



VISUALSONICS  
a subsidiary of Sonosite

# Vevo® Imaging Systems

## User Manual



**FUJIFILM VisualSonics, Inc.**

**VisualSonics – North America – Corporate:** 3080 Yonge Street, Suite 6100, Box 66, Toronto, Ontario, CANADA, M4N 3N1. Telephone +1 (416) 484-5000; Toll-free (North America): 1-866-416-4636; Fax: +1 (416) 484-5001

**VisualSonics – North America – Manufacturing/Service:** 21919 30th Drive SE, Bothell, Washington, USA, 98021-3904. Telephone +1 (425) 951-1200; Fax (425) 951-1201, Service parts fax: 425-951-6700

**VisualSonics – Europe:** VisualSonics B.V., Science Park 402, 1098 XH Amsterdam, The Netherlands. Telephone Tel: +31 20 751 2020; Toll-free +800 0751 2020

**Internet:** [www.visualsonics.com](http://www.visualsonics.com) | [customersupport@sonosite.com](mailto:customersupport@sonosite.com)

VisualSonics®, Vevo®, Vevo® LAZR, Vevo® LAZRTight™, NanoStepper™, MicroMarker®, VevoStrain™, VevoCQ™, Vevo® Color, Vevo® Multiplexer, Vevo® Spectro, SoniGene™, RMV™, EKV™, MicroScan™, Insight Through In Vivo Imaging® are registered trademarks of FUJIFILM VisualSonics, Inc. All other trademarks are the property of their respective owners.

U.S. Patents that may apply: 5,964,707, 5,840,023, 7,740,585, 7,255,678, 7,230,368, 6,984,284, 7,230,368, D520,140, D520,139, D531,316, D531,316, D518,574, D541,942, 7,808,156, 7,750,536, 7,133,713, 6,851,392, 7,426,904, 7,434,542, 7,798,963, 0239001, 0066898, 0241461, 0238954, 0078501, 0196005. This product is covered by other U.S. and Foreign patents pending.

This product is covered by other U.S. and Foreign patents pending.

Notice of non-liability: FUJIFILM VisualSonics, Inc. is providing the information in this document to you as is with all faults. FUJIFILM VisualSonics, Inc. makes no warranties of any kind (whether express, implied or statutory) with respect to the information contained herein. FUJIFILM VisualSonics, Inc. assumes no liability for damages (whether direct or indirect), caused by errors or omissions, or resulting from the use of this document or the information contained in this document or resulting from the application or use of the product or service described herein. FUJIFILM VisualSonics, Inc. reserves the right to make changes to any information herein without further notice.

Copyright © 2001-2014 by FUJIFILM VisualSonics, Inc. | All Rights Reserved

Copyright © 2014 by Bracco Suisse SA | All Rights Reserved.

Revision 2.2. 1/2/2014. Part number 50352.

# Contents

<b>Getting started</b>	<b>19</b>
<b>Vevo® Imaging Systems .....</b>	<b>20</b>
System overviews: Vevo® 1100, Vevo® 2100 and Vevo® LAZR .....	20
About this manual .....	22
Formatting conventions .....	23
Usage notes .....	24
<b>Vevo Imaging System components .....</b>	<b>25</b>
Vevo Imaging System overview .....	26
Safety warnings label .....	28
Vevo Imaging System front view .....	30
Vevo Imaging System rear view .....	31
Front panel .....	32
Rear panel connections .....	32
Rear panel fuses .....	36
Control panel .....	36
Vevo Imaging System MicroScan transducers .....	37
Grab bars .....	39
Transducer and gel holder .....	39
Castors .....	39
External air vents and filters .....	40
Internal data storage devices .....	41
Network connection .....	41
Display monitor .....	42
Speakers .....	42
Isolation transformer .....	42
Plug .....	43
Vevo® LAB software description .....	45

<b>Vevo LAZR system components .....</b>	<b>46</b>
Vevo LAZR overview .....	47
Vevo LAZR cart .....	49
Vevo LAZRTight.....	52
Vevo LAZR transducers .....	56
Vevo Imaging System ultrasound cart .....	58
Vevo LAZR safety.....	58
Setting up the Vevo LAZR components.....	66
<b>Vevo Imaging Station description .....</b>	<b>69</b>
Vevo Imaging Station setup .....	70
<b>Quick Start tutorial for ultrasound sessions .....</b>	<b>72</b>
 <b>Software workspaces</b>	 <b>75</b>
<b>User Management Mode login window workspace .....</b>	<b>76</b>
<b>Mode window workspace.....</b>	<b>78</b>
<b>Image management panels.....</b>	<b>84</b>
Physiological data options panel.....	85
Measurement tools panel.....	86
Mode settings panel .....	86
Image processing tools panel.....	87
Region graph tools panel.....	87
Laser control tools panel.....	88
Multiplexer control tools panel.....	88
3D-Mode tools panels .....	89

<b>Study Browser window workspace .....</b>	<b>92</b>
<b>Study Information window workspace .....</b>	<b>96</b>
<b>Preferences window workspace .....</b>	<b>98</b>
<b>Analysis Browser window workspace .....</b>	<b>100</b>
<b>Export and Copy To window workspace .....</b>	<b>103</b>
<b>Control panel workspace</b>	<b>105</b>
<b>Control panel groupings by image mode .....</b>	<b>106</b>
<b>Working with the TGC sliders.....</b>	<b>107</b>
Saving and loading TGC slider settings .....	108
<b>Basics</b>	<b>111</b>
<b>How the Vevo Imaging System works .....</b>	<b>112</b>
Image acquisition modes .....	112
Application packages .....	118
Studies, series and images .....	119
Users .....	119
<b>Turning the system on and off .....</b>	<b>120</b>
Turning Vevo Imaging System on and off .....	120
Turning Vevo LAZR on and off .....	123
<b>Logging in and out .....</b>	<b>125</b>
Starting the system in Standard Mode .....	125
Starting a session in Standard Mode.....	126
Logging in to a session in User Management Mode .....	126
Logging out of a session in User Management Mode .....	127

<b>General preferences tab.....</b>	<b>130</b>
General preferences .....	130
Cine Loop Size preferences .....	131
Auto SAVE preferences .....	133
Image Export preferences .....	134
Study Browser lock preferences .....	135
<b>Mode Settings preferences tab .....</b>	<b>136</b>
Frame Based Mode Screen Layout preferences.....	136
Spectrum Based Mode Screen Layout preferences.....	136
PW Doppler Scale preferences.....	137
Contrast Modes preferences.....	138
EKV Post Processing preferences .....	138
PA-Mode 3D Acquisition Method (Oxy-Hemo and NanoStepper) preferences .....	139
PA-Mode Oxy-Hemo Settings preferences .....	140
<b>Physiological preferences tab.....</b>	<b>141</b>
Physiological Enable preferences .....	141
Physiological Live Display preferences.....	143
Physiological Alarm Levels.....	144
<b>User preferences tab .....</b>	<b>146</b>
Importing and exporting user preferences .....	146
<b>Measurement preferences tab.....</b>	<b>148</b>
Measurement Package preferences .....	148
Measurement Parameters preferences.....	154
Measurement Display preferences.....	155
Histogram preferences .....	157
Heart Rate for Calculations preferences.....	158
Legacy Calculations.....	158

<b>Annotation preferences tab .....</b>	<b>159</b>
Measurement Package preferences .....	159
Annotation Display preferences .....	159
Annotation preferences.....	160
<b>Presets preferences tab .....</b>	<b>162</b>
Transducer preferences.....	162
Applications preferences .....	164
Mode Settings Presets preferences .....	167
Preset Settings section .....	171
<b>Maintenance preferences tab .....</b>	<b>172</b>
Upgrade.....	172
Monitor preferences .....	175
Systems Log preferences.....	175
Backup and Restore preferences.....	176
<b>System preferences tab .....</b>	<b>179</b>
Date and Time preferences.....	179
Display preferences .....	179
<b>Network preferences tab.....</b>	<b>181</b>
Connecting Vevo Imaging System to a domain.....	181
Changing the Vevo Imaging System workgroup .....	183
Changing the Vevo Imaging System IP address .....	183
Changing the Vevo Imaging System DNS settings .....	184
Network Maps preferences .....	184
<b>Managing user access</b>	<b>186</b>
<b>User access modes .....</b>	<b>187</b>
Standard Mode.....	187
User Management Mode .....	188
Enabling User Management Mode .....	191
Disabling User Management Mode .....	192

<b>Managing users in Standard Mode .....</b>	<b>194</b>
Adding an administrator in Standard Mode .....	194
Adding a user in Standard Mode.....	195
Modifying a user in Standard Mode.....	196
Deleting a user in Standard Mode .....	197
Changing passwords in Standard Mode.....	197
<b>Managing users in User Management Mode .....</b>	<b>199</b>
Adding an administrator in User Management Mode .....	199
Adding a standard user in User Management Mode.....	201
Modifying a standard user in User Management Mode.....	202
Disabling a standard user.....	203
Deleting a user or administrator in User Management Mode .....	204
Adding a group to a user.....	204
Deleting a user group.....	205
Changing passwords in User Management Mode .....	206
<b>Usage Log .....</b>	<b>208</b>
Usage Log Table.....	208
Enabling the usage log .....	210
Exporting usage logs .....	212
Purging usage logs .....	214
<b>Managing studies, series and images</b>	<b>217</b>
<b>About studies, series and images.....</b>	<b>218</b>
<b>Working with studies .....</b>	<b>219</b>
Creating a study.....	219
Finding a study .....	221
Customizing study information details.....	222
Locking a study .....	222
Guidelines for study passwords and study locks.....	223
Setting default study sharing levels for new studies.....	224
Setting the sharing levels for a study .....	225

Changing study ownership.....	227
<b>Working with series.....</b>	<b>230</b>
Creating a new series .....	230
Modifying the information properties of a series .....	231
Moving a series .....	232
Closing an active series .....	233
Deleting a series .....	233
<b>Working with images.....</b>	<b>235</b>
Opening an image.....	235
Labeling an image.....	235
Modifying an image after it is stored.....	236
Storing an image .....	237
Deleting an image .....	238
<b>Exporting from the Study Browser .....</b>	<b>240</b>
Exporting cine loops from the Study Browser .....	240
Exporting image frames from the Study Browser .....	243
Exporting physiological data from the Study Browser.....	246
Exporting images to DICOM from the Study Browser .....	247
Exporting the Study Browser list view as a text file .....	249
<b>Copying, deleting and importing.....</b>	<b>252</b>
Copying studies, series or images .....	252
Deleting studes, series or images .....	254
Importing studies.....	255
<b>Acquiring images</b>	<b>257</b>
<b>    Setting up the Vevo Imaging System.....</b>	<b>258</b>
Working with transducers.....	258
Connecting and disconnecting transducers.....	260
Working with the 3D motor stage.....	261

<b>Setting up Mode settings presets .....</b>	<b>265</b>
Parameters you can save to a preset .....	265
Creating a Mode settings preset .....	266
Applying a preset .....	267
Modifying a Mode settings preset.....	267
Activating a preset group .....	268
<b>Setting up to acquire physiological data.....</b>	<b>269</b>
Physiological data sources.....	269
Connecting the blood pressure equipment.....	270
Configuring the physiology data display settings.....	271
<b>Acquiring image data .....</b>	<b>281</b>
<b>Saving image data .....</b>	<b>282</b>
Saving a cine loop (multiple-frame animation).....	282
Extending the cine loop size.....	284
Saving an image frame.....	284
<b>Analyzing images</b>	<b>286</b>
<b>Vevo® LAB .....</b>	<b>287</b>
<b>Working with cine loops .....</b>	<b>288</b>
Cine loop workspace .....	288
Cine loop review controls.....	289
Creating cine loops .....	291
Creating a cine loop subset from a full cine loop.....	291
Viewing saved physiological data .....	291
<b>Measurement basics .....</b>	<b>293</b>
Measurement tools panel workspace .....	293
Generic measurements.....	295
Protocol measurements.....	297
Measurement units .....	299

