the contrast agent.

Displaying contrast agents as an overlay

Before you begin

Acquire your contrast data:

- Typical Contrast Mode image acquisition session (page 338)
- Typical Contrast 3D-Mode image acquisition session (page 341)

To display the contrast data as an overlay using the control panel:

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.
Chapter 47: Acquiring Contrast Mode images

2. Drag the frame indicator into the range of frames after the vertical green bar which identifies the destruction burst event.

3. Turn Screen Keys until Display Color appears in the control panel feedback display.

4. Press Screen Keys to cycle through the following display options:
   - Contrast overlay only
   - B-Mode image only
   - Contrast overlay and B-Mode image

To display the contrast data as an overlay using the workstation:

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 icon and cycle through the following display options:
   - Contrast overlay only
Chapter 47: Acquiring Contrast Mode images

- B-Mode image only
- Contrast overlay and B-Mode image

Related information
- Adjusting the contrast overlay display (page 350)
- Image Sequence (page 412)

Adjusting the contrast overlay display

You can modify the amount and intensity of the contrast green overlay data in three ways:

- Adjust the process persistence filter
- Adjust the contrast overlay dynamic range
- Adjust the contrast overlay data threshold

Adjusting the contrast processing filter

Process filtering adjusts the amount of contrast data the system acquires when you process the cine loop that includes your reference set.

To modify the process persistence setting:

1. In the Process box, select one of the following four options:

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Default. No additional filters are applied.</td>
</tr>
<tr>
<td>Smooth</td>
<td>Applies frame-to-frame averaging. Helpful when you want to remove transient bubble data from the image.</td>
</tr>
<tr>
<td>MIP</td>
<td>Applies a maximum intensity persistence to the images. Helpful when you want to trace bubble paths in vessel structures.</td>
</tr>
<tr>
<td>Cardiac</td>
<td>Applies a stronger filter. Helpful when you want to study fast moving cardiac structures.</td>
</tr>
</tbody>
</table>

2. Click Process Cine. The system applies the selected Process filter as it processes the contrast data in the cine loop.

3. Ensure the cine loop range control extends the full length of the cine loop and then review the post-destruction burst frames to see the result.
**Adjusting the contrast dynamic range**

Contrast DR is a dynamic range control that modifies the intensity of the contrast data overlay. You can set the value from 5dB-50dB. The lower you set the dynamic range, the more intense the contrast data appears.

**To adjust the contrast overlay dynamic range:**

1. In the Contrast DR slider control, drag or click in the range bar to coarsely set your contrast.
2. Click the – or + controls to fine tune the parameter by increments of 1dB.

**Adjusting the threshold**

The Threshold control sets the threshold at which the system displays no contrast image data. You can set the threshold in a range between 1% and 100%.

As shown in the following example, the lower you set the threshold, the more contrast image data you display.

![Contrast Mode images with different thresholds](image)

**To adjust the contrast overlay data threshold:**

1. In the Threshold slider control, drag or click in the range bar to coarsely set your threshold.
2. Click the – or + controls to fine tune the parameter by increments of 1%.

**Related information**

- Typical Contrast Mode image acquisition session (page 338)
Chapter 48

Analyzing Contrast Mode images

This chapter shows you how to analyze Contrast Mode images that are saved to a study.

In this chapter
Adding generic Contrast Mode measurements ..............................................................352

Adding generic Contrast Mode measurements

Contrast Mode provides seven generic measurement tools. Use these tools when you want to add measurements that aren't part of a measurement protocol.

Before you begin
If you want to display the measurement labels and values that you add, select the Show Values and Labels option in the Measurement tab of the Preferences window.

To access the generic measurement tools for Contrast Mode:

- If you are acquiring Contrast Mode image data, press Scan/Freeze and then press Measure.
- If you are in the Study Browser, open an image and then press Measure.

The system displays the measurement tools at the top of the left panel.

Time Interval measurement

Time interval is measured in ms.

To place a time interval measurement:

1. Click the time interval measurement button ⏳. The system highlights the button until you complete your measurement.
2. In the physiology data trace window below the image mode data, click to place the initial caliper.

3. Trackball to the location where you want to place your end caliper and then click to place the caliper.

4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**

- Complete procedure for adding a measurement (page 166)

---

**Traced distance measurement**

Traced distance is measured in \( \text{mm} \).

**To place a traced distance measurement:**

1. Click the traced distance measurement button \( \text{\image{distance}} \).
2. Click on your image to place the initial caliper.
3. Trackball along the contour of your target tissue and then right-click to place the final caliper of your trace. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.
4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**

- Complete procedure for adding a measurement (page 166)

---

**Linear distance measurement**

Linear distance is measured in \( \text{mm} \).

**To place a linear distance measurement:**

1. Click the linear distance measurement button \( \text{\image{distance}} \).
2. Click on your image to place the initial caliper.
3. Trackball to the location where you want to end your measurement and then click to place the end caliper. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.
4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.
Chapter 48: Analyzing Contrast Mode images

Related information

- Complete procedure for adding a measurement (page 166)

2D Area measurement

2D Area is measured in $\text{mm}^2$.

To place a 2D area measurement:

1. Click the 2D area measurement button.
2. Click on your image to place the initial caliper.
3. Trackball along the contour of your target tissue and then right-click to place your last caliper.
   
   If the position of the trackball 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. This feature applies to 2D area measurements in B-Mode, 3D-Mode, and Contrast Mode as well as for 3D-Mode volume contours.
4. The system adds the final line segment to connect your last caliper with your first. If you selected the Show Values and Labels option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.
5. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

Related information

- Complete procedure for adding a measurement (page 166)

Mean and standard deviations

For Contrast Mode images you can:

- Measure the mean and standard deviation of gray levels for area measurements
- View a histogram of a selected Contrast Mode ROI measurement.

To create the mean and standard deviations 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 and standard deviation values to the right of the histogram.

![Histogram Image]

The blue indicator on the gray scale indicates the mean gray level. The green indicators on the gray scale indicate the standard deviation for the gray level.

**To export an image of the histogram plot:**

1. Click Export.
2. In the Presets Export window:
   a. In the browse window, browse to the directory location where you want to export the file and select that directory.
   b. In the Options area, select the file type.
   c. In the Save As box, if you want to create a unique file name, type the name.
3. Click OK.

**Angle measurement**

Angles report interior angle values and are therefore always less than 180 degrees.

Angles are measured in deg.

**To place an angle measurement:**

1. Click the angle measurement button 

---

The blue indicator on the gray scale indicates the mean gray level. The green indicators on the gray scale indicate the standard deviation for the gray level.
2. Click on your image to place the initial caliper. This is the outside end of the first ray of your angle.

3. Trackball to where you want to position the vertex of your angle and then click to place the caliper. This completes the first ray.

4. Trackball to the position where you want to end the second ray and then click to place the final caliper. If you selected the **Show Values and Labels** option in the Measurements tab of the Preferences window, the system displays the measurement value and editable label for the measurement.

5. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

**Related information**

- **Complete procedure for adding a measurement** (page 166)

**Contrast region measurement**

The contrast region measurement traces a region of interest in a Contrast Mode frame. The system then measures the total area of the defined contrast region.

**To place a contrast region measurement:**

1. Click the contrast region measurement button.

2. Click on your image to place the initial caliper.

3. Click to place individual points around the region to create the contour of your target tissue and then right-click to place your last caliper.

The system adds the final line segment to connect your last caliper with your first.

4. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

5. Modify the points on your contour (page 171), or modify the contour (page 172) as required.
Chapter 48: Analyzing Contrast Mode images

Copying and pasting a contrast region

- **To copy and paste a region:**
  1. Right-click the contour and select **Copy Region**.
  2. Right-click in another cine loop and click **Paste Region**.
     The copied region replaces the existing region.
  3. On a cine loop that does not contain a contour, right click anywhere on the image and select **Paste Contrast Region**.
     The copied region is added to the loop, with its original coordinates.

  **Note:** You can also paste a copied contrast region to the same image and then move it to a different location.

Creating a contrast region analysis chart

The contrast region analysis graph plots the contrast intensity data of a contrast region over the course of a complete cine loop.

- **To chart the contrast region data:**
  1. On the Contrast Mode image, right-click the contour or the image label and select **Region Graph**.
2. The system calculates the contrast intensity within the boundaries of the region curve and displays the data in the **Contrast Region Analysis** window.

To export the contrast region analysis:

1. Click **Export**.

   The **Export Contrast Region** window appears.

2. In the folder browser, browse to the location where you want to export your data and select the folder.

3. In the **Options** section, select the file type(s) you want to export (CSV, BMP, TIFF) and in the **Save As** box, type the name of your report.

4. Click **OK**.

5. The system exports the analysis report for the image you are viewing.

**Working with data in the contrast region analysis chart**

The contrast region analysis chart provides four sets of controls located to the right of the chart:

- **Display Options**
- Chart Y Axis
- Chart X Axis
- Calculation

Use these controls to achieve different views of the contrast intensity data.

## Display Options

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draw Average Line</td>
<td>Draws a moving average line through the data points.</td>
</tr>
<tr>
<td>Frames</td>
<td>Sets the number of frames over which to complete the average. Select from 2, 4, 8, 16, 32</td>
</tr>
<tr>
<td>Draw Markers</td>
<td>Draws markers on the actual data points.</td>
</tr>
<tr>
<td>Draw Destroy Line</td>
<td>Displays a vertical red line at the frame number at which the destruction event occurred, if the event did occur.</td>
</tr>
</tbody>
</table>
Chapter 48: Analyzing Contrast Mode images

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curve Fitting</td>
<td>Calculates and plots a perfusion curve based on the following formula*:</td>
</tr>
<tr>
<td></td>
<td>$y = C + A \left( 1 - e^{B \left( t - t_0 \right)} \right)$, where:</td>
</tr>
<tr>
<td></td>
<td>$y =$ Contrast signal (pixel intensity)</td>
</tr>
<tr>
<td></td>
<td>$A =$ Peak of curve</td>
</tr>
<tr>
<td></td>
<td>$B =$ Slope of the curve</td>
</tr>
<tr>
<td></td>
<td>$C =$ Contrast signal offset</td>
</tr>
<tr>
<td></td>
<td>$t =$ Time</td>
</tr>
<tr>
<td></td>
<td>$t_0 =$ Time offset</td>
</tr>
</tbody>
</table>

To create the curve:

1. Click **Start Curve Fitting** and select a data point on the graph at the transition from the base line to the perfusion period.

2. Click a data point where the data begins to plateau and then click **Finish Curve Fitting**.

   The system calculates and plots the red perfusion curve.

3. Click **Export** and export the data as an image or as a CSV file for further analysis.

* Wei, 1998, *Quantification of Myocardial Blood Flow With Ultrasound-Induced Destruction of Microbubbles Administered as a Constant Venous Infusion.*

Chart Y Axis

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contrast</td>
<td>Select to plot the contrast intensity information from the contrast data, and to make the Percent Area controls and the Calculation controls available.</td>
</tr>
<tr>
<td>B-Mode</td>
<td>Select to plot the grayscale intensity data from the B-Mode image.</td>
</tr>
<tr>
<td>Auto Scale</td>
<td>Select to view a system-calculated best-fit scale value.</td>
</tr>
<tr>
<td>Scale Max</td>
<td>Type a scale value between 0-100,000.</td>
</tr>
</tbody>
</table>
Chart X Axis

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Select to scale the length of the cine loop in second increments.</td>
</tr>
<tr>
<td>Frame Number</td>
<td>Select to scale the length of the cine loop in single frame increments.</td>
</tr>
</tbody>
</table>

Calculation

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>Sets the Y axis to B-Mode mean power (linear a.u.)</td>
</tr>
<tr>
<td>Amplitude</td>
<td>Sets the Y axis to B-Mode mean amplitude (linear a.u.)</td>
</tr>
</tbody>
</table>

Exporting Contrast Mode data

To export contrast region data:

1. From the Contrast Region or Cardiac Region chart window, click Export.
2. In the export dialog box, select the destination directory, name the file, select the file type, and click Save.

The data can be saved as one of the following file types:

- **CSV** Comma separated values, for import into a database or spreadsheet.
- **TIFF** Vector based graphic.
- **BMP** Bitmap graphic.

Cardiac region measurement

The Cardiac Region measurement traces a region of interest in a 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 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. You don't need to add these points in a particular direction, the way you should when you add the first three points.
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.

The system adds the measurement label on the image and adds the measurement to the **Measured Values** section at the bottom of the left panel.

6. If you need to move the entire measurement, click on a measurement line and then drag and drop it.

*To automatically apply cardiac region contours to sequential frames in a cine loop:*

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 your first three caliper points for every contour in the same direction. For example if you start out adding your first three points for the outer wall in a clockwise direction, add your points for the inner wall in a clockwise direction also.

2. In your 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 your 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 system:

a. Calculates and creates cardiac region contours for the half-cardiac cycle frames between the maximum diastole and systole points you measured.

b. Plays the cine loop forward or reverse and applies the calculated contours to each individual frame.

<table>
<thead>
<tr>
<th>Direction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replicate Forward 1 Cycle</td>
<td>Starts from the end of your half cardiac cycle and applies the system-calculated contours to the next cardiac cycle.</td>
</tr>
<tr>
<td>Replicate Reverse 1 Cycle</td>
<td>Starts from the start of your half cardiac cycle and applies the system-calculated contours to the previous cardiac cycle.</td>
</tr>
</tbody>
</table>

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 your contour to view the results.
Creating a cardiac region analysis chart
The contrast region line graph plots the contrast intensity data of a contrast region over the course of a complete cine loop.

To chart the cardiac region data:

1. On the Contrast Mode image, right-click the contour or the image label and select Region Graph.
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 data in the cardiac region analysis chart
The cardiac region analysis chart provides four analysis features located to the right of the chart:

- Display Options
- Chart Y Axis
- Calculation
- Radius Guide

Use these controls to analyze the views of the contrast intensity data.
### Display Options

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draw Average</td>
<td>Draws a moving average line through the data points.</td>
</tr>
<tr>
<td>Plot Frame</td>
<td>Specify the frame to draw if the Draw Average check box is cleared.</td>
</tr>
</tbody>
</table>

### Chart Y Axis

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contrast</td>
<td>Plots the contrast intensity information from the contrast data.</td>
</tr>
<tr>
<td>B-Mode</td>
<td>Plots the grayscale intensity data from the B-Mode image.</td>
</tr>
<tr>
<td>Auto Scale</td>
<td>View a system-calculated best-fit scale value.</td>
</tr>
<tr>
<td>Scale Max</td>
<td>Type a volume value to redraw the graph such that the scale is drawn from 0 to the value you typed in.</td>
</tr>
</tbody>
</table>

### Calculation

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>Sets the Y axis to B-Mode mean power (linear a.u.)</td>
</tr>
<tr>
<td>Amplitude</td>
<td>Sets the Y axis to B-Mode mean amplitude (linear a.u.)</td>
</tr>
</tbody>
</table>

### Radius Guide

The X axis **Angle (deg)** on the chart represents a flattened ellipse that surrounds the short axis view. The radius guide helps you orient the plotted values by illustrating how they correspond to sites within this short axis view.