<b>Working with measurements .....</b>	<b>300</b>
Modifying the properties of a measurement .....	300
Coloring a measured area.....	301
Coloring areas in a VTI trace.....	302
Modifying points on a contour measurement.....	303
Modifying contour measurements.....	304
Adding embryo measurements .....	304
Adding measurement chains to B-Mode and M-Mode images.....	305
Copying and pasting measurements .....	306
Zooming into a measurement location.....	307
Locking measurements .....	308
Deleting measurements .....	308
<b>Working with annotations .....</b>	<b>309</b>
Annotation workspace .....	309
Predefined annotations .....	311
Adding annotations.....	315
Modifying annotations.....	315
VeoColor area tool.....	317
<b>Reporting your analysis results .....</b>	<b>319</b>
Creating an analysis report .....	319
Reviewing the image that contains a report measurement.....	321
Exporting an analysis report.....	321
<b>B-Mode imaging and analysis</b>	<b>324</b>
<b>B-Mode acquisition .....</b>	<b>325</b>
B-Mode window workspace .....	326
Control panel controls for B-Mode .....	329
B-Mode settings.....	334
Typical B-Mode image acquisition session .....	335
Optimizing your B-Mode for imaging tissue detail .....	337
Adding focal zones .....	338
Visualizing injections with a needle guide overlay .....	338

<b>B-Mode analysis .....</b>	<b>341</b>
Adding generic B-Mode measurements.....	341
Adding protocol measurements .....	342
Creating pressure-volume loop measurements in B-Mode.....	344
VevoStrain™: Strain rate step 1: Adding the LV wall trace .....	347
VevoStrain™: Strain rate step 2: Analyzing the data .....	350
<b>PA-Mode imaging and analysis</b>	<b>358</b>
<b>    PA-Mode acquisition .....</b>	<b>359</b>
PA-Mode window workspace .....	360
Control panel controls for PA-Mode .....	365
PA-Mode settings .....	367
Selecting acquisition sub-modes in PA-Mode.....	369
PA-Mode sub-modes.....	370
Changing the PA-Mode display layout.....	389
Acquiring PA-Mode images in 3D .....	390
Controlling the laser .....	391
<b>    PA-Mode analysis .....</b>	<b>395</b>
Adding generic PA-Mode measurements.....	395
Measuring blood oxygenation .....	396
Multiplexer control (NanoStepper color and layer views).....	398
Generating and analyzing NanoStepper 3D images .....	400
Measuring region changes in a Photoacoustic loop .....	401
<b>M-Mode imaging and analysis</b>	<b>403</b>
<b>    M-Mode acquisition .....</b>	<b>404</b>
M-Mode window workspace .....	405
Control panel controls for M-Mode and AM-Mode.....	409
M-Mode settings .....	412
Typical M-Mode image acquisition session.....	413
Setting the M-Mode region of interest.....	415

<b>M-Mode analysis.....</b>	<b>416</b>
Adding generic M-Mode measurements .....	416
Adding protocol measurements .....	417
Creating pressure-volume loop measurements in M-Mode .....	419
<b>Anatomical M-Mode imaging and analysis</b>	<b>423</b>
<b>Anatomical M-Mode acquisition.....</b>	<b>424</b>
Typical Anatomical M-Mode image acquisition session .....	424
Reconstructing AM-Mode images from B-Mode or EKV Mode .....	426
<b>Anatomical M-Mode analysis .....</b>	<b>429</b>
<b>PW Doppler Mode imaging and analysis</b>	<b>430</b>
<b>PW Doppler Mode acquisition.....</b>	<b>431</b>
PW Doppler Mode window workspace .....	432
Control panel controls for PW Doppler Mode .....	436
PW Doppler Mode settings .....	441
Typical PW Doppler Mode image acquisition session.....	443
Setting the PW Doppler Mode sample volume.....	444
Setting the PW Doppler Mode sample volume in a distance blockout zone .....	445
Exporting PW Doppler Mode cine loop audio.....	445
<b>PW Tissue Doppler Mode acquisition.....</b>	<b>447</b>
Typical PW Tissue Doppler Mode image acquisition session .....	447
Analyzing PW Tissue Doppler Mode images .....	448
<b>PW Doppler Mode and PW Tissue Doppler Mode analysis.....</b>	<b>449</b>
PW Doppler Mode analysis .....	449
PW Tissue Doppler Mode analysis .....	453

<b>3D-Mode imaging and analysis</b>	<b>454</b>
<b>How 3D-Mode works .....</b>	<b>455</b>
<b>3D-Mode acquisition .....</b>	<b>457</b>
Typical 3D-Mode image acquisition session .....	457
3D-Mode window workspace.....	461
Control panel controls for 3D-Mode.....	464
Setting up for a 3D-Mode image acquisition .....	465
Recording a 3D-Mode analysis session .....	469
<b>3D-Mode analysis .....</b>	<b>470</b>
3D-Mode visualization tools .....	470
Manipulating 3D-Mode image data.....	472
Creating 3D volume measurements.....	478
Thresholding color-mapped 3D images.....	484
Adding generic 3D-Mode measurements .....	485
<b>Color Doppler Mode imaging and analysis</b>	<b>487</b>
<b>Color Doppler Mode acquisition .....</b>	<b>488</b>
Color Doppler Mode window workspace .....	489
Control panel controls for Color Doppler Mode.....	493
Color Doppler Mode settings.....	496
Typical Color Doppler Mode image acquisition session .....	498
Typical Color 3D-Mode image acquisition session .....	499
<b>Color Doppler Mode analysis .....</b>	<b>501</b>
Adding generic Color Doppler Mode measurements.....	501
Adding protocol measurements .....	502
<b>Power Doppler Mode imaging and analysis</b>	<b>504</b>
<b>Power Doppler Mode acquisition .....</b>	<b>505</b>
Power Doppler Mode window workspace .....	505

Control panel controls for Power Doppler Mode .....	510
Power Doppler Mode settings .....	513
Typical Power Doppler Mode image acquisition session.....	515
Typical Power Doppler 3D-Mode image acquisition session .....	517
<b>Power Doppler Mode analysis.....</b>	<b>519</b>
Adding generic Power Doppler Mode measurements .....	519
Adding protocol measurements .....	520
<b>Linear Contrast Mode imaging and analysis</b>	<b>522</b>
<b>Linear Contrast Mode acquisition.....</b>	<b>523</b>
Linear Contrast Mode window workspace .....	524
Control panel controls for Linear Contrast Mode and Nonlinear Contrast Mode.....	527
Linear Contrast Mode settings.....	529
Typical Linear Contrast Mode image acquisition session .....	531
Typical Linear Contrast 3D-Mode image acquisition .....	534
Contrast agent technology.....	535
Displaying contrast agents as an overlay.....	536
Adjusting the contrast overlay display .....	537
<b>Linear Contrast Mode analysis.....</b>	<b>540</b>
Adding generic Contrast Mode measurements .....	540
Adding protocol measurements .....	542
<b>Nonlinear Contrast Mode imaging and analysis</b>	<b>543</b>
<b>Nonlinear Contrast Mode acquisition .....</b>	<b>544</b>
Typical Nonlinear Contrast Mode image acquisition session.....	544
<b>Nonlinear Contrast Mode analysis .....</b>	<b>548</b>
Adding generic Contrast Mode measurements .....	548
VeoCQ Analysis.....	550

<b>EKV Mode imaging and analysis</b>	<b>580</b>
<b>EKV Mode acquisition .....</b>	<b>581</b>
Typical EKV Mode acquisition from B-Mode .....	581
EKV Mode image refinement tools .....	584
<b>EKV Mode analysis.....</b>	<b>588</b>
Adding measurements to EKV Mode images .....	588
<b>RF-Mode imaging and analysis</b>	<b>589</b>
<b>RF-Mode acquisition .....</b>	<b>590</b>
Typical RF-Mode image acquisition session.....	590
<b>RF-Mode analysis .....</b>	<b>593</b>
Exporting RF-Mode data from the Study Browser.....	593
<b>Appendices</b>	<b>596</b>
<b>Generic measurements .....</b>	<b>597</b>
2D Area measurement .....	597
Acceleration measurement.....	600
Angle measurement .....	600
Cardiac region measurement .....	601
Contrast region measurement .....	603
Depth interval measurement .....	612
Heart rate measurement .....	613
Lens radius measurement .....	614
Linear distance measurement .....	614
LV Area long axis measurement .....	615
LV Area long axis measurement .....	617
LV Area short axis measurement .....	618
M-Mode LV wall trace measurements .....	619
PA region measurement .....	620
Resolution tool .....	622

Single point measurement .....	622
Time Interval measurement for B-Mode images .....	623
Time Interval measurement for Color Doppler Mode images.....	623
Time Interval measurement for M-Mode images .....	624
Time Interval measurement for PW Doppler Mode images .....	625
Traced distance measurement .....	625
Velocity measurement .....	626
VevoColor area tool.....	626
VTI measurement with automatic frequency trace .....	628
VTI measurement without real-time frequency trace enabled .....	629
<b>Measurement package protocols .....</b>	<b>631</b>
Abdominal Measurement Package .....	631
Cardiac Measurement Package .....	650
Embryology Measurement Package .....	670
Ophthalmology Measurement Package .....	671
Vascular Measurement Package.....	673
<b>Control panel keys and controls .....</b>	<b>693</b>
Control panel controls A-M .....	693
Control panel controls N-Z .....	705
<b>Multiplexer control panel descriptions .....</b>	<b>716</b>
<b>Product safety testing and electrical testing .....</b>	<b>717</b>
<b>Safety.....</b>	<b>720</b>
Warnings .....	720
Cautionary notes.....	725
<b>Specifications .....</b>	<b>728</b>
Vevo Imaging System specifications .....	728
Vevo LAZR cart specifications.....	729
Vevo LAZRTight specifications.....	731

<b>Technical support and user maintenance .....</b>	<b>732</b>
Service provided by VisualSonics .....	732
Maintaining Vevo Imaging System.....	733
Maintaining Vevo LAZR transducers.....	735
Disposal.....	736
Cleaning the air filters .....	736
<b>Troubleshooting .....</b>	<b>740</b>
Vevo Imaging System troubleshooting (Configuration A) .....	740
Vevo Imaging System troubleshooting (Configuration B) .....	741
Study Browser troubleshooting.....	741
B-Mode troubleshooting .....	742
M-Mode troubleshooting.....	742
PW Doppler Mode troubleshooting.....	742
3D-Mode troubleshooting .....	743
Power Doppler Mode troubleshooting.....	743
Linear Contrast Mode troubleshooting .....	744
Physiological data troubleshooting.....	744
Measurements, annotations and calculations troubleshooting .....	745
<b>Glossary of Terms</b>	<b>746</b>
<b>Index</b>	<b>753</b>

## Section 1

# Getting started



This section introduces you to the Vevo Imaging System.

### In this section

Vevo® Imaging Systems .....	20
Vevo Imaging System components.....	25
Vevo LAZR system components.....	46
Vevo Imaging Station description.....	69
Quick Start tutorial for ultrasound sessions .....	72

## Chapter 1

# Vevo® Imaging Systems



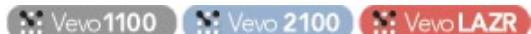
Thank you for selecting a VisualSonics Vevo® imaging system. This manual provides detailed procedures and descriptions for people who use any of the three available systems.

### In this chapter

System overviews: Vevo® 1100, Vevo® 2100 and Vevo® LAZR .....	20
About this manual.....	22
Formatting conventions.....	23
Usage notes .....	24

---

## System overviews: Vevo® 1100, Vevo® 2100 and Vevo® LAZR



Your VisualSonics imaging system is one of the the three described below:

System description	System photo
<p><b>Vevo® 1100 Imaging System</b> (referred to as Vevo 1100 in the remaining topics in this manual) is the latest entry-level system from VisualSonics. This system delivers features that are tailored to the needs of preclinical cardiac research environments, providing a powerful way to add high-frequency ultrasound capability to your facility.</p>	

---

### **Vevo® 2100 Imaging System**

(referred to as Vevo 2100 in the remaining topics in this manual) is the high-resolution *in vivo* micro imaging system that acquires, processes and analyzes high-resolution ultrasound image data through a variety of imaging modes. This ultrasound cart also serves as the control component of the Vevo LAZR imaging system.



---

### **Vevo® LAZR Photoacoustic Imaging System**

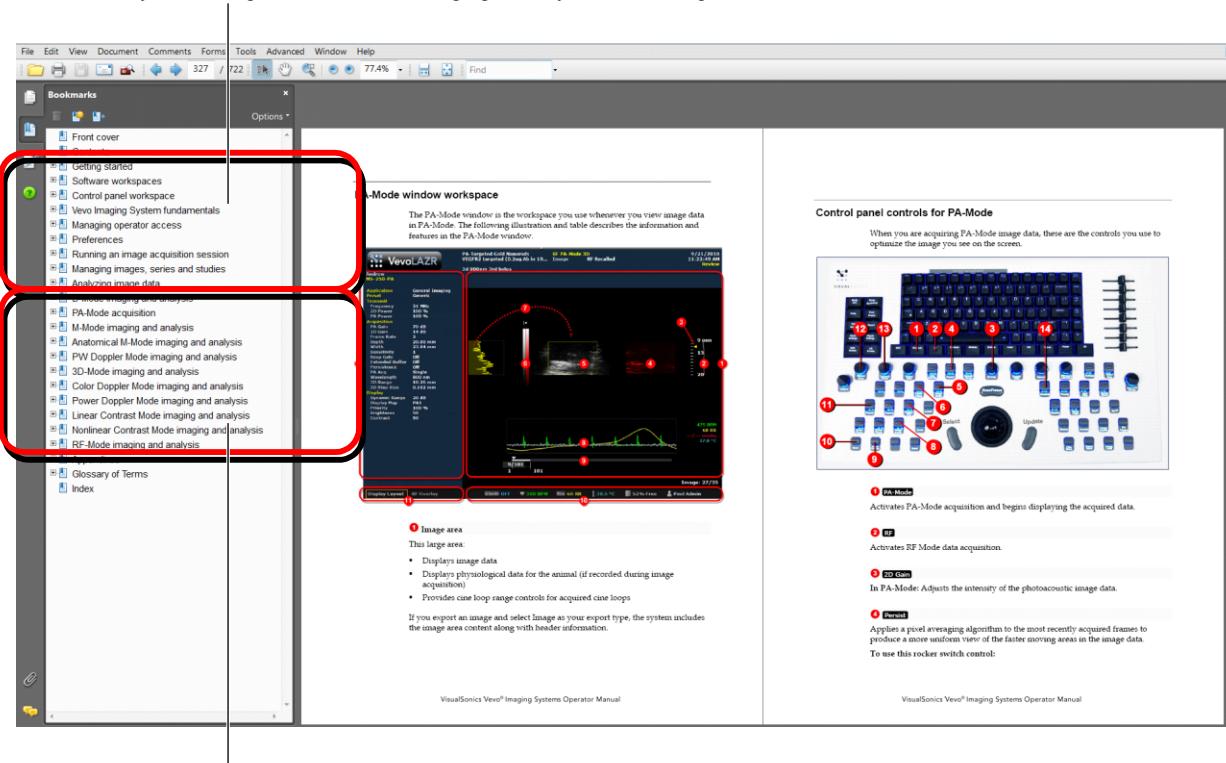
(referred to as Vevo LAZR in the remaining topics in this manual) is the multiple-component system that integrates laser light delivery with ultrasound image acquisition to produce photoacoustic (PA-Mode) image data.



## About this manual

This manual provides detailed descriptions and procedures for people who use Vevo 1100, Vevo 2100 or Vevo LAZR.

The first half of the manual introduces you to the systems and the common features that you use, regardless of which imaging mode you are working with.



The second half of the manual describes how to acquire images and analyze images in each available imaging mode.

You will see text references and software screen capture references to each of the systems.

### Topic content icons

The following table describes the icons that introduce the content in each topic.

Icon	Description
	The content applies to <b>Vevo 1100</b> .
	The content <i>does not</i> apply to <b>Vevo 1100</b> .
	The content applies to <b>Vevo 2100</b> .
	The content <i>does not</i> apply to <b>Vevo 2100</b> .

Icon	Description
 Veo LAZR	The content applies to <b>Veo LAZR</b> .
 Veo LAZR	The content <i>does not</i> apply to <b>Veo LAZR</b> .

## Formatting 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 keyboard keys
- Dial controls
- Toggle controls
- Slider controls

### *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

---

## Usage notes

 Vevo 1100    Vevo 2100    Vevo LAZR

**IMPORTANT:** If the equipment is used in a manner not specified by the manufacturer, you void the terms of the product warranty, and the protection provided by the equipment may be impaired.



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

## Chapter 2

# Vevo Imaging System components



This chapter describes the components of each imaging system that work together to acquire and analyze high-resolution ultrasound data in a range of imaging modes.

### In this chapter

Vevo Imaging System overview.....	26
Safety warnings label.....	28
Vevo Imaging System front view .....	30
Vevo Imaging System rear view .....	31
Front panel .....	32
Rear panel connections.....	32
Rear panel fuses.....	36
Control panel .....	36
Vevo Imaging System MicroScan transducers .....	37
Grab bars .....	39
Transducer and gel holder .....	39
Castors .....	39
External air vents and filters.....	40
Internal data storage devices .....	41
Network connection.....	41
Display monitor.....	42
Speakers.....	42
Isolation transformer .....	42
Plug .....	43
Vevo® LAB software description.....	45

## Vevo Imaging System overview

 Vevo 1100    Vevo 2100    Vevo LAZR



The Vevo Imaging System houses the electronics, manual controls, software and monitor that controls the transducer functions and processes the image data during all image acquisition sessions.

The cart is produced in two configurations (A and B) that feature minute differences based on component requirements. The manual identifies these differences where they appear.

**NOTE:** Vevo 1100 is produced in Configuration B.

### Vevo 1100 imaging modes

- B-Mode
- M-Mode
- PW (Pulsed Wave) Doppler Mode
- Color Doppler Mode

## **Vevo 1100 measurement features**

The following custom measurement package is provided, in addition to an array of measurement tools:

- Cardiac measurement

## **Vevo 2100/Vevo LAZR imaging modes**

- B-Mode
- M-Mode
- AM-Mode
- PW (Pulsed Wave) Doppler Mode
- PW Tissue Doppler Mode
- Color Doppler Mode
- 3D-Mode
- Power Doppler
- Linear Contrast Mode
- Nonlinear Contrast Mode
- EKV™ Mode
- RF-Mode

**PA-MODE:** In addition to the imaging modes below, Vevo LAZR supports PA-Mode.

## **Vevo 2100/Vevo LAZR features**

The following custom measurement packages are provided, in addition to an array of measurement tools:

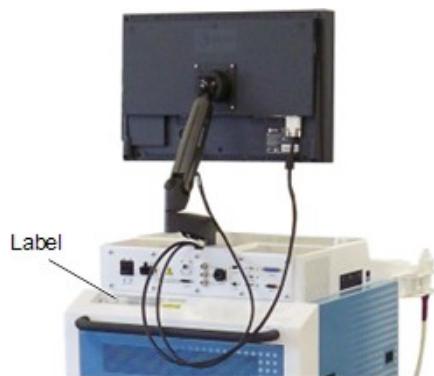
- Cardiac measurement
- Abdominal measurement
- Vascular measurement
- Embryology measurement
- Ophthalmology measurement

## Safety warnings label

Vevo 1100    Vevo 2100    Vevo LAZR

### Composite safety warnings label

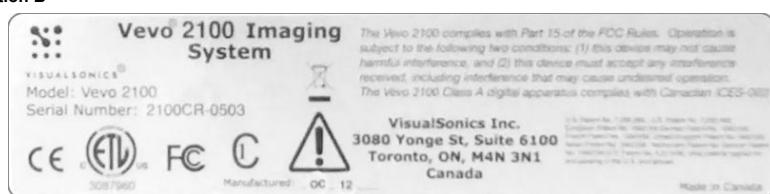
The composite safety warning label is located on the back of the cart, below the rear panel.



Configuration A



Configuration B



Vevo 1100



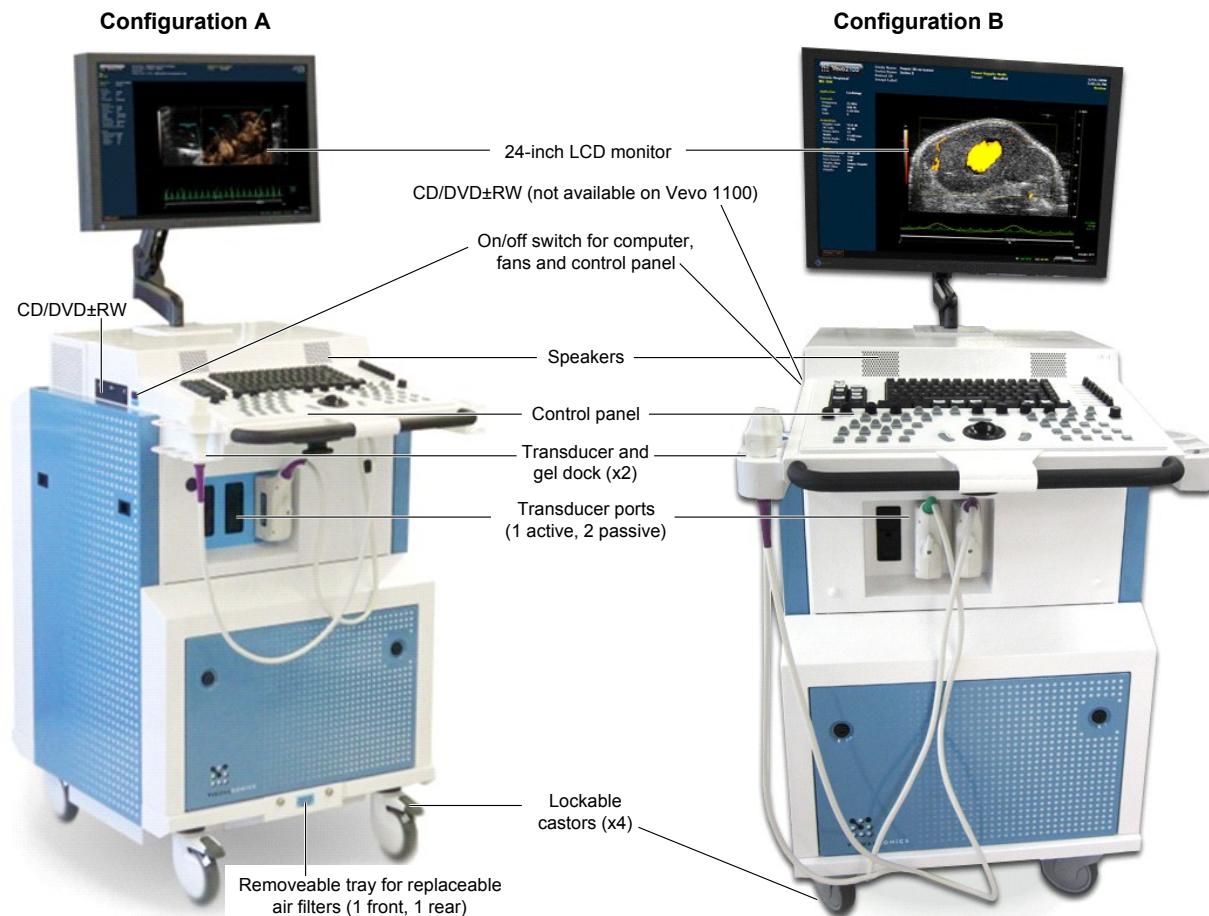
The following table explains the symbols on the composite safety warnings label placed on the cart.