For example, a point on the graph at the 225 mark on the x-axis corresponds to a site along the 225 degree radius inside the guide.
Appendixes

This section includes the following reference content.

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Descriptions of control panel controls ................................................. 406
Options and accessories ..................................................................... 422
Product safety testing and electrical testing ........................................... 427
Safety .................................................................................................... 429
Specifications ...................................................................................... 435
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Appendix A

Measurement package protocols

This appendix details the measurement and calculation definitions for each measurement package that is available with the Vevo 2100 Imaging System.

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Abdominal Measurement Package

This section provides the measurements and calculations information for the protocols in the Abdominal measurement package.

Liver protocol

Measurement definitions

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
<th>Units</th>
<th>Generic type</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver Sagg</td>
<td>Sagittal length</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>Liver Trans</td>
<td>Transverse length</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>Hepatic Vel</td>
<td>Hepatic vein velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>Hepatic Diam</td>
<td>Hepatic vein diameter</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>Hepatic Diam</td>
<td>Hepatic vein diameter</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
</tr>
<tr>
<td>RHV Vel</td>
<td>Right hepatic vein velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>RHV Diam</td>
<td>Right hepatic vein diameter</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>RHV Diam</td>
<td>Right hepatic vein diameter</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
</tr>
<tr>
<td>LHV Vel</td>
<td>Left hepatic vein velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>LHV Diam</td>
<td>Left hepatic vein diameter</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>LHV Diam</td>
<td>Left hepatic vein diameter</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
</tr>
<tr>
<td>CHA Vel</td>
<td>Common hepatic artery velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
</tbody>
</table>
### Spleen protocol

#### Measurement definitions

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
<th>Units</th>
<th>Generic type</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spleen Sagg</td>
<td>Sagittal length</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>Spleen Transverse</td>
<td>Transverse length</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>Splenic Artery Vel</td>
<td>Splenic artery velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>Splenic Artery Diam</td>
<td>Splenic artery diameter</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>Splenic Artery Diam</td>
<td>Splenic artery diameter</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
</tr>
</tbody>
</table>
Appendix A: Measurement package protocols

Gallbladder protocol

Measurement definitions

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
<th>Units</th>
<th>Generic type</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>GB Sag</td>
<td>Gallbladder sagittal length</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>GB Trans</td>
<td>Gallbladder transverse length</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>GB Wall Thickness</td>
<td>Gallbladder wall thickness</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>CBD</td>
<td>Common bile duct diameter</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
</tbody>
</table>

Kidney protocol

Measurement definitions

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
<th>Units</th>
<th>Generic type</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Kidney Sag</td>
<td>Right kidney sagittal length</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>R Kidney Trans</td>
<td>Right kidney transverse length</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>RRA PSV</td>
<td>Right kidney renal artery peak systolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>RRA DV</td>
<td>Right kidney renal artery diastolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>RRA Diam</td>
<td>Right kidney renal artery diameter</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>RRA Diam</td>
<td>Right kidney renal artery diameter</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
</tr>
<tr>
<td>RRV PSV</td>
<td>Right kidney renal vein peak systolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>RRV DV</td>
<td>Right kidney renal vein diastolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>RRV Diam</td>
<td>Right kidney renal vein diameter</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>RRV Diam</td>
<td>Right kidney renal vein diameter</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
</tr>
<tr>
<td>L Kidney Sag</td>
<td>Left kidney sagittal length</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>L Kidney Trans</td>
<td>Left kidney transverse length</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>LRA PSV</td>
<td>Left kidney renal artery peak systolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>LRA DV</td>
<td>Left kidney renal artery diastolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>LRA Diam</td>
<td>Left kidney renal artery diameter</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>LRA Diam</td>
<td>Left kidney renal artery diameter</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
</tr>
<tr>
<td>LRV PSV</td>
<td>Left kidney renal vein peak systolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>LRV DV</td>
<td>Left kidney renal vein diastolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>LRV Diam</td>
<td>Left kidney renal vein diameter</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>LRV Diam</td>
<td>Left kidney renal vein diameter</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
</tr>
<tr>
<td>Ao PSV</td>
<td>Aorta peak systolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
</tbody>
</table>
Appendix A: Measurement package protocols

**ICA PSV**
ICA peak systolic velocity

**CCA PSV**
CCA peak systolic velocity

---

Calculation definitions

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Units</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>RRA-A RI</td>
<td>Right renal artery to aorta resistive index</td>
<td>none</td>
<td>( \frac{(RRA \text{ PSV} - Ao \text{ PSV})}{RRA \text{ PSV}} )</td>
</tr>
<tr>
<td>LRA-A RI</td>
<td>Left renal artery to aorta resistive index</td>
<td>none</td>
<td>( \frac{(LRA \text{ PSV} - Ao \text{ PSV})}{LRA \text{ PSV}} )</td>
</tr>
<tr>
<td>ICA-CCA RI</td>
<td>ICA to CCA resistive index</td>
<td>none</td>
<td>( \frac{(ICA \text{ PSV} - CCA \text{ PSV})}{ICA \text{ PSV}} )</td>
</tr>
<tr>
<td>RRA RI</td>
<td>Right renal artery resistive index</td>
<td>none</td>
<td>( \frac{(RRA \text{ PSV} - RRA \text{ DV})}{RRA \text{ PSV}} )</td>
</tr>
<tr>
<td>LRA RI</td>
<td>Left renal artery resistive index</td>
<td>none</td>
<td>( \frac{(LRA \text{ PSV} - LRA \text{ DV})}{LRA \text{ PSV}} )</td>
</tr>
</tbody>
</table>

Adrenal Glands protocol

**Measurement definitions**

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
<th>Units</th>
<th>Generic type</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAG Sag</td>
<td>Right adrenal glands sagittal length</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>RAG Trans</td>
<td>Right adrenal glands transverse length</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>RAA Vel</td>
<td>Right adrenal artery velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>RAA Diam</td>
<td>Right adrenal artery diameter</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>RAV Vel</td>
<td>Right adrenal artery velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>RAV Diam</td>
<td>Right adrenal artery diameter</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
</tr>
<tr>
<td>LAG Sag</td>
<td>Left adrenal glands Sagittal length</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>LAG Trans</td>
<td>Left adrenal glands transverse length</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>LAA Vel</td>
<td>Left Adrenal artery velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>LAA Diam</td>
<td>Left Adrenal artery diameter</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>LAA Diam</td>
<td>Left Adrenal artery diameter</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
</tr>
<tr>
<td>LAV Vel</td>
<td>Left Adrenal vein velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>LAV Diam</td>
<td>Left Adrenal vein diameter</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>LAV Diam</td>
<td>Left Adrenal vein diameter</td>
<td>mm</td>
<td>Depth</td>
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## Pancreas protocol

### Measurement definitions

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<td>Pancreas Trans</td>
<td>Pancreas transverse length</td>
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<tr>
<td>Duct</td>
<td>Pancreatic duct diameter</td>
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## Female Reproductive protocol

### Measurement definitions

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<tr>
<td>UA Vel</td>
<td>Uterine artery velocity</td>
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<td>Velocity</td>
<td>PW Doppler</td>
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<tr>
<td>UA Diam</td>
<td>Uterine artery diameter</td>
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<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
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<td>Uterine vein diameter</td>
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<td>ROv Trans</td>
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<tr>
<td>ROv Art Vel</td>
<td>Right ovarian artery velocity</td>
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<td>Velocity</td>
<td>PW Doppler</td>
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<td>Left ovarian artery velocity</td>
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<td>Velocity</td>
<td>PW Doppler</td>
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<td>LO Art Diam</td>
<td>Left ovarian artery diameter</td>
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<td>Left ovarian vein velocity</td>
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<td>Velocity</td>
<td>PW Doppler</td>
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### Measurement package protocols

## Mammary Gland protocol

### Measurement definitions

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## Male Reproductive protocol

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<td>RVG Sag</td>
<td>Right vesicular glands sagittal</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
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<tr>
<td>RVG Trans</td>
<td>Right vesicular glands transverse</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
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<tr>
<td>RVA Vel</td>
<td>Right vesicular artery velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
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<td>Right vesicular artery diameter</td>
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<tr>
<td>RVV Vel</td>
<td>Right vesicular vein velocity</td>
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<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>RVV Diam</td>
<td>Right vesicular vein diameter</td>
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<tr>
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<td>Left vesicular glands sagittal</td>
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<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>LVG Trans</td>
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<td>B-Mode</td>
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<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
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<td>Left vesicular artery diameter</td>
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<tr>
<td>LVV Vel</td>
<td>Left vesicular vein velocity</td>
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<td>Velocity</td>
<td>PW Doppler</td>
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### Cardiac Measurement Package

This section provides the measurements and calculations information for the protocols in the Cardiac measurement package.

#### PSLAX protocol

**Measurement definitions**

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## Calculation definitions

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<tr>
<td>LV Vol;d (M-Mode)</td>
<td>Left ventricle volume diastole</td>
<td>µL</td>
<td>$(\frac{7.0}{(2.4 + LVID;d)} \times LVID;d^3)$</td>
</tr>
<tr>
<td>LV Vol;d (B-Mode)</td>
<td>Left ventricle volume diastole</td>
<td>µL</td>
<td>$(\frac{7.0}{(2.4 + LVID;d)} \times LVID;d^3)$</td>
</tr>
<tr>
<td>LV Vol;s (M-Mode)</td>
<td>Left ventricle volume systole</td>
<td>µL</td>
<td>$(\frac{7.0}{(2.4 + LVID;s)} \times LVID;s^3)$</td>
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<tr>
<td>LV Vol;s (B-Mode)</td>
<td>Left ventricle volume systole</td>
<td>µL</td>
<td>$(\frac{7.0}{(2.4 + LVID;d)} \times LVID;d^3)$</td>
</tr>
<tr>
<td>%EF (M-Mode)</td>
<td>LV ejection fraction</td>
<td>%</td>
<td>$100 \times ((LV Vol;d – LV Vol;s) / LV Vol;d)$</td>
</tr>
<tr>
<td>%EF (B-Mode)</td>
<td>LV ejection fraction</td>
<td>%</td>
<td>$100 \times ((LV Vol;d – LV Vol;s) / LV Vol;d)$</td>
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<tr>
<td>%FS (M-Mode)</td>
<td>LV fractional shortening</td>
<td>%</td>
<td>$100 \times ((LVID;d – LVID;s) / LVID;d)$</td>
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<td>%FS (B-Mode)</td>
<td>LV fractional shortening</td>
<td>%</td>
<td>$100 \times ((LVID;d – LVID;s) / LVID;d)$</td>
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<td>LV Mass (B-Mode)</td>
<td>LV mass uncorrected</td>
<td>mg</td>
<td>$1.053 \times ((LVID;d + LVPW;d + IVS;d)^3 – LVID;d^3)$</td>
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### Appendix A: Measurement package protocols

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<td>Inter ventricular septum (diastole)</td>
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<td>LVID;d</td>
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<tr>
<td>IVS;d</td>
<td>Inter ventricular septum (diastole)</td>
<td>mm</td>
<td>Length</td>
<td>B-Mode</td>
<td>LVID;d</td>
</tr>
<tr>
<td>LVID;d</td>
<td>Left ventricular internal diameter (diastole)</td>
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<td>M-Mode</td>
<td>LVPW;d</td>
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<td>LVID;d</td>
<td>Left ventricular internal diameter (diastole)</td>
<td>mm</td>
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<td>B-Mode</td>
<td>LVPW;d</td>
</tr>
<tr>
<td>LVPW;d</td>
<td>Left ventricular posterior wall (diastole)</td>
<td>mm</td>
<td>Length</td>
<td>B-Mode</td>
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</tr>
<tr>
<td>IVS;s</td>
<td>Inter ventricular septum</td>
<td>mm</td>
<td>Depth</td>
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<td>IVS;s</td>
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<td>LVID;s</td>
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<td>LVID;s</td>
<td>Left ventricular internal diameter (systole)</td>
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<td>LVPW;s</td>
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<td>LVID;s</td>
<td>Left ventricular internal diameter (systole)</td>
<td>mm</td>
<td>Length</td>
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<td>LVPW;s</td>
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<td>LVPW;s</td>
<td>Left ventricular posterior wall (systole)</td>
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<td>Depth</td>
<td>M-Mode</td>
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<tr>
<td>LV Mass Cor (M-Mode)</td>
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<td>LV Mass Cor (B-Mode)</td>
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<td>LV Mass AW (M-Mode)</td>
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### Calculation definitions

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<td>LV Vol;d (M-Mode)</td>
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<td>(((7.0 / (2.4 + LVID;d)) * LVID;d^3))</td>
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<td>LV Vol;d (B-Mode)</td>
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<td>µl</td>
<td>(((7.0 / (2.4 + LVID;d)) * LVID;d^3))</td>
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<td>LV Vol;s (M-Mode)</td>
<td>Left ventricle volume systole</td>
<td>µl</td>
<td>(((7.0 / (2.4 + LVID;s)) * LVID;s^3))</td>
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<td>LV Vol;s (B-Mode)</td>
<td>Left ventricle volume systole</td>
<td>µl</td>
<td>(((7.0 / (2.4 + LVID;s)) * LVID;s^3))</td>
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<td>%EF (M-Mode)</td>
<td>LV ejection fraction</td>
<td>%</td>
<td>100 * ((LV Vol;d – LV Vol;s) / LV Vol;d)</td>
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</table>
Appendix A: Measurement package protocols

%EF (B-Mode) LV ejection fraction % \( 100 \times \frac{(LV \ Vol;d - LV \ Vol;s)}{LV \ Vol;d} \)

%FS (M-Mode) LV fractional shortening % \( 100 \times \frac{(LVID;d - LVID;s)}{LVID;d} \)

%FS (B-Mode) LV fractional shortening % \( 100 \times \frac{(LVID;d - LVID;s)}{LVID;d} \)

LV Mass (M-Mode) LV mass uncorrected mg \( 1.053 \times \frac{(LVID;d + LVPW;d + IVS;d)^3 - LVID;d^3)}{LVID;d} \)

LV Mass (B-Mode) LV mass uncorrected mg \( 1.053 \times \frac{(LVID;d + LVPW;d + IVS;d)^3 - LVID;d^3)}{LVID;d} \)

LV Mass Cor (M-Mode) LV mass corrected mg \( LV \ Mass (M-Mode) \times 0.8 \)

LV Mass Cor (B-Mode) LV mass corrected mg \( LV \ Mass (B-Mode) \times 0.8 \)

**LV MASS protocol**

**Measurement definitions**

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<td>M-Mode</td>
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<tr>
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<td>M-Mode</td>
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<td>Area</td>
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<td>mm</td>
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## Calculation definitions

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<tr>
<td>Endocardial Volume; d</td>
<td>Endocardial volume in diastole</td>
<td>µl</td>
<td>[\frac{4\pi}{3} \times \frac{\text{End Major; } d}{2} \times \left(\frac{\text{End Area; } d}{\pi \left(\frac{\text{End Major; } d}{2}\right)}\right)^2]</td>
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<td>Endocardial Volume; s</td>
<td>Endocardial volume in systole</td>
<td>µl</td>
<td>[\frac{4\pi}{3} \times \frac{\text{End Major; } s}{2} \times \left(\frac{\text{End Area; } s}{\pi \left(\frac{\text{End Major; } s}{2}\right)}\right)^2]</td>
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<tr>
<td>Endocardial %EF</td>
<td>Percent ejection fraction</td>
<td>%</td>
<td>[\frac{\text{Endocardial SV}}{\text{Endocardial Vol; } d} \times 100]</td>
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<tr>
<td>Endocardial %FAC</td>
<td>Percent fractional area change</td>
<td>%</td>
<td>[\frac{\text{Endocardial Area; } d - \text{Endocardial Area; } s}{\text{Endocardial Area; } d} \times 100]</td>
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<tr>
<td>Endocardial Area Change</td>
<td>Area change</td>
<td>mm²</td>
<td>[\text{Endocardial Area; } d - \text{Endocardial Area; } s]</td>
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<td>Fractional shortening</td>
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<tr>
<td>Endocardial CO</td>
<td>Cardiac output</td>
<td>ml/min</td>
<td>[\frac{\text{Endocardial SV}}{2} \times \text{Heart Rate}]</td>
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</table>

Note: Heart rate is additional parameter for Endocardial Major; d measurement.