**Symbol Description**

	Conformité Européenne. Product meets the safety requirements of the European Union.
	Proof of product compliance (electrical, gas and other safety standards) to North American safety standards.
	Device authorized under the FCC Declaration of Conformity procedure.
	Product has been tested to CAN/CSA-C22.2 No. 61010-1, second edition, including Amendment 1, or a later version of the same standard incorporating the same level of testing requirements.
	European Union WEEE (Waste Electrical and Electronic Equipment) Directive. Identifies the directive on waste electrical and electronic equipment.
	Catalog number
	Serial number
	Manufacturer
	Attention, see the user guide.

## Vevo Imaging System front view

Vevo 1100   Vevo 2100   Vevo LAZR



The ultrasound cart is produced in two configurations:

- **Configuration A** features retractable air filter trays situated at the bottom of the cart chassis, both back and front
- **Configuration B** features an integrated power components assembly on the rear panel that includes power switch + fuse box + AC In

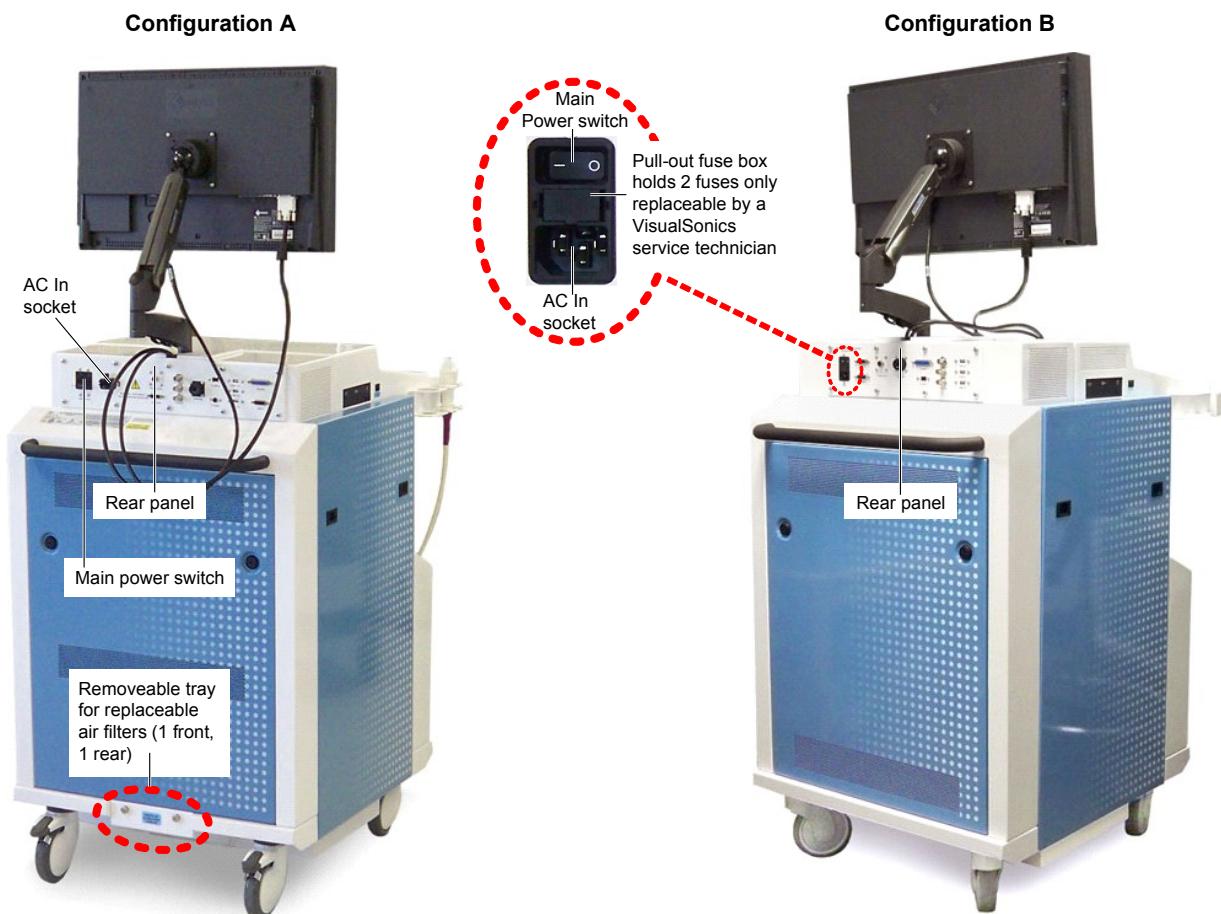
**NOTE:** Vevo 1100 is produced in Configuration B.

### Related information

- *Vevo Imaging System rear view* (page 31)

## Vevo Imaging System rear view

Vevo 1100 Vevo 2100 Vevo LAZR



The ultrasound cart is produced in two configurations:

- **Configuration A** features retractable air filter trays situated at the bottom of the cart chassis, both back and front.
- **Configuration B** features an integrated power components assembly on the rear panel that includes power switch + fuse box + AC In.

**NOTE:** Vevo 1100 is produced in Configuration B.

### Related information

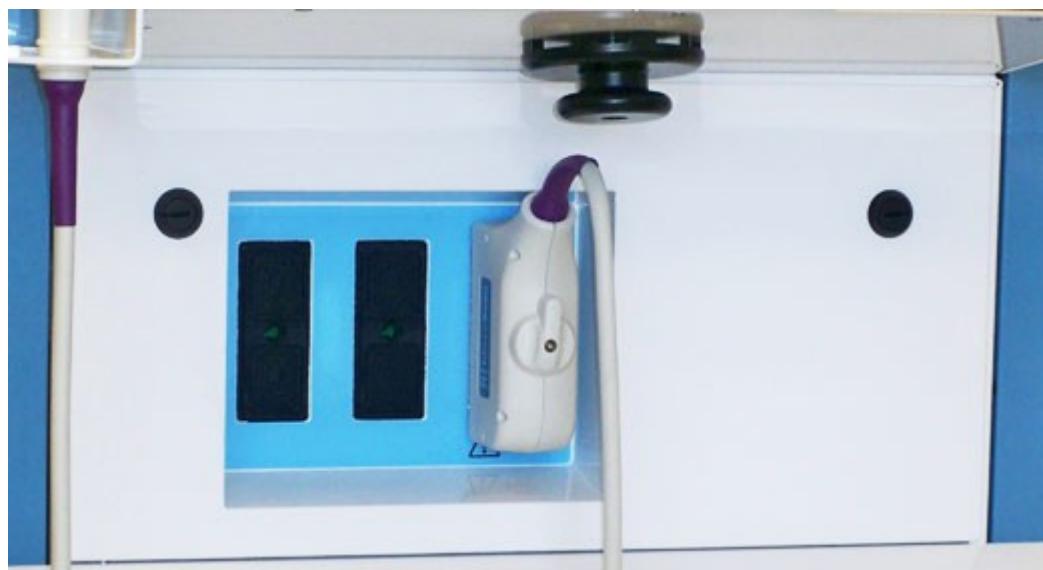
- *Vevo Imaging System front view* (page 30)

---

## Front panel



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



### Related information

- *Connecting and disconnecting transducers* (page 260)
- *Working with transducers* (page 258)

---

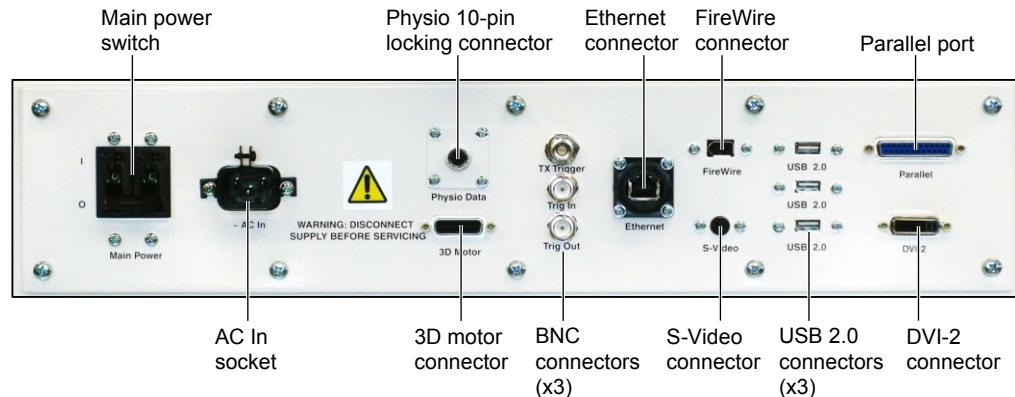
## Rear panel connections



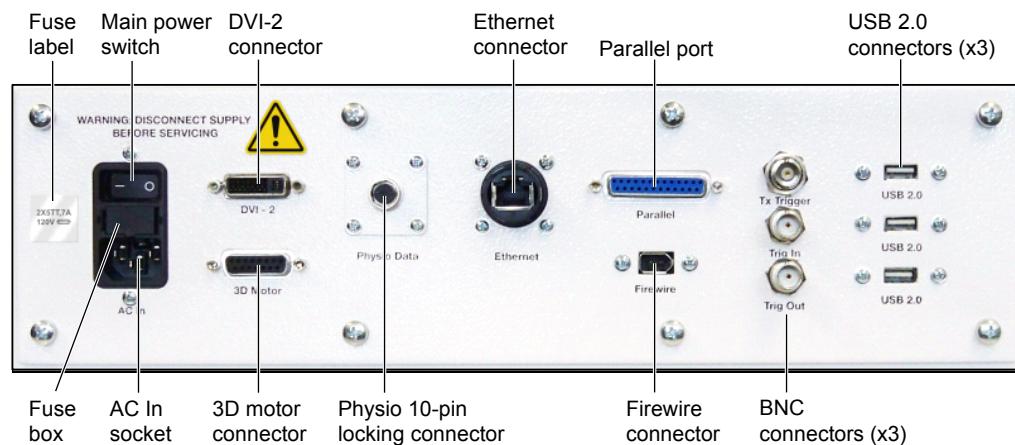
The rear panel provides the power controls and the connectors to external devices. The panel is designed in one of two configurations, based on the two ultrasound cart configurations (page 31).

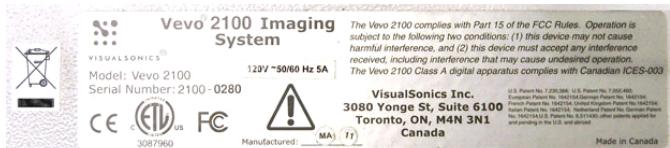
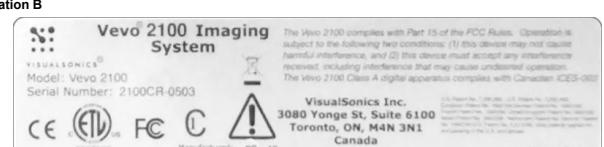
**NOTE:** Vevo 1100 is produced in Configuration B.