- a; d Average LV epicardial radius in diastole \[\sqrt{\frac{\text{LV Epicardial Area}}{\pi}}\]
- b; d Average LV endocardial radius in diastole \[\sqrt{\frac{\text{Endocardial Area; } d}{\pi}}\]
- T; d Average wall thickness \[a - b\]

<table>
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<th>Name</th>
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<td>LV Mass; d</td>
<td>LV Mass</td>
<td>mg</td>
<td>[1.05 \times \left(\frac{2}{3} \times \text{Epicardial Area; } d + (\text{Epicardial Major; } d + T; d) \right) - \frac{3}{2} \times \text{Endocardial Area; } d + \text{Endocardial Major; } d]</td>
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### ARCH protocol

#### Measurement definitions
### Simpson's protocol

#### Measurement definitions

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<td>Length</td>
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<td>Length</td>
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#### Calculation definitions

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<td>Simpson's volume calculation in diastole</td>
<td>µL</td>
<td>((\text{Area}<em>{\text{Prox};d} + \text{Area}</em>{\text{Mid};d}) \times h + \text{Area}_{\text{Dist};d} \times \frac{h}{2} + \frac{\pi}{6} \times h^2)</td>
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<td>Where: (h = \text{Simp Length in diastole})</td>
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<tr>
<td>Simp Volume; s</td>
<td>Simpson's volume calculation in systole</td>
<td>µL</td>
<td>((\text{Area}<em>{\text{Prox};s} + \text{Area}</em>{\text{Mid};s}) \times h + \text{Area}_{\text{Dist};s} \times \frac{h}{2} + \frac{\pi}{6} \times h^2)</td>
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<td></td>
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<td>Where: (h = \text{Simp Length in systole})</td>
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<table>
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<td>Simp Volume; d - Simp Volume; s</td>
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<td>Simp FAC</td>
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<tr>
<td>Simp %EF</td>
<td>Ejection fraction</td>
<td>%</td>
<td>100 * Simp Sv / Simp Volume; d</td>
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<td>Simp %FS</td>
<td>Fractional shortening</td>
<td>%</td>
<td>100 * (Simp Length; d - Simp Length; s) / (Simp Length; d)</td>
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<td>Simp CO</td>
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## Volume/Flow protocol

### Measurement definitions

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<td>cm</td>
<td>VTI</td>
<td>PW Doppler</td>
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<td>PW Doppler</td>
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<td>PW Doppler</td>
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<td>PW Doppler</td>
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### Appendix A: Measurement package protocols

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<td>PW Doppler</td>
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<td>Peak Vel</td>
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<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
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<td>PW Doppler</td>
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<td>Vertical Velocity</td>
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### Calculation definitions

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<td>AoV SV</td>
<td>Aortic valve stroke volume</td>
<td>µL</td>
<td>$7.85 \times \text{LVOT}^2 \times \text{AoV VTI}$</td>
</tr>
<tr>
<td>AoV CO</td>
<td>Aortic valve cardiac output</td>
<td>ml/min</td>
<td>$(\text{AoV SV} \times \text{HR(from LVOT)}) / 1000$</td>
</tr>
<tr>
<td>PV SV</td>
<td>Pulmonary valve stroke volume</td>
<td>µL</td>
<td>$7.85 \times \text{RVOT}^2 \times \text{PV VTI}$</td>
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<tr>
<td>PV CO</td>
<td>Pulmonary valve cardiac output</td>
<td>ml/min</td>
<td>$(\text{PV SV} \times \text{HR(from RVOT)}) / 1000$</td>
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<td>MV SV</td>
<td>Mitral valve stroke volume</td>
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<td>$7.85 \times \text{MV Ann}^2 \times \text{MV VTI}$</td>
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<td>Mitral valve cardiac output</td>
<td>ml/min</td>
<td>$(\text{MV SV} \times \text{HR(from MV Ann)}) / 1000$</td>
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<td>Tricuspid valve stroke volume</td>
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<td>TV CO</td>
<td>Tricuspid valve cardiac output</td>
<td>ml/min</td>
<td>$(\text{TV SV} \times \text{HR(from TV Ann)}) / 1000$</td>
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<td>Aortic valve area</td>
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<td>$\left(\frac{\text{LVOT}}{2}\right)^2 \times \pi \times \text{LVOT VTI, peak} / \text{AV Peak V}$</td>
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### AoV Flow protocol

#### Measurement definitions

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<td>Length</td>
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### Measurement package protocols

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<td>Peak Grad</td>
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<td>Aortic valve peak velocity</td>
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<td>Vertical Velocity</td>
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<td>Aorta peak velocity</td>
<td>mm/s</td>
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<td>Peak Grad</td>
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<td>VTI</td>
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### Calculation definitions

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<th>Formula</th>
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<tr>
<td>AV Peak Press</td>
<td>Aortic valve peak pressure gradient</td>
<td>mmHg</td>
<td>((4 \times (AV \text{ Peak } V)^2) / 1000)</td>
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<td>AV Mean V</td>
<td>Aortic valve mean velocity</td>
<td>mm/s</td>
<td>(\text{AoV VTI, Mean Velocity})</td>
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<tr>
<td>AoV SV</td>
<td>Stroke volume</td>
<td>µl</td>
<td>((7.85 \times \text{LVOT}^2 \times \text{AoV VTI}))</td>
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<tr>
<td>AoV CO</td>
<td>Cardiac output</td>
<td>ml/min</td>
<td>((\text{AoV SV} \times \text{HR(from LVOT)}) / 1000)</td>
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<tr>
<td>AVA</td>
<td>Aortic valve area</td>
<td>mm²</td>
<td>(\frac{(\text{LVOT}/2)^2 \times \pi \times \text{LVOT VTI, peakvel}}{\text{AV PeakV}})</td>
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## MV Flow protocol

### Measurement definitions

<table>
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<td>Mean Vel</td>
<td>Mitral valve mean velocity</td>
<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
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<td>Mean Grad</td>
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<td>mmHg</td>
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</tr>
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<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
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<td>Peak Grad</td>
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<td>mmHg</td>
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<td>PW Doppler</td>
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<td>PW Doppler</td>
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<td>mm/s</td>
<td>Vertical</td>
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<td>mm/s</td>
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<td>MV PHT</td>
<td>Mitral valve pressure half time</td>
<td>mm/s²</td>
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<tr>
<td>T</td>
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### Calculation definitions

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<td>Mitral valve E to A ratio</td>
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<td>MV Area</td>
<td>MV area</td>
<td>mm²</td>
<td>220 / (MV PHT, time)</td>
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## LV Diastolic Function protocol

### Measurement definitions

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<td>Mean Vel</td>
<td>Mitral valve mean velocity</td>
<td>mm/s</td>
<td>VTI</td>
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<td>Peak Vel</td>
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<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
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<tr>
<td>Peak Grad</td>
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<td>PW Doppler</td>
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<td>mm/s</td>
<td>Vertical</td>
<td>PW Doppler</td>
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</table>
## Appendix A: Measurement package protocols

### MV A Mitral valve A velocity mm/s
**Vertical Velocity** PW Doppler

### MV Decel E wave deceleration time mm/s²
**Acceleration** PW Doppler

### T E wave deceleration time ms
**Time** PW Doppler

### IVRT Isovolumic relaxation time ms
**Time** PW Doppler

### IVCT Isovolumic contraction time ms
**Time** PW Doppler

### MV ET Mitral valve ejection time ms
**Time** PW Doppler

### NFT Non-filling time ms
**Time** PW Doppler

### AET Aortic ejection Time ms
**Time** PW Doppler

### Calculation definitions

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### TV Flow protocol

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<td>mmHg</td>
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<td>PW Doppler</td>
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<tr>
<td>Cycles</td>
<td>Tricuspid aorta cycles</td>
<td>(none)</td>
<td>VTI</td>
<td>PW Doppler</td>
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<td>Tricuspid valve E wave velocity</td>
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#### Calculation definitions

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## PV Flow protocol

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<td>Pulmonary mean velocity</td>
<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
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<td>Mean Grad</td>
<td>Pulmonary mean pressure gradient</td>
<td>mmHg</td>
<td>VTI</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>Peak Vel</td>
<td>Pulmonary peak velocity</td>
<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
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<tr>
<td>Peak Grad</td>
<td>Pulmonary aorta peak pressure gradient</td>
<td>mmHg</td>
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<td>PW Doppler</td>
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<td>Time</td>
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<td>Pulmonary ejection time</td>
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<td>VTI</td>
<td>PW Doppler</td>
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### Calculation definitions

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<tbody>
<tr>
<td>Peak Gradient</td>
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<td>( \frac{(4 \times \text{Pulmonary valve peak velocity}^2)}{1000} )</td>
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<tr>
<td>PVA</td>
<td>Pulmonic valve area</td>
<td>mm²</td>
<td>( \frac{((RVOT / 2)^2 \times \pi \times RVOT\text{VTI, peak}^2)}{PV\text{ VTI, peak}^2} )</td>
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</table>
Appendix A: Measurement package protocols

Tissue Doppler protocol

Measurement definitions

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<td>E'</td>
<td>Velocity at E'</td>
<td>mm/s</td>
<td>Velocity</td>
<td>Tissue Doppler</td>
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<tr>
<td>A'</td>
<td>Velocity at A'</td>
<td>mm/s</td>
<td>Velocity</td>
<td>Tissue Doppler</td>
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<tr>
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<td>Isovolumic relaxation time</td>
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<td>Time</td>
<td>Tissue Doppler</td>
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<tr>
<td>IVCT</td>
<td>Isovolumic contraction time</td>
<td>ms</td>
<td>Time</td>
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<tr>
<td>ET</td>
<td>Ejection time</td>
<td>ms</td>
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<td>Velocity</td>
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<td>MV LW A'</td>
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Calculation definitions

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RV Diastolic Function protocol

Measurement definitions
Appendix A: Measurement package protocols

### Measurement definitions

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<td>PW Doppler</td>
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<td>Vertical Velocity</td>
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### Calculation definitions

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### Embryology Measurement Package

This section provides the measurements and calculations information for the protocols in the Embryology measurement package.

#### Uterine Horn protocol

### Measurement definitions

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<td>mm</td>
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Appendix A: Measurement package protocols

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Placenta protocol

Measurement definitions

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Ophthalmology Measurement Package

This section provides the measurements and calculations information for the protocols in the Ophthalmology measurement package.

Ophthalmology protocol

Measurement definitions

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Appendix A: Measurement package protocols

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 protocol

Measurement definitions

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<td>Abdominal aorta diameter</td>
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<td>Linear</td>
<td>B-Mode</td>
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<tr>
<td>AA Diam</td>
<td>Abdominal aorta diameter</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
</tr>
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<td>AA VTI</td>
<td>Abdominal aorta velocity time integral</td>
<td>cm</td>
<td>VTI</td>
<td>PW Doppler</td>
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<td>cm</td>
<td>VTI</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>Mean Vel</td>
<td>Abdominal aorta mean velocity</td>
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<td>VTI</td>
<td>PW Doppler</td>
</tr>
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<td>Peak Grad</td>
<td>Abdominal aorta peak gradient</td>
<td>mmHg</td>
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Mesenteric Arteries protocol

Measurement definitions

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<td>SMA EDV</td>
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<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
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### Appendix A: Measurement package protocols

#### SMA Diam;
- **Superior mesenteric artery diameter**
  - Systole (mm, Linear B-Mode)
  - Diastole (mm, Depth M-Mode)

#### SMA VTI
- **Superior mesenteric artery velocity time integral**
  - mm, VTI, PW Doppler

#### Peak Vel
- **Superior mesenteric artery peak velocity**
  - mm/s, VTI, PW Doppler

#### Mean Vel
- **Superior mesenteric artery mean velocity**
  - mm/s, VTI, PW Doppler

#### Peak Grad
- **Superior mesenteric artery peak gradient**
  - mmHg, VTI, PW Doppler

#### IMA PSV
- **Inferior mesenteric artery peak systolic velocity**
  - mm/s, Velocity, PW Doppler

#### IMA EDV
- **Inferior mesenteric artery end diastolic velocity**
  - mm/s, Velocity, PW Doppler

#### IMA Diam;
- **Inferior mesenteric artery diameter**
  - Systole (mm, Linear B-Mode)
  - Diastole (mm, Depth M-Mode)

#### IMA VTI
- **Inferior mesenteric artery velocity time integral**
  - mm, VTI, PW Doppler

#### Calculation definitions

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<td>SMA PI</td>
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<tr>
<td>IMA RI</td>
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<td>IMA PI</td>
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# Carotid Arteries protocol

## Measurement definitions

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<td>Velocity</td>
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<td>Left common carotid end diastolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
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<td>Left common carotid diameter, diastole</td>
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<td>Depth</td>
<td>M-Mode</td>
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<td>M-Mode</td>
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### Appendix A: Measurement package protocols

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### Calculation definitions

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## Appendix A: Measurement package protocols