### Configuration A



### Configuration B



Rear panel connector	Description
Main power switch	Turns the Vevo Imaging System on and off.
	<p><b>! WARNING:</b> 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: toll-free in North America at 1-866-416-4636; or toll-free in Europe at +800 0751 2020; or by email at support@visualsonics.com.</p>
	<p><b>! WARNING:</b> Do not move the system when the plug is connected to the power outlet.</p>
	<p><b>! WARNING:</b> Before connecting the system ensure that the voltage is correct. Ensure the power cable is undamaged before plugging the system directly into the wall outlet. Do not connect the system's power supply to an MPSO or extension cord. The voltage is specified on the rear panel of the system on the composite safety warning label, directly above the warning symbol.</p>
<p><b>Configuration A</b></p>  <p>The Vevo 2100 complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. The Vevo 2100 Class A digital apparatus complies with Canadian ICES-003</p> <p>Model: Vevo 2100 Serial Number: 2100-0280 Manufactured: MA TR 3087960</p> <p>VisualSonics Inc. 3080 Yonge St, Suite 6100 Toronto, ON, M4N 3N1 Canada</p> <p>U.S. Patent No. 7,232,086, U.S. Patent No. 7,260,402, U.S. Patent No. 7,489,154, French Patent No. 1402143, United Kingdom Patent No. 2462284, German Patent No. 102003004432.6, Italian Patent No. 102003004432.6, Spanish Patent No. 102003004432.6, Other patents applied for and pending in the United States and abroad.</p> <p>Made in Canada</p>	
<p><b>Configuration B</b></p>  <p>The Vevo 2100 complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. The Vevo 2100 Class A digital apparatus complies with Canadian ICES-003</p> <p>Model: Vevo 2100 Serial Number: 2100CR-0503 Manufactured: OC 12 3087960</p> <p>VisualSonics Inc. 3080 Yonge St, Suite 6100 Toronto, ON, M4N 3N1 Canada</p> <p>U.S. Patent No. 7,232,086, U.S. Patent No. 7,260,402, U.S. Patent No. 7,489,154, French Patent No. 1402143, United Kingdom Patent No. 2462284, German Patent No. 102003004432.6, Italian Patent No. 102003004432.6, Spanish Patent No. 102003004432.6, Other patents applied for and pending in the United States and abroad.</p> <p>Made in Canada</p>	
<p><b>Vevo 1100</b></p>  <p>The Vevo 1100 complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. The Vevo 1100 Class A digital apparatus complies with Canadian ICES-003</p> <p>REF 50725 SN 1100CR0001 3087960</p> <p>FUJIFILM VisualSonics, Inc. 3080 Yonge St, Suite 6100 Toronto, ON, M4N 3N1 Canada</p> <p>Manufactured: _____</p> <p>Made in USA</p>	

Rear panel connector	Description
Fuse box	<p><b>NOTE:</b> The rear panel mounted fuse box is only available on the ultrasound cart configuration B (page 31).</p> <p>The fuse box is located between the Main Power switch and the AC In socket. The fuse box contains replaceable fuses that must be replaced by a VisualSonics service technician.</p>
AC In	Connect the power cable here.
Physio/ECG 10-pin locking connector	Connect the Advanced Physiological Monitoring Unit (optional VisualSonics accessory) cable here.
3D motor connector	 Connect your 3D motor stage (optional VisualSonics accessory) cable here.
TX Trigger, Trig In, Trig Out	Connect BNC cables here. For future use.
Ethernet connector	Connect your network data cable here.
FireWire connector	Connect your Firewire equipped data storage device here.
S-Video connector	<p><b>NOTE:</b> This feature is only available on the ultrasound cart configuration A (page 31).</p> <p>Connect your S-Video equipped external video recording device here.</p>
USB connectors	Connect your USB equipped data storage device here.
DVI connector	Connect an additional monitor (optional VisualSonics accessory) in the open DVI port.

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

## Related information

- *Connecting the Vevo LAZR system powered components* (page 66)
- *Connecting the blood pressure equipment* (page 270)
- *Connecting the 3D motor stage to the Vevo Imaging Station* (page 261)
- *Turning the system on and off* (page 120)

## Rear panel fuses

 Vevo 1100  Vevo 2100  Vevo LAZR

To protect the AC mains (the power switch on the system) from overcurrent damage, the Vevo Imaging System fuses can be replaced. If the fuse blows, it must be replaced by a VisualSonics service technician. The following table describes the fuse labels.

Label	Description	Fuse part #
<b>2X5TT,7A 120V</b>	100V, 120V fuse replacement	50039
<b>2X5HT,4A 250V</b>	240V fuse replacement	50038

## Control panel

 Vevo 1100  Vevo 2100  Vevo LAZR

The control panel provides image acquisition controls and study management controls.



The control panel also provides variable backlighting underneath 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 **↑** to increase the brightness or the Down arrow key **↓** to decrease the brightness between the Off setting and through a series of seven brightness levels.

#### Related information

- *Description of control panel keys and controls* (page 693)

## Vevo Imaging System MicroScan transducers



Vevo MicroScan™ transducers are solid state devices that acquire real-time images of the target in all Vevo Imaging System imaging modes.



**NOTE:** Vevo MicroScan transducers cannot acquire Photoacoustic Mode (PA-Mode) image data.

**IMPORTANT:** Only transducers manufactured by VisualSonics may be used with this system.

#### Features

- Designed as a hand-held probe for rapid screening procedures

- 256-element linear array detector
- Delivers a usable frame rate of more than 500 frames per second depending on the transducer model you use and the field of view you have set for your image acquisition
- Connects to the front of the Vevo Imaging System

## Available models

The following transducers can be used with the Vevo Imaging System and Vevo LAZR.

Transducer	Description
MS200	Rat cardiovascular and abdominal (>400g), rabbit (cardiovascular)
MS201	Rat cardiovascular and abdominal (>400g), rabbit (cardiovascular)
MS250	Rat cardiology and abdominal (<400 g), large tumor imaging (up to 23 mm in diameter), all contrast applications
MS250S	Rat abdominal (<300 grams), mouse cardiology for aortic banding models, mouse abdominal; small tumor imaging (up to 15 mm in diameter); all contrast applications
MS400	Optimized for mouse cardiovascular, rat abdominal, rabbit eye, all vascular (mouse, rat, rabbit)
MS550D	Mouse abdominal, reproductive, mouse/rat embryology, tumor imaging (up to 14 mm in diameter), mouse vascular, small rat vascular, some abdominal (kidney)
MS550S	Optimized for mouse/rat embryology, mouse abdominal, reproductive, epidermal imaging, tumor imaging (up to 13 mm in diameter), mouse vascular, small rat vascular, some abdominal (kidney), ophthalmology
MS700	Mouse embryology, epidermal imaging, superficial tissue, subcutaneous tumors (< 9 mm), mouse vascular, ophthalmology



**CAUTION:** Only use coupling gels that are specifically approved for use with this system.



**CAUTION:** Only transducers manufactured by VisualSonics may be used with this system.

## Related information

- *Connecting the transducer to the Vevo Imaging System* (page 260)

- *Vevo LAZR transducers* (page 56)

---

## 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 dock located on the left and right sides of the cart to store gel bottles and MS series transducers. Store both items facing up.

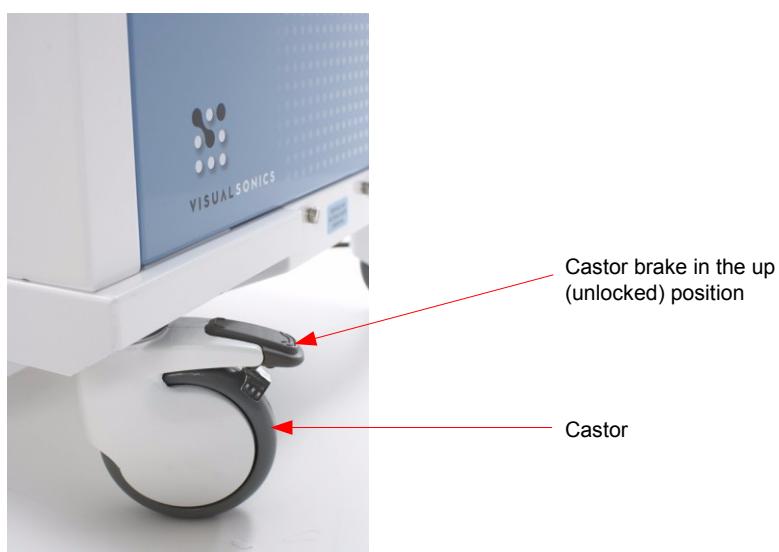
VisualSonics recommends the use of the ultrasound gel that is acoustically correct for the range of frequencies used, and is completely aqueous.

---

## Castors



Castors allow the Vevo 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.



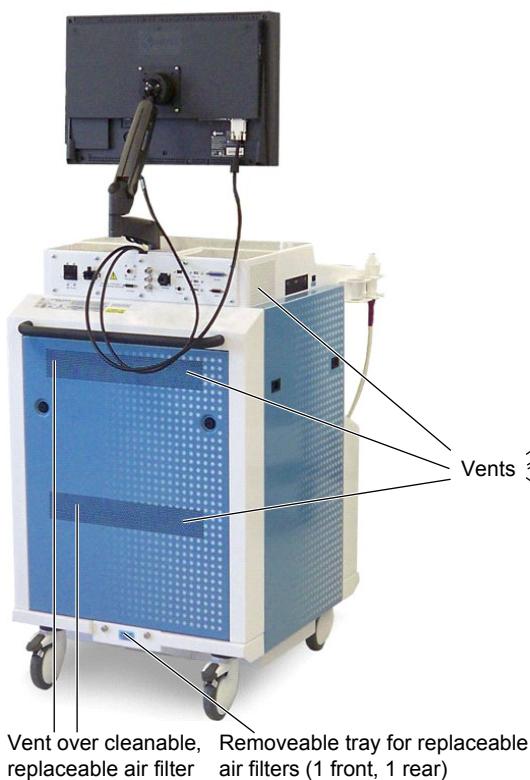


**WARNING:** Ensure that the castors are locked whenever the Vevo Imaging System is not being transported.

## External air vents and filters

Vevo 1100   Vevo 2100   Vevo LAZR

**Configuration A**



**Configuration B**



Both ultrasound cart configurations feature replaceable air filters and multiple air vents.

**NOTE:** Vevo 1100 is produced in Configuration B.



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

## Related information

- *Cleaning your air filters* (page 736)

## Internal data storage devices



The following table describes the range of storage device technology:

Vevo 1100	Vevo 2100 and Vevo LAZR
	CD/DVD±RW
Hard drive 1 (Windows® operating system, Vevo® software)	Hard drive 1 (Windows® operating system, Vevo® software)
Hard drive 2 (study storage)	Hard drive 2 (study storage)
USB*	USB*
Firewire*	Firewire*
	S-Video*

\*Rear panel connector for exporting image data to an external device.

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

## Network connection



The computer unit includes a 100 Mbps Ethernet network connection.

---

## Display monitor

 Vevo 1100    Vevo 2100    Vevo LAZR

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



---

## Speakers

 Vevo 1100    Vevo 2100    Vevo LAZR

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

 Vevo 1100    Vevo 2100    Vevo LAZR

The isolation transformer that powers the system is located inside the system and protects you and the equipment from electrical shock and power surges.

The Vevo 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 specifies the electrical requirements.

The system manages electrical overload in one of two ways, depending on which ultrasound cart configuration (A or B) (page 31) you are working with.

### Configuration A



This configuration 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: toll-free in North America at 1-866-416-4636; or toll-free in Europe at +800 0751 2020; or by email at support@visualsonics.com.

## Configuration B



This configuration does not include a circuit breaker. Rather, it features a power module that integrates the AC In socket, the power switch, and a removable fuse box with replaceable fuses.