### Innominant and Subclavian Arteries protocol

#### Measurement definitions

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<td>Velocity</td>
<td>PW Doppler</td>
</tr>
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<td>IA Diam;s</td>
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<td>Linear</td>
<td>B-Mode</td>
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<td>Innominant artery diameter, diastole</td>
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<td>mm</td>
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<td>M-Mode</td>
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<td>mm</td>
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<td>M-Mode</td>
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<td>VTI</td>
<td>PW Doppler</td>
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<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
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<td>Mean Vel</td>
<td>Innominant artery mean velocity</td>
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<td>Left Subclavian artery diameter, systole</td>
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Appendix A: Measurement package protocols

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<tr>
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**Calculation definitions**

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## Iliac Arteries protocol

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### Appendix A: Measurement package protocols

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## Measurement package protocols

### Femoral Arteries protocol

#### Measurement definitions

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### Saphenous Arteries protocol

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<th>Units</th>
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<tbody>
<tr>
<td>LSaA PSV</td>
<td>Left saphenous artery peak systolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>LSaA EDV</td>
<td>Left saphenous artery end diastolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>LSaA Diam;s</td>
<td>Left saphenous artery diameter, systole</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>LSaA Diam;d</td>
<td>Left saphenous artery diameter, diastole</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>LSaA Diam;s</td>
<td>Left saphenous artery diameter, systole</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
</tr>
<tr>
<td>LSaA Diam;d</td>
<td>Left saphenous artery diameter, diastole</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
</tr>
<tr>
<td>LSaA VTI</td>
<td>Left saphenous artery velocity time integral</td>
<td>cm</td>
<td>VTI</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>Peak Vel</td>
<td>Left saphenous artery peak velocity</td>
<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>Mean Vel</td>
<td>Left saphenous artery mean velocity</td>
<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>Peak Grad</td>
<td>Left saphenous artery peak gradient</td>
<td>mmHg</td>
<td>VTI</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>Mean Grad</td>
<td>Left saphenous artery mean gradient</td>
<td>mmHg</td>
<td>VTI</td>
<td>PW Doppler</td>
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<tr>
<td>RSaA PSV</td>
<td>Right saphenous artery peak systolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
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</table>
### Appendix A: Measurement package protocols

#### Right Saphenous Artery Protocol

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
<th>Units</th>
<th>Type</th>
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<tbody>
<tr>
<td>RSaA EDV</td>
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<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
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<tr>
<td>RSaA Diam;s</td>
<td>Right saphenous artery diameter, systole</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>RSaA Diam;d</td>
<td>Right saphenous artery diameter, diastole</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
</tr>
<tr>
<td>RSaA Diam;s</td>
<td>Right saphenous artery diameter, systole</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
</tr>
<tr>
<td>RSaA Diam;d</td>
<td>Right saphenous artery diameter, diastole</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
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<td>RSaA VTI</td>
<td>Right saphenous artery velocity time integral</td>
<td>cm</td>
<td>VTI</td>
<td>PW Doppler</td>
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<tr>
<td>Peak Vel</td>
<td>Right saphenous artery peak velocity</td>
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<td>PW Doppler</td>
</tr>
<tr>
<td>Mean Vel</td>
<td>Right saphenous artery mean velocity</td>
<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
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<tr>
<td>Peak Grad</td>
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<td>mmHg</td>
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<td>PW Doppler</td>
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#### Renal Arteries Protocol

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<td>Velocity</td>
<td>PW Doppler</td>
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<td>LRA EDV</td>
<td>Left renal artery end diastolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
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<tr>
<td>LRA Diam;s</td>
<td>Left renal artery diameter, systole</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
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<tr>
<td>LRA Diam;d</td>
<td>Left renal artery diameter, diastole</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
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<tr>
<td>LRA Diam;s</td>
<td>Left renal artery diameter, systole</td>
<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
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<td>LRA Diam;d</td>
<td>Left renal artery diameter, diastole</td>
<td>mm</td>
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<td>M-Mode</td>
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<tr>
<td>LRA VTI</td>
<td>Left renal artery velocity time integral</td>
<td>cm</td>
<td>VTI</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>Peak Vel</td>
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<td>mmHg</td>
<td>VTI</td>
<td>PW Doppler</td>
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</table>

### Calculation definitions

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Units</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSaA RI</td>
<td>Left saphenous artery resistive index</td>
<td>none</td>
<td>((\text{Left Saphenous Artery PSV} - \text{Left Saphenous Artery EDV}) / \text{Left Saphenous Artery PSV})</td>
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<tr>
<td>LSaA PI</td>
<td>Left saphenous artery pulsatility index</td>
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<td>((\text{Left Saphenous Artery PSV} - \text{Left Saphenous Artery EDV}) / \text{Left Saphenous Artery VTI}, \text{Mean Velocity})</td>
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<tr>
<td>RSaA RI</td>
<td>Right saphenous artery resistive index</td>
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<td>((\text{Right Saphenous Artery PSV} - \text{Right Saphenous Artery EDV}) / \text{Right Saphenous Artery PSV})</td>
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<tr>
<td>RSaA PI</td>
<td>Right saphenous artery pulsatility index</td>
<td>none</td>
<td>((\text{Right Saphenous Artery PSV} - \text{Right Saphenous Artery EDV}) / \text{Right Saphenous Artery VTI}, \text{Mean Velocity})</td>
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</table>

### Renal Arteries protocol

#### Measurement definitions

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
<th>Units</th>
<th>Generic type</th>
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<tr>
<td>LRA PSV</td>
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<td>Velocity</td>
<td>PW Doppler</td>
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<td>LRA EDV</td>
<td>Left renal artery end diastolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
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<td>LRA Diam;s</td>
<td>Left renal artery diameter, systole</td>
<td>mm</td>
<td>Linear</td>
<td>B-Mode</td>
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<tr>
<td>LRA Diam;d</td>
<td>Left renal artery diameter, diastole</td>
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<td>mm</td>
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<td>M-Mode</td>
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<td>mm</td>
<td>Depth</td>
<td>M-Mode</td>
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<td>LRA VTI</td>
<td>Left renal artery velocity time integral</td>
<td>cm</td>
<td>VTI</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>Peak Vel</td>
<td>Left renal artery peak velocity</td>
<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>Mean Vel</td>
<td>Left renal artery mean velocity</td>
<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
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<tr>
<td>Peak Grad</td>
<td>Left renal artery peak gradient</td>
<td>mmHg</td>
<td>VTI</td>
<td>PW Doppler</td>
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</table>
**Appendix A: Measurement package protocols**

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<th>Measurement</th>
<th>Description</th>
<th>Unit(s)</th>
<th>Mode</th>
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<td>mmHg</td>
<td>VTI</td>
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<td>RRA PSV</td>
<td>Right renal artery peak systolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
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<td>RRA EDV</td>
<td>Right renal artery end diastolic velocity</td>
<td>mm/s</td>
<td>Velocity</td>
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<td>Linear B-Mode</td>
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<td>Linear B-Mode</td>
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<td>VTI</td>
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<tr>
<td>Peak Vel</td>
<td>Right renal artery peak velocity</td>
<td>mm/s</td>
<td>VTI</td>
</tr>
<tr>
<td>Mean Vel</td>
<td>Right renal artery mean velocity</td>
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**Calculation definitions**

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<tr>
<th>Name</th>
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<th>Units</th>
<th>Formula</th>
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<tr>
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<tr>
<td>LRA PI</td>
<td>Left renal artery pulsatility index</td>
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<tr>
<td>RRA RI</td>
<td>Right renal artery resistive index</td>
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<tr>
<td>RRA PI</td>
<td>Right renal artery pulsatility index</td>
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<td>(\frac{\text{Right Renal Artery PSV} - \text{Right Renal Artery EDV}}{\text{Right Renal Artery VTI, Mean Velocity}})</td>
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**Other Artery measurements**

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<td>PW Doppler</td>
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<td>OA EDV</td>
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<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
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<td>B-Mode</td>
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<td>B-Mode</td>
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<td>Depth</td>
<td>M-Mode</td>
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<tr>
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<td>Other artery diameter, diastole</td>
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<td>M-Mode</td>
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<td>OA VTI</td>
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<td>cm</td>
<td>VTI</td>
<td>PW Doppler</td>
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<tr>
<td>Peak Vel</td>
<td>Other artery peak velocity</td>
<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
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<td>OA PI</td>
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### Umbilical Arteries protocol

#### Measurement definitions

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<td>Velocity</td>
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<td>mm/s</td>
<td>Velocity</td>
<td>PW Doppler</td>
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<tr>
<td>UT VTI</td>
<td>Uterine artery velocity time integral</td>
<td>cm</td>
<td>VTI</td>
<td>PW Doppler</td>
</tr>
<tr>
<td>Peak Vel</td>
<td>Uterine artery peak velocity</td>
<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
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<tr>
<td>Mean Vel</td>
<td>Uterine artery mean velocity</td>
<td>mm/s</td>
<td>VTI</td>
<td>PW Doppler</td>
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<td>VTI</td>
<td>PW Doppler</td>
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<td>PW Doppler</td>
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<td>PW Doppler</td>
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<td>Velocity</td>
<td>PW Doppler</td>
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<td>VIT EDV</td>
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<td>Velocity</td>
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<td>Mean Grad</td>
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<td>VTI</td>
<td>PW Doppler</td>
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## Calculation definitions

<table>
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<tr>
<th>Name</th>
<th>Description</th>
<th>Units</th>
<th>Formula</th>
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<tbody>
<tr>
<td>UT RI</td>
<td>Uterine artery resistive index</td>
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<td>((\text{Uterine Artery PSV} - \text{Uterine Artery EDV})/ \text{Uterine Artery PSV})</td>
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<tr>
<td>UM RI</td>
<td>Umbilical artery resistive index</td>
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<td>((\text{Umbilical Artery PSV} - \text{Umbilical Artery EDV})/ \text{Umbilical Artery PSV})</td>
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<td>VIT RI</td>
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<td>((\text{Vitelline Artery PSV} - \text{Vitelline Artery EDV})/ \text{Vitelline Artery PSV})</td>
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</table>
Appendix B

Troubleshooting

If a problem is encountered when using the Vevo 2100 Imaging System, try the solutions described in this appendix. If none of the solutions solves the problem, contact a VisualSonics Technical Support representative (support@visualsonics.com).

System panel controls

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>System does not power up</td>
<td>▪ Ensure that the main power cable for the system is properly connected to the Vevo 2100 Imaging System.</td>
</tr>
<tr>
<td></td>
<td>▪ Ensure that the system is plugged into a grounded/earthed wall outlet. Turn the main power switch On.</td>
</tr>
<tr>
<td></td>
<td>▪ Turn the computer standby switch On.</td>
</tr>
<tr>
<td>No audio</td>
<td>▪ Adjust the Volume dial</td>
</tr>
<tr>
<td></td>
<td>▪ Adjust any PW Doppler settings (such as the PW Doppler angle, the Doppler Gain, the Sample Volume Position) to increase the strength of the PW Doppler signal.</td>
</tr>
</tbody>
</table>

Study Browser

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unable to create new studies</td>
<td>Ensure that an transducer is connected to the front panel of the Vevo 2100 Imaging System, and ensure that it has been initialized.</td>
</tr>
<tr>
<td>Unable to commit a study session</td>
<td>Ensure that an operator has been specified.</td>
</tr>
<tr>
<td>The system tells you that your study is corrupted</td>
<td><strong>Cause:</strong> You are still in an active image acquisition session working on an active series. The system cannot open the Study Info window until you close the series. This prevents you from accidentally leaving and closing the series before you have added all the required images to your series.</td>
</tr>
<tr>
<td></td>
<td><strong>Solution:</strong> Click Close Series now or complete all the images you need to acquire for your series and then return to the Study Browser and click Close Series. Then press <strong>Study Info</strong>.</td>
</tr>
</tbody>
</table>
B-Mode

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of penetration or sensitivity</td>
<td>• Ensure that there is adequate coupling medium (for example, ultrasound gel) between the transducer and the animal.</td>
</tr>
<tr>
<td></td>
<td>• Adjust the position of the TGC sliders.</td>
</tr>
<tr>
<td></td>
<td>• Increase the Transmit Power.</td>
</tr>
<tr>
<td></td>
<td>• Ensure the appropriate transducer is being used.</td>
</tr>
</tbody>
</table>

Related information

- Transducer options (page 20)

M-Mode

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of penetration or sensitivity</td>
<td>• Ensure that there is adequate coupling medium (for example, ultrasound gel) between the transducer and the animal.</td>
</tr>
<tr>
<td></td>
<td>• Adjust the position of the TGC sliders.</td>
</tr>
<tr>
<td></td>
<td>• Increase the Transmit Power.</td>
</tr>
<tr>
<td></td>
<td>• Ensure the appropriate transducer is being used.</td>
</tr>
</tbody>
</table>

PW Doppler Mode

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aliasing in the PW Doppler Mode acquisition</td>
<td>• Increase the Frequency.</td>
</tr>
<tr>
<td></td>
<td>• Decrease the Doppler Angle.</td>
</tr>
<tr>
<td></td>
<td>• Adjust the Baseline setting.</td>
</tr>
<tr>
<td>The PW Doppler signal is very small when the viewed flow is slow</td>
<td>• Decrease the Frequency setting.</td>
</tr>
<tr>
<td>Signal appears to be low intensity</td>
<td>• Adjust the Doppler Gain setting.</td>
</tr>
<tr>
<td>Signal exhibits saturation</td>
<td>• Lower the Doppler Gain setting.</td>
</tr>
</tbody>
</table>
Appendix B: Troubleshooting

### Low frequency noise level in PW Doppler acquisition is high

- Increase the Wall Filter setting.

### Noise appears in the image

- Adjust the Sample Volume size and position such that it includes tissue only.

---

**3D-Mode**

### Can’t initialize the motor

- Ensure that the cable for the 3D motor stage is connected to the rear panel.
- Ensure that the motor is positioned such that there are no objects obstructing the path of the transducer during initialization.

### Expected data is not acquired

- Ensure the transducer is oriented correctly, with the transducer arm of the transducer moving perpendicular to the direction of travel of the 3D motor stage.
- Ensure that the Range and Step Size settings are adequate for acquiring the desired amount of data.
- If two transducers are connected, ensure that the active transducer is the one connected to the 3D motor stage.
- Ensure that the transducer is tightly connected to the port on the front of the cart.

---

**Power Doppler Mode**

### Color bands in the image

- Enable Respiration Gating.
- Adjust Wall Filter setting.
- Adjust Scan Speed setting.
- Adjust the Priority settings.

### Respiration artifacts in the image

- Enable Respiration Gating.
- Adjust Wall Filter setting.
- Adjust Sweep Speed setting.

### Lack of sensitivity

- Ensure the anatomy being studied is in the focal zone for the transducer.
### Lack of penetration or sensitivity

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase the Transmit Power.</td>
<td></td>
</tr>
<tr>
<td>Ensure that there is adequate coupling medium (for example, ultrasound gel) between the transducer and the animal.</td>
<td></td>
</tr>
<tr>
<td>Adjust the position of the TGC sliders.</td>
<td></td>
</tr>
<tr>
<td>Ensure the appropriate transducer is being used.</td>
<td></td>
</tr>
</tbody>
</table>

### Contrast Mode

#### Problem Solution

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contrast Mode functions are not available</td>
<td>Ensure that Contrast Mode is the active mode.</td>
</tr>
<tr>
<td>The green in the contrast overlay is not displayed where expected</td>
<td>The reference data set should be one that doesn’t have bubbles (created either before the contrast agent is injected or after a destroy function). The reference data set must be the darker data set (in other words, it should be the data with the least amount of material in the blood stream.)</td>
</tr>
<tr>
<td>The amount of green in the contrast overlay is too much or too little</td>
<td>Ensure that the Contrast setting is appropriate before creating the reference loop. To do this, create a temporary reference loop, and process it against itself (i.e., against the same reference loop). There should be no green in the processed image. If there is, adjust the Contrast setting and repeat.</td>
</tr>
</tbody>
</table>

### Physiological data

#### Problem Solution

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ECG signal is displayed</td>
<td>Ensure the ECG cable is connected to the physiological monitoring and control system, and the keyed end of the cable is connected to the front panel of the Vevo cart.</td>
</tr>
<tr>
<td>ECG signal appears flatlined</td>
<td>Ensure that the ECG monitor is producing a strong, consistent signal.</td>
</tr>
<tr>
<td>ECG signal is poor</td>
<td>Ensure that all of the animal’s limbs are secured to the ECG pads on animal platform.</td>
</tr>
<tr>
<td></td>
<td>Ensure that no gel has leaked onto any of the contacts on the animal platform.</td>
</tr>
<tr>
<td></td>
<td>Ensure that there is no 50/60 Hz noise source near the animal platform (for example a lamp or a power cable).</td>
</tr>
</tbody>
</table>
### Appendix B: Troubleshooting

#### Problem Solution

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure signal is not accurate</td>
<td>• Calibrate the blood pressure signal.</td>
</tr>
<tr>
<td></td>
<td>• Check hardware gain and blood pressure check box in Operator Preferences.</td>
</tr>
<tr>
<td></td>
<td>• Check positioning and operation of blood pressure catheter.</td>
</tr>
</tbody>
</table>

### Measurements, annotations and calculations

#### Problem Solution

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement tools are not available</td>
<td>• Ensure that the system is not acquiring data or playing a cine loop.</td>
</tr>
<tr>
<td></td>
<td>• Ensure that data is displayed in the mode window.</td>
</tr>
<tr>
<td>A calculated value is not displayed in the Value column for calculations</td>
<td>• Not all the measurements from which the calculation is derived have been made. Make the additional measurements so that the software may compute the calculation.</td>
</tr>
<tr>
<td>PV Loop calculations are not available</td>
<td>• The system might not have recorded a blood pressure signal. Ensure that a blood pressure source is connected to the animal.</td>
</tr>
</tbody>
</table>
Appendix C

Descriptions of control panel controls

This appendix lists all available controls in alphabetical order and describes the function of each control.

2D Gain

Adjusts the strength of the ultrasound signal when it returns to the face of the transducer. Range values for the control are specific to each individual transducer.

Turn clockwise to add gain and brighten your entire image. Turn counterclockwise to reduce gain and darken your image.

In M-Mode: Applies to the images in both the M-Mode window as well as the B-Mode scout window.

Active during: B-Mode, M-Mode, Contrast Mode, Color Doppler Mode and Power Doppler Mode.

3D

Activates 3D-Mode acquisition and opens the dialog box you use to set up the 3D motor stage and the transducer settings for the image slices that will create the 3D data.

Annotate

Opens the text annotation tool if the cursor is not enabled.

Back

Will remove or undo the last measurement point before you commit your measurement.

Press and hold **FN** while you tap this Up arrow key to increase the keyboard backlighting brightness between the Off setting and a series of seven brightness levels.

**Shift**
Press and hold FN while you tap this Down arrow key to decrease the keyboard backlighting brightness between the series of seven brightness levels and the Off setting.

**Baseline**

Adjusts the vertical position of the horizontal zero frequency line (the baseline) that divides the image data coming toward the transducer face from the image data moving away from the transducer face. Push up to raise the line. Pull down to lower the line.

**Beam Angle**

Helps you generate flow direction information when the orientation of your target vessel is perpendicular or almost perpendicular to your ultrasound beam.

This control applies a graduated series of transmission and reception delays to the ultrasound sound signals of each crystal in the transducer. These carefully calibrated sequences can effectively steer the ultrasound beam in order to detect minute frequency shifts.

In PW Doppler Mode and PW Tissue Doppler Mode, the current beam angle setting is displayed in the top-left corner of the B-Mode scout image.

In Power Doppler Mode and Color Doppler Mode, this changes the color box.

Active during Color Doppler Mode, Power Doppler Mode, PW Doppler Mode, PW Tissue Doppler Mode imaging sessions.

**To use this rocker switch control:**

Push up or pull down the control depending on the orientation of your transducer to steer the beam angle.

**B-Mode**

Activates B-Mode acquisition and begins displaying the acquired B-Mode data in the B-Mode window.

**Burst**

Transmits an ultrasound pulse at maximum setting. This destroys the contrast agent in the region of interest. In the cine loop the system displays a vertical green bar to mark the destruction event.

**Cine Loop Review**

Push-button dial.

- Press to toggle cine loop playback on/off.
- Turn to adjust playback speed or move from frame to frame when in pause mode.
- When you review M-Mode, PW Doppler Mode and PW Tissue Doppler Mode data, turn to increase or decrease the sweep speed of the Doppler data.

**Cine Store**

In **B-Mode, M-Mode, Contrast Mode, Color Doppler Mode and Power Doppler Mode**: Stores a set of sequential frames.

In **PW Doppler Mode, PW Tissue Doppler Mode and M-Mode**: Stores image data acquired over time.

In **3D-Mode**: Stores 3D image data.

**Close**

Closes the active study or series.

**Color**

Activates Color Doppler Mode acquisition and begins displaying the color box overlay over the B-Mode background image.

**Copy From**

Copies studies from an external storage location into the Study Browser.

**Copy To**

Copies studies to an external storage location.

**Cursor**

Toggles the trackball function from the cine loop frame control to a standard cursor. When the cursor is toggled off, you can position an overlay. When the cursor on, the cursor is displayed but you cannot use the trackball. When you stop scanning in PW Doppler Mode or M-Mode and the cursor is off, you can move the trackball and scroll through the cine loop.

**DEL**

Deletes the selected item.

**Depth Offset**

Available during all acquisition sessions for all modes that are based on B-Mode or include a B-Mode scout window. Adjusts, in 1mm increments, the distance
from the face of the transducer at which the system begins to display the ultrasound image.

**To use this rocker switch control:**

- Pull down to remove a 1mm strip of image data from the top. For example, if your transducer is set to acquire data from 2mm to 12mm, when you pull the control down once, the display will only show the data between 3mm and 12mm. The minimum depth varies by transducer.
- Push up to add a 1mm strip of image data to the top.

**Display Map**

Cycles you through a predefined set of optimization maps that you can apply either while you are acquiring or reviewing image data.

Push up or pull down to cycle through the available maps for the active imaging mode.

**Doppler Angle**

Adjusts the angle correction in 5-degree increments 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.

When the system receives the return signal, it applies an algorithm to the signal data to correct for the delta. This produces usable PW Doppler Mode data.

**To use this dial control:**

1. Turn the dial to align the dashed yellow line with the direction of the vascular flow in your sample volume region.
   
   The system always displays the value of the resulting angle as a positive value between 0 degrees and 80 degrees, regardless of which side of the vertical line you align the dashed line.
   
   For angles between 60 degrees and 80 degrees, the system applies the color blue to the dashed line. This indicates that the angle is too great to correct.

2. Reposition your transducer and/or the animal to bring the angle of the vessel as parallel as you can to the vertical yellow line that represents the transducer beam.

**Doppler Gain**

Adjusts the frequency shift in increments of 1.0 dB. Turn clockwise to add gain and brighten the Doppler data. Turn counterclockwise to reduce gain and darken the data.
Active during: PW Doppler Mode, PW Tissue Doppler Mode, Color Doppler Mode, Power Doppler Mode image acquisition sessions.

Dynamic Range

Adjusts the input signal strength that is mapped into the spectral display. Range: 5-100dB.

- Push up to increase the range by 5dB and lower contrast. Higher dynamic ranges are often used in cardiac imaging.
- Pull down to decrease the range by 5dB and increase contrast. Lower dynamic ranges are often used in abdominal imaging.

Active during: M-Mode, PW Doppler Mode, PW Tissue Doppler Mode, Power Doppler Mode image acquisition sessions.

ESC

Click to cancel an individual measurement, or store the measurements you have made during a measurement chain.

Export

Exports image frames, cine loops, DICOM images, reports and tables. Opens the Export window.

Focal Zones

This control adjusts the number and configuration of focal zones on your B-Mode based image.

Focal zones enhance the resolution across your image, while slightly reducing the acquisition frame rate. The system always displays at least one focal zone, and you can apply a maximum of two additional zones depending on the transducer. When you add focal zones the system maximizes the resolution for a larger area of your image, and reduces the acquisition frame rate.

To use this rocker switch control:

1. Push the rocker switch forward to cycle through the following focal zone application sequence:
   - Single zone
   - Two zones, narrow
   - Two zone, wide
   - Three zones, narrow
   - Three zones, wide
2. Pull the rocker switch back to cycle back through the focal zone options in reverse.

**Focus Depth**
Adjusts the depth of the B-Mode focal zone or focal zones on your image. When you have more than one focal zone this control moves the depth of all the focal zones as a group. Push up to decrease the depth. Pull down to increase.

**Frame Rate**
Adjusts the acquisition frame rate. Turn clockwise to increase the frame rate. Turn counterclockwise to lower the frame rate.
- In Contrast Mode you can select Low, Medium, High, Max
- In PW Doppler Mode and PW Tissue Doppler Mode at high pulse rate frequencies in the dual mode window view, use the control to increase or decrease the refresh rate for the B-Mode scout window

**Active during:** Contrast Mode, PW Doppler Mode and PW Tissue Doppler Mode image acquisition sessions.

**Frame Store**
Stores a snapshot of all the content in the visible frame in the ultrasound image area.
In M-Mode, PW Doppler Mode and PW Tissue Doppler Mode, stores the complete cine loop.

**Frequency**
Adjusts the transmit frequency of the transducer between the higher and lower frequency levels that are supported by the specific transducer. When you increase the frequency you can improve detail at the focus depth but the system tends to lose detail at deeper tissues.

Push forward to increase the frequency. Pull back to decrease the frequency.

**Help**
Opens the Help system for the Vevo 2100 Imaging System.

**Image Depth**
Adjusts how deep in mm you want to display the ultrasound signal. Pull down to increase the depth. Push up to decrease the depth. The available depth is transducer dependent.
**Image Label**

In the Study Browser: Adds a name to the image that is currently selected in the list.

In a Mode window: Stores the current image and adds the name that you type in the box if the **Auto SAVE on Image Label** option is selected in the General tab of the Preferences window.

**Image Process**

Provides additional pre- and post-processing options for the active imaging Mode. **Note:** Not supported in the current release.

**Image Sequence**

In Contrast Mode this control starts a sequence of configurable events. When you press the control:

1. The system begins to store image data for the predefined number of frames in the cine loop, as configured in the **Contrast Mode** preferences (page 74) section of the **General** tab in the **Preferences** window.

2. The destruction burst event (page 407) runs automatically:
   - Using a) the transducer that you connect to the front panel of the Vevo 2100 Imaging System, or using b) the *external* Vevo SoniGene transducer that you connect to the **Parallel** port on the rear panel of the cart
   - At a predefined percentage point of the entire pretrigger cine loop length
   - For a predefined period in tenths of seconds between 0.1 and 1.0 seconds (defaults to 0.5)

3. The system continues to acquire image data for the remainder of the predefined cine loop size, but the image is not automatically stored when the loop is completed unless you select **Auto SAVE on Scan Completion** for **Contrast Mode** in the **General** tab of the **Preferences** window.

To configure the control for Contrast Mode:

- In the **Cine Loop Size** section (page 71) of the **General** tab in the **Preferences** window configure the size of the cine loop.
- In the Contrast Mode preferences section (page 74) of the **General** tab in the **Preferences** window configure the parameters for the destruction sequence.
<table>
<thead>
<tr>
<th><strong>Image Width</strong></th>
<th>Adjusts the physical width of the area the transducer is imaging. Push up to increase the width. Pull down to decrease the width. <strong>Tip:</strong> The closer you can reasonably narrow the width of your image around your target structure, the higher the system sets the acquisition frame rate. This is especially helpful when you are studying cardiac tissue movement.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Invert</strong></td>
<td>Flips the image. <strong>In B-Mode:</strong> Press to flip the image left/right. <strong>In M-Mode:</strong> In the dual window view, press to flip the B-Mode scout image left/right. <strong>In PW Doppler Mode and PW Tissue Doppler Mode in the dual window view:</strong> Press to flip the spectrum window vertically. <strong>In Color Doppler Mode:</strong> Press to flip the image left/right. <strong>In Power Doppler Mode:</strong> Press to flip the image left/right. <strong>In Contrast Mode:</strong> Press to flip the image left/right. <strong>Active during:</strong> Image acquisition and review sessions in all imaging Modes except 3D-Mode.</td>
</tr>
<tr>
<td><strong>L/R Screen</strong></td>
<td>Toggles focus from left to right screen when in split screen mode.</td>
</tr>
<tr>
<td><strong>Line Density</strong></td>
<td>Adjusts the resolution of your image by adjusting how many lines of image data the transducer acquires over your image area. Push up to increase the line density. Pull down to decrease. The higher you set your line density, the lower the system sets the acquisition frame rate. Because of this trade off, you might find that higher line density is most useful for examining features in tissues that don't move very much such as liver, spleen, pancreas, and prostrate. For cardiology applications, you will tend to keep the line density lower so you can increase the frame rate to measure more tissue movements over the time span of a complete cardiac cycle.</td>
</tr>
<tr>
<td><strong>Measure</strong></td>
<td>When in a Mode window, activates the measurement panel.</td>
</tr>
</tbody>
</table>
**M-Mode**

Activates M-Mode image acquisition.

**To use this key control:**

1. Press to begin displaying the M-Mode sample volume overlay on the full-window B-Mode acquisition data.
2. Press M-Mode again (or press Update) to display the live M-Mode data in the lower window and the live B-Mode data with the sample volume overlay data in the scout window.

**Mode Settings**

When in a Mode window, activates the mode settings panel.

**New**

When you are in the Study Browser, opens the New dialog box so you can create a new study or a new series.

**Persist**

Applies a pixel averaging algorithm to the most recently acquired frames to produce a more uniform view of the faster moving areas in the image data.

**To use this rocker switch control:**

Push up or down to cycle through the persistence levels. In the bottom-left corner of the screen the status bar briefly displays the name of the persistence label as you select.