**WARNING:** If you cannot power on the system, unplug the machine immediately and contact a Technical Support Representative: toll-free in North America at 1-866-416-4636; or toll-free in Europe at +800 0751 2020; or by email at support@visualsonics.com.

---

## Plug



Your Vevo 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 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: toll-free in North America at 1-866-416-4636; or toll-free in Europe at +800 0751 2020; or by email at support@visualsonics.com.



**WARNING:** Do not move the system when the plug is connected to the power outlet.

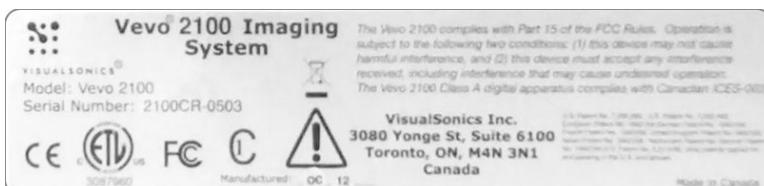


**WARNING:** Before connecting the system ensure that the voltage is correct. Ensure the power cable is undamaged before plugging the system directly into the wall outlet. Do not connect the system's power supply to an MPSO or extension cord. The voltage is specified on the rear panel of the system on the composite safety warning label, directly above the warning symbol.

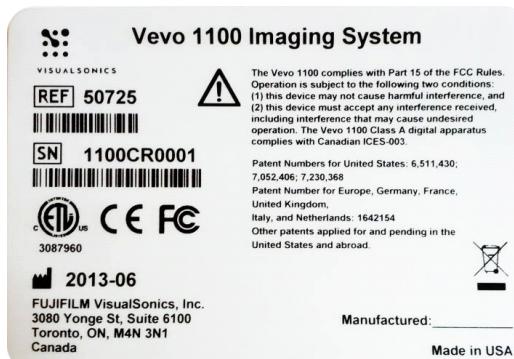
#### Configuration A



#### Configuration B



#### Veo 1100



---

## Vevo® LAB software description



VisualSonics offers optional Vevo LAB software which includes all the software tools and features that you will find on the Vevo Imaging System, excluding the image acquisition tools features.

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

### Related information

- *Vevo LAB analysis (optional)* (page 287)

## Chapter 3

# Vevo LAZR system components

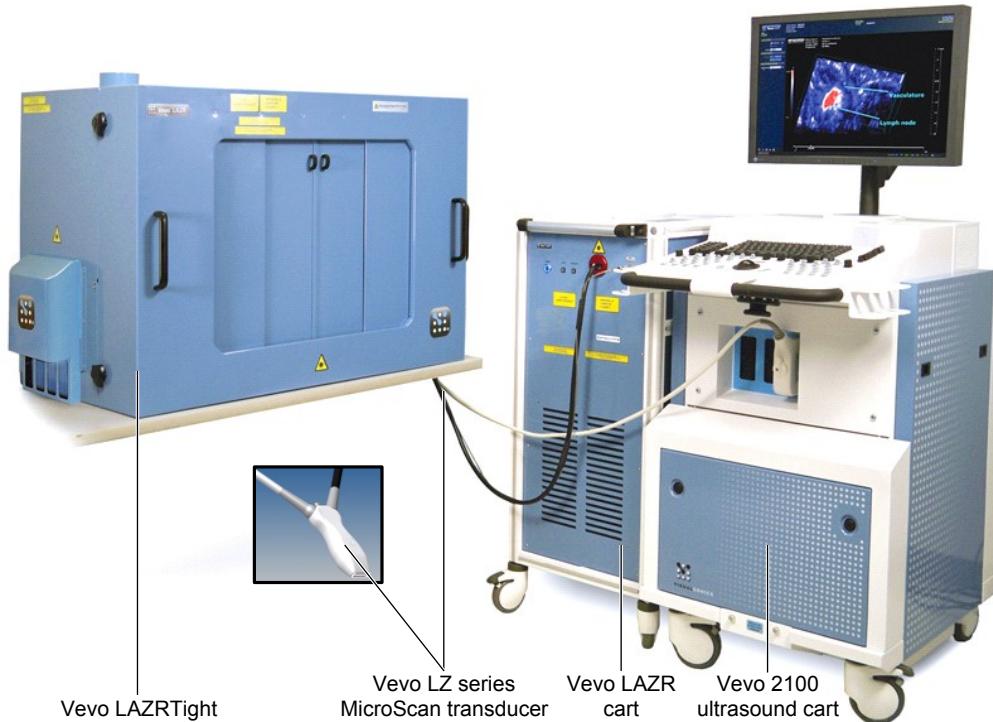


This chapter provides the safety information as it relates to the hardware components that produce and acquire photoacoustic mode (PA-Mode) image data.

### In this chapter

Vevo LAZR overview .....	47
Vevo LAZR cart .....	49
Vevo LAZRTight .....	51
Vevo LAZR transducers .....	56
Vevo Imaging System ultrasound cart .....	58
Vevo LAZR safety .....	58
Setting up the Vevo LAZR components .....	66

## Vevo LAZR overview



Vevo® LAZR Photoacoustic Imaging System (referred to from here on in this manual as Vevo LAZR) is the system that integrates laser light delivery with ultrasound image acquisition to produce photoacoustic (PA-Mode) image data. Vevo LAZR is comprised of the following four components:

- **Vevo LAZR cart:** the enclosure that houses the laser optical system that generates the laser light delivered through the LZ series MicroScan laser transducer for PA-Mode (photoacoustic mode) imaging sessions.
- **Vevo® LAZRTight™:** the dedicated steel cabinet that gives users a protected environment where they can perform photoacoustic imaging (PA-Mode) sessions without exposing themselves to laser light.
- **LZ series MicroScan transducer:** the probe that delivers the laser light and receives ultrasound signals that produce the images during PA-Mode imaging sessions.
- **Vevo Imaging System ultrasound cart:** the standing system that houses the electronics, manual controls, software and monitor that controls the transducer functions and processes the image data during all image acquisition sessions.

The system supports the following imaging modes:

- PA-Mode (photoacoustic)
- B-Mode
- M-Mode
- Anatomical M-Mode
- PW (Pulsed Wave) Doppler Mode
- PW Tissue Doppler Mode
- Color Doppler Mode
- 3D-Mode
- Power Doppler Mode
- Linear Contrast Mode
- Nonlinear Contrast Mode
- EKV™ Mode

The following custom measurement packages are provided, in addition to an array of measurement tools:

- Cardiac measurement
- Abdominal measurement
- Vascular measurement
- Embryology measurement
- Ophthalmology measurement

---

## Vevo LAZR cart



The Vevo LAZR cart houses the optical, cooling and power generation components of the laser light generation system.



**WARNING:** Only those who have been formally trained by VisualSonics to use this laser system may operate this photoacoustic imaging system.



**WARNING: Laser radiation.** Users must not attempt to defeat the switches inside the fiber port.

## Front panel



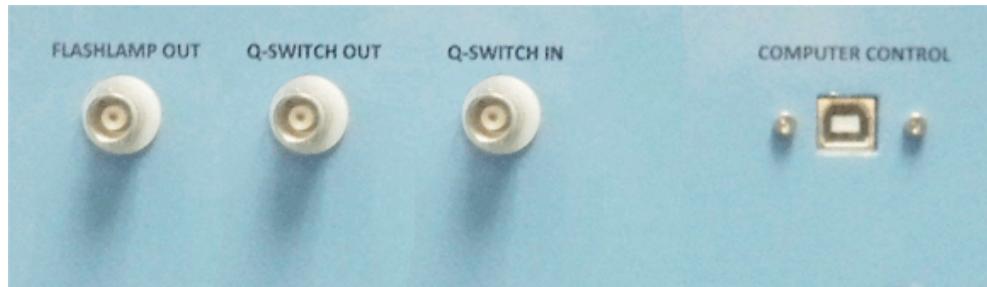
### Area Description

- 
- ① Laser cart power on/off.** Light indicates whether the system is or is not powered by AC. **On=system is powered.**
  - ② Laser light status.** Solid light indicates that the laser is firing. Blinking light indicates that the laser is firing single shots.
  - ③ Interlock status light.** Indicates whether or not the interlock system is activated. **On=interlock is activated and at least one of the interlocks is not completely closed.** The laser cannot fire in this state.
  - ④ Laser fiber port with interlock.** Accepts the laser fiber bundle optic cable that connects to the laser system to deliver the laser light from the cart to the transducer. If the cable is pulled from the cart, the interlock instantly stops the laser from firing.
  - ⑤ Water quality status** indicator light. Indicates whether the ionization level in the distilled water is within the required range. After 20 minutes or less, the light turns green if the ionization level is within range. If the light turns red and remains red after the warm up period, the ionization level in the distilled water is out of range. The distilled water and the water filter must now be changed only by VisualSonics service personnel.
-

## Area Description

- ⑥ **FIBER INTERLOCK** connector. Connects with the **FIBER INTERLOCK** box inside Vevo LAZRTight. This laser safety fiber bundle interlock cable tether prevents any user from operating the transducer outside of the fully interlocked Vevo LAZRTight.

## Back panel



Connector	Description
<b>FLASH LAMP OUT</b>	Connects with a BNC cable to the <b>TRIG IN</b> port on the rear connector panel of the ultrasound cart*. Triggers synchronization signal from the laser to the ultrasound cart.
<b>Q-SWITCH OUT</b>	For future use. Do not use.
<b>Q-SWITCH IN</b>	Connects with a BNC cable to the <b>TRIG OUT</b> connector on the ultrasound cart*.
<b>COMPUTER CONTROL</b>	Connects with a USB Type B cable to a <b>USB 2.0</b> connector on the ultrasound cart*. The ultrasound cart communicates with the laser cart electronics to coordinate the timing of the ultrasound pulses with the laser light.

\* **NOTE:** The Vevo LAZR software on the ultrasound cart that controls the functions through this connector is installed by VisualSonics personnel, following validated procedures.

## Vevo LAZRTight



Vevo® LAZRTight Containment Enclosure (referred to from here on in this manual as Vevo LAZRTight) is the light-shielded workspace where you complete lab studies that require the use of the laser transducer.



**WARNING:** Only those who have been formally trained by VisualSonics to use this laser system may operate this photoacoustic imaging system.

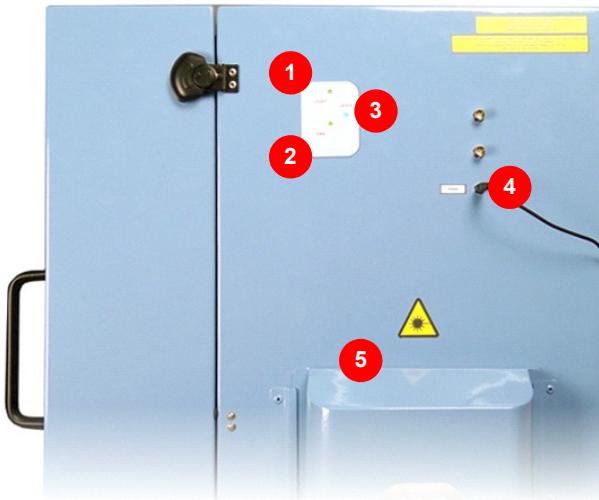
### Positioning Vevo LAZRTight

Vevo LAZRTight can be set up on a table, or under a fume hood to thoroughly vent anesthetic gases.



**WARNING:** Ensure that you orient the position of Vevo LAZRTight such that the laser fires in a direction away from any doorways.