**Active during:** All image acquisition sessions except 3D-Mode.

**In B-Mode:** Reduces distracting artifacting such as shimmering effects. Levels: Off, Low, Med, High. This is most useful when you are imaging uniform tissues such as the liver, kidney and prostate.

**In M-Mode:** In the dual window view, applies only to the M-Mode image data window. It does not apply persistence to the B-Mode scout window. To change the persistence on your B-Mode image, press Update to view the full B-Mode image, apply the appropriate persistence level, and then press Update again to return to M-Mode. The updated persistence applies to the image in your B-Mode scout window.
In Color Doppler Mode and Power Doppler Mode: Applies to the color signal data only. It does not apply to the B-Mode background data. Levels: Off, Low, Med, High, Max. Helpful when you are studying abdominal organ tissue such as liver, kidney and pancreas.

In Contrast Mode: Sets the process persistence filter level. Levels: None, MIP.

Physio Settings
When in a Mode window, activates the physiological settings panel.

Power
Activates Power Doppler Mode acquisition and begins displaying the power box overlay over the B-Mode background image.

Pre Trigger
In Contrast Mode, starts an analysis based on the number of frames defined in the General tab of the Preferences window.

Stores cine loop data for a predefined number of image frames acquired after you press the control, as compared to Cine Store which stores data acquired before you press the control. To ensure that the system stores your cine loop, select the Auto SAVE at Scan Completion option in the General tab of the Preferences window.

In B-Mode, Color Mode, Power Doppler Mode, Contrast Mode: You define the pretrigger's cine loop size in the Cine Loop Size section (page 71) of the General tab in the Preferences window.

Presets
Active during image acquisition in all modes except 3D-Mode. This rocker switch cycles you through all the preset groups of acquisition parameters for the active imaging Mode. The list of presets include the transducer-specific presets as well as any custom presets that other operators added to the system.

All presets are both mode dependent, transducer dependent and application dependent.

Priority
Determines the threshold point on the gray scale above which the system does not apply color data. The red marker along the left side of the gray scale indicates the threshold point.

Push up to assign more priority to the color data. Pull down to assign less priority to the color data and more priority to the threshold on the B-Mode grayscale bar.
Useful when you suspect, for example, that color data is covering over the actual contour of a vessel wall. In this case you would lower the priority until the overlay data matches the actual tissue contour and properties.

**PW**

Activates PW Doppler Mode acquisition. Press to begin displaying the yellow PW Doppler Mode sample volume, press **Update** to display the live PW Doppler Mode spectral data in the lower window and the live B-Mode data in the scout window, then press **Simul**.

**Report**

Displays the Measurement/Analysis report page for the selected studies or series.

**Save Preset**

Opens the Save Preset Settings dialog box so you can label and save the current image acquisition parameters as a single preset in the current imaging mode.

**Scan/Freeze**

During image acquisition, toggles between acquiring image data and freezing the acquisition. When you freeze the acquisition the system stores cine loop data if you select **Auto SAVE on Image Label** in the General tab of the Preferences window.

During image analysis, starts and stops data playback.

**Screen Keys**

Push dial control to cycle through options for the current imaging mode.

**In B-Mode:** Toggles the needle guide display on and off during an injection imaging session.

**In Color Doppler Mode, Power Doppler Mode, Contrast Mode:** Cycles through three image states: Overlay + B-Mode, B-Mode only, overlay only.

**Select**

This control is the equivalent of the left button on a computer mouse. When a procedure in this documentation directs you to **click**, press this control.

**Note:** When the manual directs you to right-click, press **Update**.
Appendix C: Descriptions of control panel controls

**Sensitivity**

Adjusts the signal-to-noise ratio so that you can:

- Better identify weak-signal targets in the near field that are difficult to distinguish because they are very small
- Better identify large targets in the far field that are difficult to distinguish because the signal is so attenuated at depth.

The higher you set the sensitivity level, the lower the system sets the frame rate. Push up to increase sensitivity. Pull down to decrease.

**Simul**

This toggle control sets the system to acquire live data simultaneously in both the B-Mode scout window as well as the PW Doppler image window.

In the dual window view, use this feature when you want to adjust your sample volume in the B-Mode scout window while you view the waveform data in the PW Doppler Mode window.

**To use this toggle control:**

1. Press to activate the simultaneous state.
   
   A black vertical strip scans across the spectrum from left to right.
2. To eliminate this striping, press the toggle again to freeze the scout window and return to PW Doppler image data only.

**Active during:** M-Mode, PW Doppler Mode and PW Tissue Doppler Mode image acquisition sessions.

**Split Screen**

During analysis in a Mode window, toggles between full screen and vertical split screen. In split-screen display, you can acquire data in one of the two screens.

**Study Info**

**In the Study Browser:** Opens the Study Info window for the selected study.

**In a Mode window:** Opens the Study Info window for the displayed image.

**Study Management**

Opens the Study Browser window.
**SV/Gate**

Push up to increase. Pull back to decrease.

**In M-Mode:** This control adjusts the size of the sample gate, measured in mm. The control adjusts the distance of the vertical line between the two yellow calipers.

In the dual window view, the system displays the M-Mode sample gate image data. Current data is on the right side, trailing data extends to the left.

**In PW Doppler Mode:** This control adjusts the distance in mm of the vertical line between the two yellow calipers of the sample volume.

In the dual window view, the system displays the spectral data that the system acquires along this line. Current data is on the right side, trailing data extends to the left.

**In Power Doppler Mode and Color Doppler Mode:** Adjusts the size of the gate, indexed in a range from 1-6.

- Set your gate to 1 for the best axial resolution. This is optimal for identifying very small vessels.
- Set your gate to 6 for the best sensitivity. This is optimal for studying deep vessels such as an abdominal aorta.

**Active during:** Color Doppler Mode and Power Doppler Mode image acquisition sessions. In M-Mode and PW Doppler Mode, the control is active in the full-screen B-Mode window after you select the Mode.

**Sweep Speed**

Adjusts the cine loop playback speed parameter so that you can stretch out or compress the cine loop data in the review window. Push up to increase the speed and compress the cine loop image. Pull down to decrease the speed and expand the cine loop image.

When you are reviewing the cine loop you can also use the **Cine Loop Review** control to adjust the sweep speed.

**In M-Mode:** Set the sweep speed parameter in a range from 200 Hz to 4000 Hz in increments of 100 Hz. The system displays the updated values in the status bar in the lower left area of the screen.

In cardiac applications you might want to decrease the M-Mode sweep speed so you can view more wall movements over more cardiac cycles in the window, or increase the speed so you can view more wall detail over one cycle.

**In PW Doppler Mode** and **PW Tissue Doppler Mode:** Set the sweep speed parameter in a range from 0.25 seconds at 4000 Hz to 5.1 seconds at 200 Hz. In
some cases, if your imaging window is large and the Velocity is set high, the minimum speed may be greater. The system displays the updated values in the status bar in the lower left area of the screen.

**Active during:** M-Mode, PW Doppler Mode and PW Tissue Doppler Mode image acquisition and review sessions.

| Time gain compensation controls. During image acquisition in any B-Mode based imaging mode, each slider adjusts the ultrasound signal to compensate for minor attenuation as it returns through deeper situated tissue. Each slider adjusts the return signal across a specific depth band. The top slider adjusts the return signal across the area closest to the probe face. The bottom slider adjusts the return signal across the area furthest from the probe face. Push the slider to the right to boost the signal and brighten the image data in that horizontal band, and left to attenuate the signal and darken that band. |
|---|---|

**Tissue**

During a PW Doppler Mode image acquisition, activates PW Tissue Doppler Mode image acquisition.

**Transmit Power**

Adjusts the power of the ultrasound signal transmission.

Turn clockwise to increase power. Turn counterclockwise to decrease power. Between 1% and 10% power the control adjusts power in increments of 1%. Between 10% to 100% power the control adjusts in increments of 10%.

<table>
<thead>
<tr>
<th>Update</th>
</tr>
</thead>
</table>

**Function 1: display control**

Alternates the display from the dual view (B-Mode scout window on top, Mode image window on the bottom) to the B-Mode image plus overlay so you can position your sample gate (in M-Mode) or sample volume (in PW Doppler Mode) more precisely.

**To use this toggle control:**

1. Press to view the dual view.
2. Press again to display the B-Mode window and overlay.

**Function 2: right-click button**

When the manual directs you to right-click, press Update.
### Velocity

Adjusts the PRF (pulse repetition frequency). The higher you set the PRF, the lower the signal resolution.

**In PW Doppler Mode:** Adjust the range of the scale of the Y axis on the Power Doppler Mode image window by adjusting the pulse rate frequency of the ultrasound signal. Use this control when the spectral waveform is either too compressed or too expanded for your purposes.

**Note:** In the General tab of the Preferences window you can set the **PW Doppler Scale** (Y axis) to display either velocity or frequency.

Turn the dial clockwise to compress the waveform by increasing the range of the scale. Turn counterclockwise to expand the waveform by decreasing the range of the scale.

### Volume

Adjusts the speaker volume for the PW Doppler Mode and PW Tissue Doppler Mode audio data that the system acquires along with the spectral data.

**To use this dial control:**

- Turn clockwise to increase the volume.
- Turn counterclockwise to decrease the volume.

**Active during:** PW Doppler Mode and PW Tissue Doppler Mode image acquisition and review sessions.

### Wall Filter

Filters out signals that correspond to low velocity axial motion. Typically these include vessel wall movement, cardiac wall movement and tissue movement caused by respiration. Push up to filter out more. Pull down to filter out less.

**In PW Doppler Mode:** Use this control to filter out the display of low velocity signal artifacting that appears as a horizontal black band along either side of the white baseline. Push up to reduce the lower velocity signals and bring the waveform of the spectral data closer to the baseline. Pull down to display more low velocity signals.

**In Color Doppler Mode and Power Doppler Mode:** Set as low as you can so that you don't lose any flow, but higher than any motion that creates low frequency artifacting.
### Zoom

Activates a customizable blue zoom box overlay and magnifies the image data inside that box.

**To use this three-stage toggle control:**

1. Press **Zoom** to activate the control and display the blue zoom box overlay.
2. Modify the proportion of the zoom box.
   a. Press **Update**. The system changes the box to a dashed-line box.
   b. Trackball left/right and up/down to change the width and height of the zoom box.
   c. Press **Update** to reapply the box.
3. Trackball to position the zoom box.
4. Press **Zoom** when you are satisfied with the proportion and position of your zoom box.

   The system crops out all data outside the zoom box and applies a 2x magnification to the data inside the box.

5. Press **Zoom** to zoom out to the original image area.

**Active during:** B-Mode, Color Doppler Mode, Power Doppler Mode image acquisition sessions. Available in M-Mode, PW Doppler Mode, PW Tissue Doppler Mode only when you are only displaying the B-Mode image and sample volume or gate overlay.
Appendix D

Options and accessories

This appendix lists the available options and accessories for the Vevo 2100 Imaging System.

### MicroScan transducers

<table>
<thead>
<tr>
<th>Item</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS-200: 15MHz MicroScan transducer</td>
<td>VS-11956</td>
</tr>
<tr>
<td>- Broadband Frequency: 9 MHz - 18 MHz</td>
<td></td>
</tr>
<tr>
<td>- Applications: Rabbit, general and abdominal imaging</td>
<td></td>
</tr>
<tr>
<td>MS-250: 20 MHz MicroScan transducer</td>
<td>VS-11957</td>
</tr>
<tr>
<td>- Broadband Frequency: 13 MHz - 24 MHz</td>
<td></td>
</tr>
<tr>
<td>- Applications: Rat cardiology and abdominal imaging</td>
<td></td>
</tr>
<tr>
<td>MS-400: 30 MHz MicroScan transducer</td>
<td>VS-11959</td>
</tr>
<tr>
<td>- Broadband Frequency: 18 MHz - 38 MHz</td>
<td></td>
</tr>
<tr>
<td>- Applications: Optimized for Mouse Cardiovascular imaging with frame rates greater than 300 frames per second</td>
<td></td>
</tr>
<tr>
<td>MS-550D: 40 MHz MicroScan transducer</td>
<td>VS-11960</td>
</tr>
<tr>
<td>- Broadband Frequency: 22 MHz - 55 MHz</td>
<td></td>
</tr>
<tr>
<td>- Applications: Mouse cancer and abdominal imaging</td>
<td></td>
</tr>
<tr>
<td>MS-550S: 45 MHz MicroScan transducer</td>
<td>VS-11961</td>
</tr>
<tr>
<td>- Broadband Frequency: 32 MHz - 56 MHz</td>
<td></td>
</tr>
<tr>
<td>- Applications: Optimized for mouse embryology imaging and injection</td>
<td></td>
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</tbody>
</table>

### Imaging and analysis software options

<table>
<thead>
<tr>
<th>Item</th>
<th>Part number</th>
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<tbody>
<tr>
<td>ECG-Triggered - Respiration Gated Analysis</td>
<td>VS-11954</td>
</tr>
<tr>
<td>M-Mode</td>
<td>VS-11948</td>
</tr>
<tr>
<td>PW Doppler Mode</td>
<td>VS-11949</td>
</tr>
<tr>
<td>PW Tissue Doppler Mode</td>
<td>VS-11950</td>
</tr>
<tr>
<td>Color Doppler Mode</td>
<td>VS-11951</td>
</tr>
<tr>
<td>Power Doppler Mode</td>
<td>VS-11952</td>
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<tr>
<td>3D Mode</td>
<td>VS-11484</td>
</tr>
<tr>
<td>Contrast Imaging Functionality</td>
<td>VS-11953</td>
</tr>
<tr>
<td>LV Analysis</td>
<td>VS-11955</td>
</tr>
<tr>
<td>VevoStrain™ Analysis</td>
<td>VS-11846</td>
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</table>
## Vevo 2100 Workstation Software and System

<table>
<thead>
<tr>
<th>Item</th>
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<tbody>
<tr>
<td>Vevo 2100 Workstation Software</td>
<td>VS-11962</td>
</tr>
<tr>
<td>Vevo 2100 Workstation System</td>
<td>VS-11963</td>
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</table>

## MicroMarker™ contrast agent and cannulation kits

<table>
<thead>
<tr>
<th>Item</th>
<th>Part number</th>
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</thead>
<tbody>
<tr>
<td>Vevo MicroMarker™ Non-Targeted Contrast Agent Kit</td>
<td>VS-11694</td>
</tr>
<tr>
<td>Vevo MicroMarker™ Target-Ready Contrast Agent Kit</td>
<td>VS-11675</td>
</tr>
<tr>
<td>Vevo MicroMarker™ DEPO™ Contrast Agent Kit</td>
<td>VS-11676</td>
</tr>
<tr>
<td>MicroMarker™ VA (Vascular Access) Cannulation Kit (1-pack)</td>
<td>VS-11720</td>
</tr>
<tr>
<td>MicroMarker™ VA (Vascular Access) Cannulation Kit (3-pack)</td>
<td>VS-11721</td>
</tr>
<tr>
<td>MicroMarker™ TVA (Tail Vein Access) Cannulation Kit</td>
<td>VS-11848</td>
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<tr>
<td>Tail Vein Catheters</td>
<td>VS-11912</td>
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## Imaging stations and image-guided injection components

<table>
<thead>
<tr>
<th>Item</th>
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<tbody>
<tr>
<td>Vevo 2100 Imaging Station 1</td>
<td>SA-11982</td>
</tr>
<tr>
<td>Vevo 2100 Imaging Station 2</td>
<td>SA-11983</td>
</tr>
<tr>
<td>Mouse Handling Table</td>
<td>SA-11436</td>
</tr>
<tr>
<td>Rat Handling Table</td>
<td>SA-11550</td>
</tr>
<tr>
<td>Advanced Physiological Monitoring Unit (TMH 150)</td>
<td>SA-11426</td>
</tr>
<tr>
<td>Imaging Station Extension with Injection Mount</td>
<td>SA-11934</td>
</tr>
<tr>
<td>Vevo Embryo Injection Expansion Set</td>
<td>SA-11852</td>
</tr>
<tr>
<td>Vevo SoniGene™ System</td>
<td>SA-11820</td>
</tr>
<tr>
<td>Vevo Replacement Injection Unit</td>
<td>SA-11315</td>
</tr>
<tr>
<td>Vevo Ball Joint Unit - Short</td>
<td>SA-11179</td>
</tr>
<tr>
<td>Vevo Ball Joint - Tall and Quick-Lift Unit</td>
<td>SA-11278</td>
</tr>
<tr>
<td>Universal Rotating RMV Clamp for Rail System</td>
<td>SA-11801</td>
</tr>
<tr>
<td>Universal Power Supply Kit (120V)</td>
<td>SA-11208</td>
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<tr>
<td>Universal Power Supply Kit (230V)</td>
<td>SA-11209</td>
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<tr>
<td>Replacement Rectal Temperature Probe</td>
<td>SA-11271</td>
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<tr>
<td>Vevo 2100 Imaging Starter Kit</td>
<td>SA-10907</td>
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<tr>
<td>Image-Guided Injection Starter Kit</td>
<td>SA-11059</td>
</tr>
<tr>
<td>10-Pack Glass Pulled Capillaries</td>
<td>SA-11052</td>
</tr>
<tr>
<td>Glass Capillary Tubes (3.5” long, unfinished)</td>
<td>SA-11454</td>
</tr>
<tr>
<td>10-Pack High Wall Petri Dish</td>
<td>SA-11213</td>
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<tr>
<td>10-Pack Low Wall Petri Dish</td>
<td>SA-11620</td>
</tr>
<tr>
<td>Membranes (1pk = 50 pcs)</td>
<td>SA-11054</td>
</tr>
<tr>
<td>Membrane tape (1 pk = 50 pcs)</td>
<td>SA-11053</td>
</tr>
<tr>
<td>Thermasonic Gel Warmer (110V)</td>
<td>SA-10749</td>
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</tbody>
</table>
### Appendix D: Options and accessories

<table>
<thead>
<tr>
<th>Item</th>
<th>Part number</th>
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<tbody>
<tr>
<td>Thermasonic Gel Warmer (230V)</td>
<td>SA-10750</td>
</tr>
<tr>
<td>Low Viscosity Ecogel (1 pk = 6 x 250mL)</td>
<td>SA-11621</td>
</tr>
<tr>
<td>High Viscosity Aquasonic Gel (1 pk = 6 x 250mL)</td>
<td>SA-11622</td>
</tr>
<tr>
<td>ECG Sigma Gel - Electrode gel (60g)</td>
<td>SA-10740</td>
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<tr>
<td>Nair Hair Remover Cream</td>
<td>SA-10747</td>
</tr>
<tr>
<td>Aquagel Lubricant</td>
<td>SA-10738</td>
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<tr>
<td>T-Spray</td>
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### Power cords and plugs

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Mains AC Power Cord – North America</td>
<td>SA-11233</td>
</tr>
<tr>
<td>Mains AC Power Cord - Australia/New Zealand</td>
<td>SA-11234</td>
</tr>
<tr>
<td>Mains AC Power Cord - Japan</td>
<td>SA-11235</td>
</tr>
<tr>
<td>Mains AC Power Cord - Israel</td>
<td>SA-11236</td>
</tr>
<tr>
<td>Mains AC Power Cord - Continental Europe</td>
<td>SA-11237</td>
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<tr>
<td>Mains AC Power Cord - Italy</td>
<td>SA-11238</td>
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<tr>
<td>Mains AC Power Cord - UK/Ireland</td>
<td>SA-11239</td>
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<tr>
<td>Mains AC Power Cord - Switzerland</td>
<td>SA-11240</td>
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<tr>
<td>Mains AC Power Cord - Denmark</td>
<td>SA-11241</td>
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<tr>
<td>Mains AC Power Cord - China</td>
<td>SA-11242</td>
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<tr>
<td>Mains AC Power Cord - Argentina</td>
<td>SA-11243</td>
</tr>
<tr>
<td>Plug - Australia/New Zealand</td>
<td>SA-10759</td>
</tr>
<tr>
<td>Plug - Japan</td>
<td>SA-10760</td>
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<td>Plug - Israel</td>
<td>SA-10761</td>
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<td>Plug - Italy</td>
<td>SA-10763</td>
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<tr>
<td>Plug - UK/Ireland</td>
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<tr>
<td>Plug - Switzerland</td>
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<td>Plug - Denmark</td>
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<td>Plug - China</td>
<td>SA-10767</td>
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<tr>
<td>Plug - France/Belgium</td>
<td>SA-10768</td>
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<tr>
<td>Plug - Argentina</td>
<td>SA-10769</td>
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<tr>
<td>Plug - India/South Africa</td>
<td>SA-10770</td>
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### Vevo anesthesia systems and accessories - oxygen and Medical Air

<table>
<thead>
<tr>
<th>Item</th>
<th>Part number</th>
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<tbody>
<tr>
<td>Vevo Compact Dual Anesthesia System (Tabletop Version)</td>
<td>SA-12055</td>
</tr>
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</table>

New orders must be shipped with 2 regulators of O2 and MA types
### Vevo Compact Dual Anesthesia System (Mobile Version)

New orders must be shipped with 2 regulators of O2 and MA types.

<table>
<thead>
<tr>
<th>Option Description</th>
<th>Part Number</th>
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<tbody>
<tr>
<td>Vevo Compact Medical Air Anesthesia System Conversion Kit (Tabletop Version)</td>
<td>SA-11829</td>
</tr>
<tr>
<td>Vevo Compact Medical Air Anesthesia System Conversion Kit (Mobile Version)</td>
<td>SA-11922</td>
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</table>

### "H" Type Regulator

<table>
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<th>Part Number</th>
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### "E" Type Regulator

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### "H" Type Medical Air Regulator

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### "E" Type Medical Air Regulator

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### Single Yoke Assembly/Regulator

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### Single Yoke Medical Air Assembly/Regulator

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### Dual Procedure Anesthesia Circuit

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### 9 mm Bain Circuit (for Mouse Anesthesia)

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### 12.5 mm Bain Circuit (for Rat Anesthesia)

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### 14 mm Bain Circuit (for Rat Anesthesia)

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### 10’ (3m) Oxygen Hose D.I.S.S. x D.I.S.S. - Green (NA) (931530)

<table>
<thead>
<tr>
<th>Part Number</th>
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<tbody>
<tr>
<td>SA-11795</td>
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### 10’ (3m) Oxygen ISO D.I.S.S. Female –Male Hose Assembly (Japanese)

<table>
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<tbody>
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### 10’ (3m) Oxygen ISO D.I.S.S. Female –Female Hose Assembly (Australian)

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<th>Part Number</th>
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<tbody>
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<td>SA-11304</td>
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### 10’ (3m) Oxygen ISO D.I.S.S. Female –Male Hose Assembly (German)

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<th>Part Number</th>
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<tbody>
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### 10’ (3m) Oxygen ISO D.I.S.S. Female – Male Hose Assembly (British)

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<tbody>
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<td>SA-11306</td>
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### 10’ (3m) Oxygen ISO D.I.S.S. Female – Drager Din

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<td>SA-11307</td>
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### 10’ (3m) Oxygen ISO D.I.S.S. Female – Afnor Male Hose Assembly (French)

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<tbody>
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<td>SA-11308</td>
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### 10’ (3m) Hose Assembly ISO Air DF – Afnor Male Hose Assembly (French)

<table>
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<th>Part Number</th>
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<tr>
<td>SA-11923</td>
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### 10’ (3m) Hose Assembly ISO Air DF – Male Hose Assembly (German)

<table>
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<th>Part Number</th>
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<tbody>
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<td>SA-11924</td>
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### 10’ (3m) Hose Assembly ISO Air DF – Female Hose Assembly (Scandinavian)

<table>
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### 10’ (3m) Hose Assembly ISO Air DF – Male Hose Assembly (British)

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<th>Part Number</th>
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<tr>
<td>SA-11926</td>
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### 10’ (3m) Hose Assembly ISO Air DF – Male Hose Assembly (Japanese/Korean)

<table>
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</thead>
<tbody>
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</table>

### 10’ (3m) Hose Assembly ISO Air DF – N.I.S.T Female Hose Assembly (European)

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<th>Part Number</th>
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### 10’ (3m) Hose Assembly ISO Air DF – Female Hose Assembly (Australian)

<table>
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<tr>
<td>SA-11929</td>
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### 10’ (3m) Hose Assembly ISO Air DF – Drager Din (Italy)

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<tr>
<th>Part Number</th>
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<tbody>
<tr>
<td>SA-11930</td>
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### User training

<table>
<thead>
<tr>
<th>Item</th>
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<tbody>
<tr>
<td>Introductory 2-Day On-Site User Training</td>
<td>VS-INTUSRTRAIN</td>
</tr>
<tr>
<td>On-Site 1-Day User Training</td>
<td>VS-ADDUSRTRAIN</td>
</tr>
</tbody>
</table>
Appendix D: Options and accessories

<table>
<thead>
<tr>
<th>Training/Workshop</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-Day On-Site MicroMarker™ Training</td>
<td>VS-2D-MMTRAIN</td>
</tr>
<tr>
<td>1-Day On-Site MicroMarker™ Training</td>
<td>VS-1D-MMTRAIN</td>
</tr>
<tr>
<td>Additional 1-Day of On-Site User Training</td>
<td>VS-ADD-1DTRAIN</td>
</tr>
<tr>
<td>Customized 2-Day In Vivo User Training (Toronto)</td>
<td>VS-INVIVOTRAIN</td>
</tr>
<tr>
<td>2-Day In Vivo Workshop (Toronto)</td>
<td>VS-2D-WSHOP</td>
</tr>
<tr>
<td>1-Day In Vivo Workshop (Toronto)</td>
<td>VS-1D-WSHOP</td>
</tr>
<tr>
<td>2-Day In Vivo Imaging Workshop (Amsterdam)</td>
<td>VS-2D-WSHOP-EU</td>
</tr>
<tr>
<td>1-Day In Vivo Imaging Workshop (Amsterdam)</td>
<td>VS-1D-WSHOP-EU</td>
</tr>
</tbody>
</table>

Supplier

VisualSonics Inc. is the supplier for all the items that are listed in this appendix.
VisualSonics Inc.
3080 Yonge Street, Suite 6100, Box 66
Toronto, Ontario CANADA M4N 3N1
Tel: +1 (416) 484-5000
Toll Free: 1-866-416-4636 (North America)
Fax: +1 (416) 484-5001
www.visualsonics.com
Appendix E

Product safety testing and electrical testing

VisualSonics products tested
Vevo 2100 Imaging System
VisualSonics MicroScan transducers: MS-200, MS-250, MS-400, MS-550D, MS-550S

Tested to the following standards
CAN/CSA C22.2 No. 61010-1-04; µL Std No. 61010-1; EN 61010-1:2001

Test laboratories
Global Advantage International Inc.
180 Brodie Drive, Unit 2
Richmond Hill, Ontario, Canada, L4B 3K8

Send any questions to
Product Safety and Testing
Quality Assurance and Regulatory Affairs
VisualSonics Inc.
3080 Yonge Street, Suite 6100, Box 66
Toronto, Ontario, Canada, M4N 3N1
Tel: +1 (416) 484-5000
Toll-Free: 1-866-416-4636 (North America)
Fax: +1 (416) 484-5001
E-mail: productsafety@visualsonics.com
Authorized representative

Europe

Atlantic Bridge Limited
Zenith House 11 the Street Chirton Devizes Wiltshire SN10 3QS UK
Tel: +44(0) 1380.848170
Contact: Mr. David Baker
E-mail: david.baker@atlanticbridge.co.uk
Appendix F

Safety

Please read the safety information before using the Vevo 2100 Imaging System. The following information applies to the Vevo 2100 Imaging System and supporting equipment.

The use of this equipment is intended for qualified research scientists.

Read all warnings and cautionary notes carefully before you use this equipment.

**IMPORTANT:** If you operate the Vevo 2100 Imaging System products in a manner not specified in this operator manual you void the terms of the product warranty.

## Warnings

**WARNING:** **THIS EQUIPMENT IS NOT APPROVED FOR USE ON HUMANS.**

The Vevo 2100 Imaging System has been designed and tested for use on laboratory research animals. This equipment must not be used on any living human being.

**WARNING:** Where available, always use the lowest power settings necessary to obtain diagnostically acceptable images.

High levels of transmitted ultrasound energy can damage tissue. Never tamper with or alter the Vevo 2100 Imaging System in any way such that the acoustic power level is increased.

**WARNING:** **Use ONLY VisualSonics transducers with the Vevo 2100 Imaging System.** The use of other transducers may affect safety and system performance.
Appendix F: Safety

Electric shock hazards

**WARNING:** Before connecting the Vevo 2100 to the mains, verify that the specified voltage on the rear panel matches the power source voltage.

An incorrect power source voltage could cause an electrical hazard and could cause serious damage to the equipment.

**WARNING:** Before connecting the Vevo 2100 to the mains, always check that the mains cable is undamaged.

**WARNING:** Do not remove any panels from the Vevo 2100 Imaging System. Do not remove the outer transducer housing.

Service to the system is to be performed by qualified personnel only, with the exception of servicing the air filters. No operator-serviceable parts are located inside the system.

Any internal adjustments, replacements or modifications to the Vevo 2100 Imaging System electronics or to the transducers should be made only by qualified VisualSonics Technical Support Representatives.

**WARNING:** If the system is not properly grounded or earthed, it becomes a possible electrical shock hazard. Protection against electrical shock has been provided through an isolation transformer and chassis grounding via a plug to an appropriate power source.