## Right side controls



### Area Description

- | Area | Description  |
|------|--|
| 1    | <b>Interior light control.</b> Press to cycle through on, low, medium, high and off settings.  |
| 2    | <b>Interior fan On/Off toggle button.</b> Illuminated light indicates that the fan is on. Off=off.   |
| 3    | <b>Interlock status light.</b> For this indicator light (labeled Laser), illuminated light (blue) indicates that all the interlocks are engaged and you can operate the laser. Light off = at least one interlock is open and the system prevents the laser from firing. Blinking light indicates that one of the interlocks is not engaged and the system prevents the laser from firing. |
| 4    | <b>LAZRTight power.</b> Connects to AC outlet.   |
| 5    | <b>Access port cover with interlock.</b> Access ports on left and right provide an opening for extending cables and tubing into Vevo LAZRTight. To remove the cover, slide the cover up and out of the magnetic interlock. Interlocks here prevent the laser from firing until you slide both covers down to their base position.  |

## Removable front panel

Removable front panel, for installing and removing the rail system, and for when you are completing tasks that do not require the laser.



**CAUTION:** You must open the sliding front doors BEFORE you remove or replace the front panel. If you do not open the sliding doors, you can permanently damage the interlock assembly for the sliding doors.

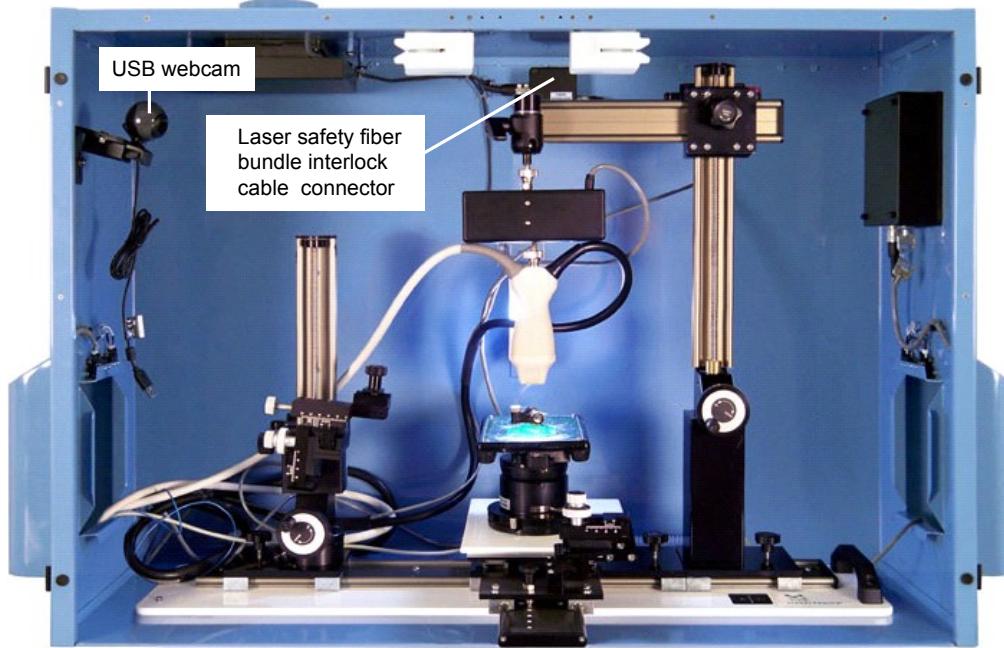
### Area Description

- 
- ① Sliding doors with interlock.** Interlocks here prevent the laser from firing until the doors are completely closed. Interlock also instantly stops the laser from firing if the doors are opened. When you shut the doors, pull the handles together carefully but firmly until the doors physically connect. A complete connection establishes the interlock.
  - ② Latches for removable front panel with interlock.** To remove the front panel, unlatch the top and bottom latches on each side and then carefully remove it.
- 



**WARNING:** Do not use Vevo LAZRTight if either of the front panel sliding doors is damaged.

## Interior

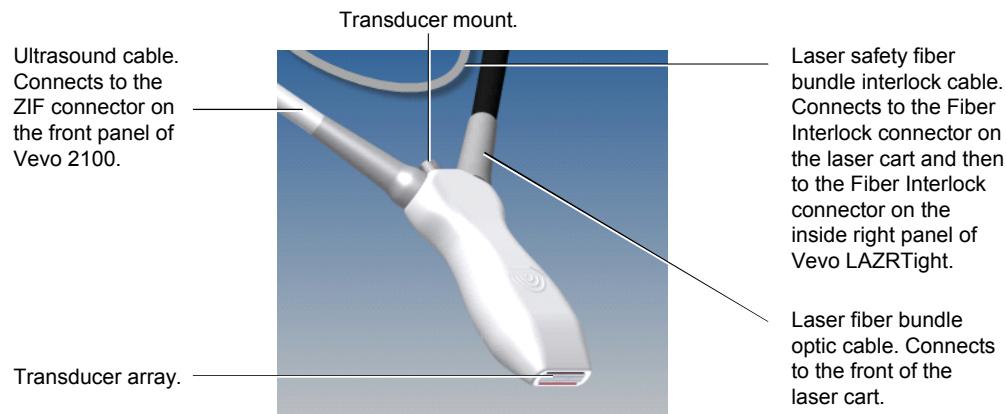


The laser safety fiber bundle interlock cable connector is located on the back panel of Vevo LAZRTight. The cable feeds out one of the side ports to connect to the **FIBER INTERLOCK** connector on the back of the laser cart. This laser safety fiber bundle interlock cable prevents users from operating the transducer outside the fully interlocked Vevo LAZRTight.

## Vevo LAZR transducers



Vevo® LAZR transducers are solid state devices that acquire real-time images of the target in any Photoacoustic Mode (PA-Mode) by integrating laser light delivery with ultrasound signal acquisition. These transducers also acquire data in all other modes supported by the system.



### Features

- 256-element linear array detector
- 3 cables
- Connects either to the ball joint on the Vevo Imaging Station or to the 3D motor connected which, in turn, is connected to the ball joint on the Vevo Imaging Station

**NOTE:** Vevo LAZR transducers can only acquire Photoacoustic Mode (PA-Mode) image data when used with the Vevo LAZR system.

**IMPORTANT:** Only transducers manufactured by VisualSonics may be used with this system.

### Available models

The following LZ transducers can be used with Vevo LAZR.

Transducer	Operating specifications
LZ250	Axial resolution: 75 µm; Broadband frequency: 13 MHz-24 MHz
LZ550	Axial resolution: 44 µm; Broadband frequency: 32 MHz-55 MHz



**WARNING:** Only those who have been formally trained by VisualSonics to use this laser system may operate this photoacoustic imaging system.



**WARNING:** Do not use protective sheaths when operating an LZ series transducer.



**CAUTION:** Only transducers manufactured by VisualSonics may be used with this system.



**CAUTION:** Only use coupling gels that are specifically approved for use with this system.

### Related information

- *Connecting the transducer to the Vevo Imaging System* (page 260)
- *Vevo Imaging System Microscan transducers* (page 37)

---

## Vevo Imaging System ultrasound cart

 Vevo 1100    Vevo 2100    Vevo LAZR



The ultrasound cart houses the electronics, manual controls, software and monitor that controls the transducer functions and process the image data during all image acquisition sessions.

### Related information

- *Vevo Imaging System system components* (page 25)

---

## Vevo LAZR safety

 Vevo LAZR

The laser cart operates as a Class 1 laser (as per Standard IEC/EN 60825-1, 2nd Edition: 2007 for Laser Safety and Class I compliance).

The system is comprised of an optical system and laser power supply. The entire laser system is software controlled. Software provides user controls for wavelength tuning and scanning, and also controls the following laser functions: flashlamp and Q-switch, pulse repetition rate and laser energy output.



**WARNING:** Only those who have been formally trained by VisualSonics to use this laser system may operate this photoacoustic imaging system.

Should an accident or incident occur, or if you are in doubt concerning the operation of the laser, contact the VisualSonics technical support representative.

## Laser radiation warnings



**WARNING: Laser radiation.** Unauthorized personnel must not attempt to defeat the switches inside the fiber port in the laser cart, as well as the Veo LAZRTight side access ports and front sliding doors.

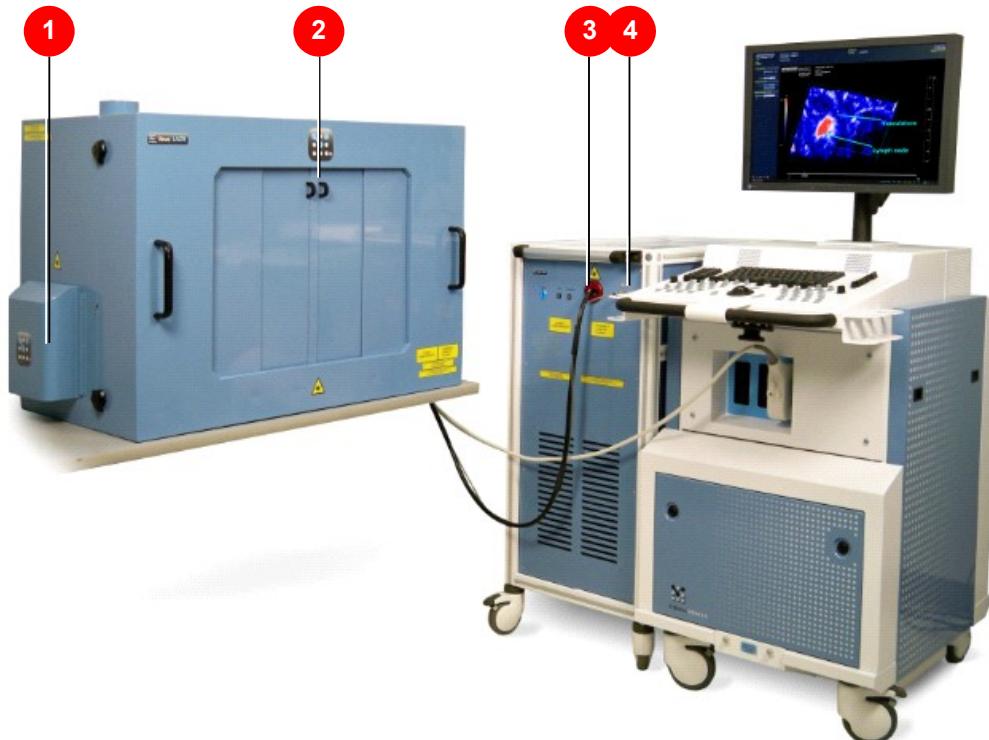
### Related information

- *Laser cart warnings* (page 61)
- *Veo LAZRTight warnings* (page 64)

## Laser interlock signals



Interlocks are magnetic and mechanical limit switches that prevent the laser from emitting light during typical user use until all the interlock connections are in the locked (connected) state. Vevo LAZR incorporates a series of safety interlocks at each opening where laser light could escape.



### Key Interlock location

- 
- ① **Vevo LAZRTight** - Left and right access port covers
  - ② **Vevo LAZRTight** - Sliding doors/front cover
  - ③ **Vevo LAZR cart** - Laser fiber bundle port
  - ④ **Vevo LAZR cart** - Fiber Interlock port
- 

The interlock sites on the system include magnetic connections, mechanical limit switches or a combination of the two. All interlocks on the system must be closed in order for the laser to emit light. If the laser is running and any interlock in the system opens for any reason, the system instantly stops the system from emitting laser light.

**IMPORTANT:** Contact VisualSonics technical support if any of the interlocks do not perform as expected.

## Related information

- *Vevo LAZR cart* (page 49)
- *Vevo LAZRTight* (page 51)

## Safety eyewear (optional)



Users can wear Sperion 31-30123 goggles in this Class 1 laser environment.