DO NOT remove the ground wires from any part of the Vevo 2100 Imaging System for any reason.

**WARNING:** Ensure that all power sources, whether a UPC or a wall outlet, are properly grounded or earthed.
WARNING: Disconnect the system from the power source before cleaning the system or performing any maintenance operations.

WARNING: Connection of devices not authorized by VisualSonics to the Vevo 2100 Imaging System isolation transformer could result in an electrical hazard.

WARNING: If any part of the Vevo 2100 Imaging System is in contact with hazardous chemicals or biological materials, appropriate precautions must be taken by all who come into contact with the Vevo 2100 Imaging System until the device is declared completely free of harmful contamination.

WARNING: The Vevo 2100 Imaging System is both delicate and heavy. Careless moving and rough handling can damage the system and cause injury to others (e.g., rolling over feet, colliding with people or walls). Never use the system if there is damage to the cart, cables or accessories.

WARNING: Do not immerse the transducer in coupling medium beyond the lowest ring on the transducer housing.

The housing of the transducer is not watertight. If the transducer is immersed beyond the lowest ring on the transducer housing, the electrical safety features may be compromised.

WARNING: DO NOT spray or drip any liquid into the system or onto the keyboard, as this could affect reliable operation and electrical safety.
Electromagnetic interference

**WARNING:** The Vevo 2100 Imaging System should never be used where patient safety could be affected by the malfunction of medical devices.

The Vevo 2100 Imaging System is designed for use in preclinical laboratories and is not cleared for use with or in the vicinity of active medical devices. High levels of electromagnetic energy may interfere with the operation of the Vevo 2100 Imaging System. Furthermore, the Vevo 2100 Imaging System could affect the safe operation of sensitive medical devices.

Cautionary notes

This operator manual includes a broad range of cautionary notes.

Safety symbols used in this manual

The following table lists the safety symbols used in this manual.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Publication</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IEC 60417 - 5031</td>
<td>Alternating current</td>
</tr>
<tr>
<td><img src="image" alt="Alternating current" /></td>
<td>IEC 60417 - 5017</td>
<td>Earth (ground) terminal</td>
</tr>
<tr>
<td><img src="image" alt="Earth" /></td>
<td>IEC 60417 - 5019</td>
<td>Protective earth (ground)</td>
</tr>
<tr>
<td><img src="image" alt="On (supply)" /></td>
<td>IEC 60417 - 5007</td>
<td>On (supply)</td>
</tr>
<tr>
<td><img src="image" alt="Off (supply)" /></td>
<td>IEC 60417 - 5008</td>
<td>Off (supply)</td>
</tr>
<tr>
<td><img src="image" alt="Attention" /></td>
<td>ISO 7000 - 0434</td>
<td>Attention, consult accompanying documents</td>
</tr>
</tbody>
</table>

Physical hazards
CAUTION: Watch out for strained and twisted cables.

Some of the optional accessories have long cables. Take care when working around the cables.

CAUTION: VisualSonics recommends that the Vevo 2100 Imaging System be pushed by one person from behind and guided by another person in front, using the grab bars. Please use caution when going up or down ramps. Keep the system upright during transport.

Ensure that the castors are locked when the Vevo 2100 Imaging System is not being transported.

Never lift the system using the grab bars.

Magnetic field sensitivity

CAUTION: DO NOT station the Vevo 2100 Imaging System close to large clinical magnets as the magnetic fields may affect the performance of the Vevo system and cause distortion in the acquired image.

Labeling and verification

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference; and
- This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the operator will be required to correct the interference at his own expense.
WARNING: Changes or modifications not expressly approved by VisualSonics could void the operator’s authority to operate the equipment.
Appendix G

Specifications

**Environmental specifications**

The Vevo 2100 Imaging System operating environment should be free of fumes, dirt, and electrical interference.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>10° to 40° C (50° to 104° F)</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>15% to 80% non-condensing</td>
</tr>
<tr>
<td>Altitude</td>
<td>Up to 2000m</td>
</tr>
</tbody>
</table>

**System dimensions**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (without monitor)</td>
<td>112 cm (44 in.)</td>
</tr>
<tr>
<td>Height (with monitor)</td>
<td>155 cm (61 in.)</td>
</tr>
<tr>
<td>Width</td>
<td>71 cm (28 in.)</td>
</tr>
<tr>
<td>Depth</td>
<td>101 cm (39.5 in.)</td>
</tr>
<tr>
<td>Weight</td>
<td>170kg (375 lb.)</td>
</tr>
</tbody>
</table>

Ensure that sufficient clearance is available around the system for adequate airflow and cooling. Do not block the air vents or air filters.

**Electrical specifications**

VisualSonics manufactures systems that operate with AC line voltages of 100V, 120V, and 240V. The electrical configuration of the system is noted on the system nameplate.

- 100V~, 50/60Hz, 5A
- 120V~, 50/60Hz, 5A
- 240V~, 50/60Hz, 2.5A

For optimal system performance, use a dedicated, interference-free, isolated, grounded/earthed wall outlet.
WARNING: Before having the system installed, ensure that the electrical service in the facility is adequate.

Do not modify the attachment plug or use an adapter. Doing so may cause an electrical hazard.
Appendix H

Technical support and user maintenance

This appendix details the technical support and user maintenance information.

Service provided by VisualSonics

If problems arise with the Vevo 2100 Imaging System, VisualSonics will ensure that the system remains operational, with minimal downtime.

When such problems occur, please contact the VisualSonics Technical Support department so that a Technical Support representative can assess and resolve the problem:

In North America

- Phone: 1-416-484-5000
- Fax: 1-416-484-5001
- Toll-Free: 1-866-416-4636
- E-mail: support@visualsonics.com

In Europe

- Phone: +31 (0) 20 751 2020
- Fax: +31 (0) 20 751 2021
- Toll-Free: +800 0751 2020
- E-mail: support@visualsonics.com

For minor problems, the Technical Support representative can help you troubleshoot the situation by phone or by e-mail. For more complex problems, VisualSonics may:

- Send a Technical Support representative to the location to evaluate the problem
- Request that the equipment be transported to the VisualSonics Service department
Maintaining the Vevo 2100 Imaging System

The Vevo 2100 Imaging System requires proper care and cleaning. Improper system care voids the warranty or the service contract.

Move the system carefully. Be especially alert when you move the system along inclined passages.

Moving the system

Use the following precautions when you move the system:

- Turn the system off and disconnect the power cord and any other cords. Secure loose cables using the cable holder beneath the keyboard shelf.
- Disconnect the transducers and store them in the provided cases.
- Unlock the castors.
- Use the grab bars to move the system.
- Do not use the grab bars to lift the system.
- Do not allow the system to strike walls or door frames.
- Use care when moving the system off ramps or elevators.
- Lock the castors when the system is to remain stationary.

CAUTION: Care should also be taken when handling heavy items, as it is easy to crush limbs when lifting or moving them.

Cleaning the system

To clean the Vevo 2100 Imaging System:

1. Turn the system off and unplug it from the power outlet.
2. Clean the system cart, the integrated keyboard/trackball, and the monitor with a damp cloth soaked in mild soap and water.

CAUTION: DO NOT spray or drip any liquid into the system or onto the keyboard.

To clean the trackball if it rolls roughly:

1. With the tip of a pen turn the trackball housing ring counterclockwise.
2. Remove the ring, remove the ball, and then wipe it with a damp cloth.
3. Replace the ball and the housing ring.

**To disinfect the system:**
Use Sporicidin wipes.

---

**Maintaining the MicroScan transducer**

The MicroScan transducer is the most delicate component of the Vevo 2100 Imaging System. Use care when handling the transducer. Proper handling maintains the high quality performance of the transducer in addition to extending the working lifetime of the transducer and the transducer.

**WARNING:** High levels of ultrasound energy can damage tissue. Do not touch the transducer when acoustic power could be generated. Always switch off the Vevo 2100 before attempting any cleaning or replacing the transducer.

**Cleaning the transducer**

After every imaging session, gently wipe down the transducer with a soft cloth and isopropyl alcohol or use Sporacidin wipes.

**Storing the transducer**

The transducer may be stored in the holder attached to the sides of the Vevo 2100 Imaging System.

Place the transducer into one of the holders with the nose pointing upward. Always ensure that the cable is not twisted when storing the transducer.

Always use the provided case to transport the transducer from one site to another.

**Follow these guidelines when you store the transducer in the provided case:**

- Make sure that the transducer is clean and dry before you place it in the case.
- Place the transducer in the case carefully to prevent kinking of the cable.
- Avoid storing the transducer in areas of extreme temperatures or in direct sunlight.
- Store the transducer separately from other instruments to avoid inadvertent damage.
Appendix H: Technical support and user maintenance

Disposal

The equipment owner is required to ensure that environmental and health and safety regulations are met when disposing of this equipment.

Because the Vevo 2100 Imaging System includes components that may contain substances that could be harmful, particular care should be taken to meet the current regulations for the disposal of hazardous substances.

The following substances within the Vevo 2100 Imaging System are potential health hazards:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Location in Vevo 2100 Imaging System</th>
<th>Indication of Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead (Pb)</td>
<td>Soldered joints</td>
<td>Very small quantities</td>
</tr>
<tr>
<td>Lithium Ion</td>
<td>Back-up battery in computer</td>
<td>Very small quantities</td>
</tr>
<tr>
<td>Mercury</td>
<td>LCD monitor</td>
<td>Very small quantities</td>
</tr>
</tbody>
</table>

These substances are only capable of being released when the component or the whole assembly is being disposed of.

Should there be any queries about any of the substances within the Vevo 2100 Imaging System, please contact VisualSonics.

Cleaning the air filters

The Vevo 2100 Imaging System includes three air filters. One is situated on the rear panel, the other two are situated at bottom of the front and back of the cart.

VisualSonics recommends that you clean the air filters every three months. If an air filter has been torn, it should be replaced. Contact a VisualSonics Technical Support Representative (support@visualsonics.com).

Cleaning the rear panel air filter

You will need a flathead screwdriver to complete this procedure.
To clean the air filter:

1. With a flat-head screwdriver turn the panel latch screw counter-clockwise until you loosen the panel from the frame.

2. Firmly but carefully lift the panel until the white tongues are out of the frame slots.

3. Carefully pull the panel straight back.

4. Twist off the filter housing lid thumbscrews and remove the filter housing lid.

5. Slide the filter from the filter housing.

6. Wash the filter with water or vacuum it to remove dust.
To replace the air filter:

1. Slide the filter back into the filter housing.
2. Replace the filter housing lid and twist on the filter housing lid thumbscrews.
3. Carefully slide the panel tongues into the frame slots and then screw the panel latch screw back in until it is tight.

Cleaning the frame base air filters

Your system includes one air filter at the front of the frame base and an identical one at the rear.

To clean either frame base air filter:

1. Loosen the thumbscrews that secure the filter housing to the base of the cart frame.
2. Slide the filter housing away from the cart to release it.
3. Remove the four wing-nuts.
4. Remove the filter from the filter housing.
5. Wash the filter with water, or vacuum it to remove dust.

To replace the air filter:

1. Place the filter in the filter housing.
2. Secure the filter using four wing-nuts.
3. Slide the filter housing back into the cart.
4. Tighten the thumbscrews to secure the filter housing to the base of the cart frame.
Appendix I

Declaration of Conformity

E C DECLARATION OF CONFORMITY
FOR THE VEVO 2100®

The EC Directives covered by this Declaration

1. Council Directive 2006/95/EC concerning electrical equipment designed for use within certain voltage limits (the “Low Voltage Directive” and


The Products Covered by this Declaration

Vevo 2100® High Resolution Imaging System

The Basis on which Conformity is Declared

The product identified above complies with the Safety Requirements of the Low Voltage Directive and applicable requirements of the EMC Directive. Compliance has been achieved by reference to the following Harmonised and International Standards:

EN 61010-1: 2001 (IEC 61010:2001)  

EN 60950-1 2006  

The technical documentation required to demonstrate compliance with the Essential Requirements of the Low Voltage Directive and the Electro-Magnetic Compatibility Directive has been compiled by the signatory below and is available for inspection by the relevant enforcement authorities.

Signed: ...........................................  Date:  
Name:  Randy AuCoin  Position: VP, QA & Regulatory Affairs

Authorised Representative in Europe

Signed: ...........................................  Date:  
Name:  D H G Baker  Position: Director Atlantic Bridge Limited
Address:  Zenith House, 11 The Street, Chirton, Devizes, Wiltshire. England. SN10 3QS

The attention of the specifier, purchaser, assembler or user is drawn to the special precautions and limitations which are included in the Technical and User Manuals for the product and which are also available from the Company on request.
Glossary of Terms

**3D-Mode**
3D-Mode provides a three-dimensional view of an area of interest. The system acquires the 3D data by creating a rapid series of B-Mode slices, then combining these slices into a whole image.

You can then use the analysis tools to manipulate the three-dimensional renderings and make volumetric measurements of the structures you are interested in.

**Annotation**
A text label 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-Mode**
B-Mode is an ultrasonic imaging mode that produces a two-dimensional image to represent a cross-section of an object through the scanning plane.

 Typically, B-Mode is the most commonly used imaging mode in the system because it is the most effective mode for scanning to locate anatomical structures that you might then want to examine using one of the other imaging modes.

**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.

**Caliper**
An operator-defined point for a measurement.

**CD-R**
Recordable CD format.

**CD-ROM**
Read only CD format.

**CD-RW**
Re-writeable CD format.

**Cine loop**
A multiple frame animation of your image frames.

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

**Contrast Mode**
Contrast Mode imaging provides tools to detect and quantify vascular structures and dynamics at the molecular level.

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

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.

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 connector.

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.

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.

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 in B-Mode. A higher acquisition frame rate is desirable when watching a moving structure such as the heart, or when moving the transducer.

M-Mode
M-Mode is used primarily to measure the movement of structures in the heart such as valves, chambers, and walls.

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.

Operator
A specified operator of the system with whom study sessions may be associated.

Power Doppler Mode
Power Doppler Mode displays the energy from the returning Doppler signal and assigns a color range to the energy generated by moving blood flow. Power Doppler.

Pressure-volume loop
A graphical method of identifying and evaluating LV pressure-volume relationship changes related to dynamic levels of cardiac stress.

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 system speakers.

Rocker switch
A rocker switch is a spring-return key that provides the operator with dynamic and incremental control of a parameter value. To increase the parameter value, press the switch forward; to decrease the value, press the switch backward.

Sample volume
The region of interest being imaged during PW Doppler Mode, PW Tissue Doppler Mode or M-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 M-Mode, PW Doppler Mode or PW Tissue Doppler Mode acquisition.

Session
A period of time that an operator spends adding information (acquiring data or making measurements and/or annotations on acquired data) to a study.

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.

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.

Workstation
VisualSonics offers an optional Vevo 2100 Workstation Software package which includes all the software tools and features that you will find on the Vevo 2100 Imaging System.
excluding the image acquisition tools features.
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