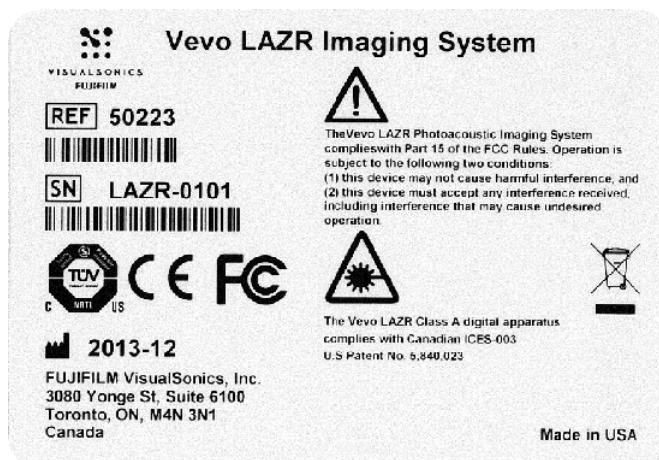


## Laser cart warning labels



### Composite safety warnings label

The composite safety warning label is located on the back panel of the cart.



The following table describes the composite safety warnings displayed on the label.

Symbol	Description
	TÜV SÜD America, Inc. (TUVAM)
	Acronym for "Conformité Européenne. Product meets the safety requirements of the European Union."
	Device authorized under the FCC Declaration of Conformity procedure.
	Attention, see the user guide.
	Laser hazard.

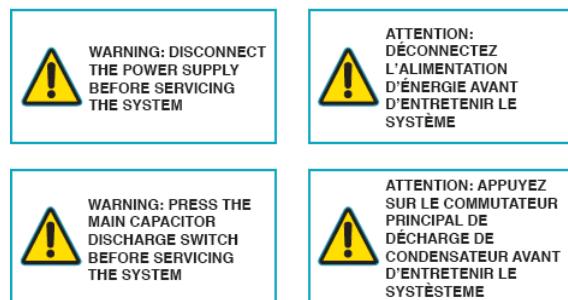
### Individual warning labels

The following individual safety labels (English and French) not described in the composite label are placed on the laser cart.

### Class 1 designation alert (as per IEC 60825-1:2007)



### Electrical warnings



## Class 4 designation warnings

CAUTION - CLASS 4 VISIBLE AND INVISIBLE LASER RADIATION WHEN OPEN  
AND INTERLOCKS DEFEATED  
AVOID EYE OR SKIN EXPOSURE TO  
DIRECT OR SCATTERED RADIATION

ATTENTION - RAYONNEMENT LASER VISIBLE ET INVISIBLE DE CLASSE 4 - EN CAS D'OVERTURE  
ET LORSQUE LA SÉCURITÉ EST NEUTRALISÉE  
EXPOSITION DANGEREUSE AU RAYONNEMENT DIRECT OU DIFFUS  
DES YEUX OU DE LA PEAU

## Fuse labels



To protect the AC mains (the power switch on the system) from overcurrent damage, the fuses on the laser cart can be replaced. If the fuse blows, it must be replaced by a VisualSonics service technician.

The following table describes the fuse labels.

Label	Description	Fuse part #
<b>2xT15A, 250V</b>	120V fuse replacement	50130
<b>2xT8A, 250V</b>	230V fuse replacement	50262

## Vevo® LAZRTight™ warning labels



### Composite safety warnings label

The composite safety warning label is located on the outside back panel of the Vevo®LAZRTight™.



The following table describes the composite safety warnings label placed on the LAZRTight.

## Symbol    Description

	Acronym for "Conformité Européenne." Product meets the safety requirements of the European Union.
	Device authorized under the FCC Declaration of Conformity procedure.
	Attention, see the user guide.

## Individual warning labels

The following individual safety labels (English and French) not described in the composite label are placed on the LAZRTight.

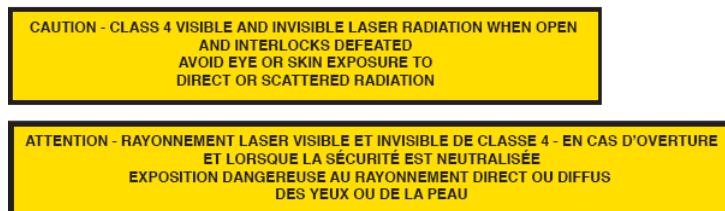
### Laser hazard warning



### Class 1 designation alert (as per IEC 60825-1:2007)



### Class 4 designation warnings



## Vevo LAZR Laser Safety Guide



VisualSonics provides an 11"x17" *Vevo LAZR Laser Safety Guide* poster that is suitable for posting in the immediate area where your Vevo LAZR system is installed.

**How does Vevo®LAZR protect me from laser light?**

**A Enclosures shield you from laser light emissions**

Vevo LAZR is a Class 1 laser product. This means that you are always shielded from laser light.

**A1** Laser light is generated in the completely shielded and enclosed laser cart.

**A2** Laser light is transmitted through shielded and enclosed fiber optic cable.

**A3** Laser light is applied to the tissue inside the fully shielded and enclosed LAZRTight™ animal enclosure.

**B Interlocks stop the laser from firing if light could escape anywhere**

Interlocks are automated OFF switches that instantly stop the laser from firing when they detect an enclosure opening point either before the laser fires or while it is firing.

The blue LASER status light on the LAZRTight displays the interlock state:

- Light on** = All the interlocks are closed.
- Light off** = At least one interlock is open.
- Light blinks** = The front sliding doors are slightly open.

**Do I have to wear laser goggles?**

**NO** In a Class 1 system, all laser light is shielded from you by the metal shielding and the access interlocks. As an option, you can wear Alexandreite model LS-BG3B-33 goggles while you operate the system.

**Do I have to take dedicated Vevo LAZR training?**

**YES** Do not operate this system until you have completed VisualSonics training. You must complete this training to operate this photoacoustic imaging system.

**VISUALSONICS**

For more information on laser safety, contact:  
support@visualsonics.com  
www.visualsonics.com

**Vivo LAZR transducers can only operate in the light-sealed LAZRTight animal enclosure**

**Side port cover interlocks**

When open, the side port on the left and right doors provide an opening for extending cables and reaching into the enclosure.

Interlock prevents the laser from firing and you must both covers down to their base position.

**Front panel door interlocks**

When open, the panel provides access to the enclosure for animal preparation.

Interlocks on each of the two cover latches prevent the laser from firing until you both turn the latches to completely seal and lock the contact interlocks.

**Front cover sliding door interlocks**

When open, the doors provide full access to the inside of the enclosure during imaging sessions.

Interlocks on the door frame stop the laser from firing until you fully but firmly pull the doors together to the physically connected position.

**Fiber optic cable source interlock**

Accepts the fiber optic cable bundle that connects to the laser cart to deliver the generated laser light from the transducer to the enclosure.

If the cable is pulled from the interlock instantly stops the laser from firing.

**Transducer restraint cable interlock**

The restraint cable extends from the front of the laser cart to the inside of the animal enclosure to prevent you from pulling the transducer outside the enclosure.

The laser cannot fire unless both ends of the cable are plugged into the connectors.

**Laser safety Do's and Don'ts**

- DO** use the laser probe only to image in-vivo and in-vitro tissue. Never image any other materials (paper, plastic, metal, etc.)
- DO** ensure that you orient the position of the laser probe so that the laser aims away from any doorway.
- DO** avoid eye or skin exposure to direct or scattered radiation.
- DO NOT** use protective sheaths when operating an L2 Integrated laser / series transducers.
- DO NOT** attempt to override any of the interlocks.

**What should I do if the system gets damaged?**

**RED** Turn off and unplug the system and contact the VisualSonics technical support representative immediately. A service technician will come and test the system to ensure it will operate safely.

If you would like an additional copy of this guide, contact VisualSonics.

## Setting up the Vevo LAZR components



This section describes the required cable connections between Vevo 2100, Vevo LAZRTight and the Vevo LAZR laser cart.

## Connecting the Vevo LAZR system components



Complete the following procedure to connect the Vevo LAZR components.

► **STEP 1: To connect the laser cart to Vevo Imaging System:**

Connect the cables between the back of the laser cart and the rear panel of the ultrasound cart, as described in the following table.



Laser cart connector	Cable connector type	Ultrasound cart connector
FLASHLAMP OUT	BNC	TRIGGER IN
Q-SWITCH IN	BNC	TRIGGER OUT
COMPUTER CONTROL	USB-B or USB 2.0 to USB 2.0	USB 2.0

► **STEP 2: To connect the power cables:**

1. Connect the laser cart power from the AC socket on the rear panel of the laser cart to the wall socket.
2. Connect the Vevo LAZRTight power adapter cable from the AC socket to the **POWER** connector on the right side of Vevo LAZRTight.
3. Connect the ultrasound cart power cable from the **AC In** socket on the rear panel of the ultrasound cart to the wall socket.

## Connecting the transducer to the laser cart



Each Vevo LAZRTight transducer features two cables that extend from the top of the transducer housing to connect to the two core components of the system: the laser cart and the ultrasound cart.

The cable to the laser cart delivers the laser light to the transducer head. The cable to the ultrasound cart delivers the ultrasound signal to the ultrasound cart. You must connect both transducer cables in order to acquire data in PA-Mode.

A third cable, the Laser Safety Fiber Interlock cable, connects to Vevo LAZRTight.

► **To connect the transducer to the laser cart:**

1. Loosen the two securing screws on the locking ring until the locking ring can freely slide up and down.
2. Insert the fiber bundle optic cable through the locking ring into the fiber bundle cable holder. Because the end of this cable must fit into an extremely tight opening, you may need to try it a few times until it fits in.

**CAUTION:** Take care not to scratch the front surface of the fiber bundle optic cable.

The locking ring slides down and rests on the fiber bundle optic cable.



3. Finger-tighten the securing screws.
4. When required, to disconnect the transducer from the laser cart, loosen the securing screws and carefully withdraw the cable.
5. To connect the Laser Safety Fiber Interlock cable, connect one end to the **FIBER INTERLOCK** connector on the front panel of the laser cart, and connect the other end to the **FIBER INTERLOCK** connector on the inside of Vevo LAZRTight.

► **To connect the transducer to the ultrasound cart:**

Complete the procedure described in *Connecting the transducer to the ultrasound cart* (page 260).

## Chapter 4

# Vevo Imaging Station description



Vevo® Imaging Station is VisualSonics' advanced system for managing anesthetized mice and rats during imaging procedures.

This optional, component-based apparatus helps you position the animal in a stable position in relation to the transducer so you can:

- Maintain the optimal image plane during an imaging session
- Monitor the animal's ECG, heart rate, respiration and core body temperature and display and record this data in real time
- Manipulate the animal for image-guided injection and embryonic aspiration procedures

### Related information

- *Vevo Imaging Station Operator Manual* (printed manual)
- *Setting up the Vevo Imaging System* (page 258)
- *Working with physiological data* (page 269)

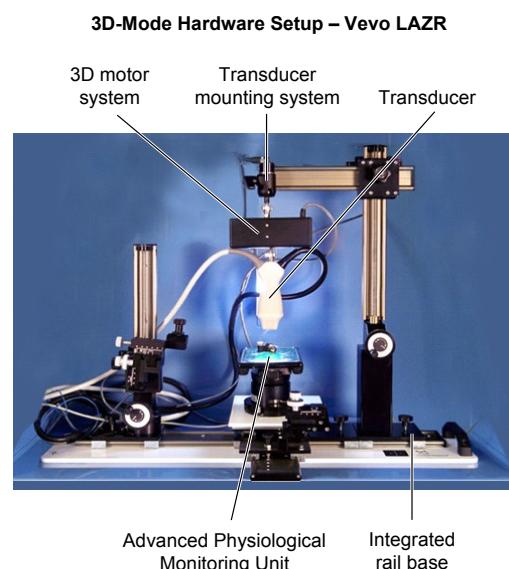
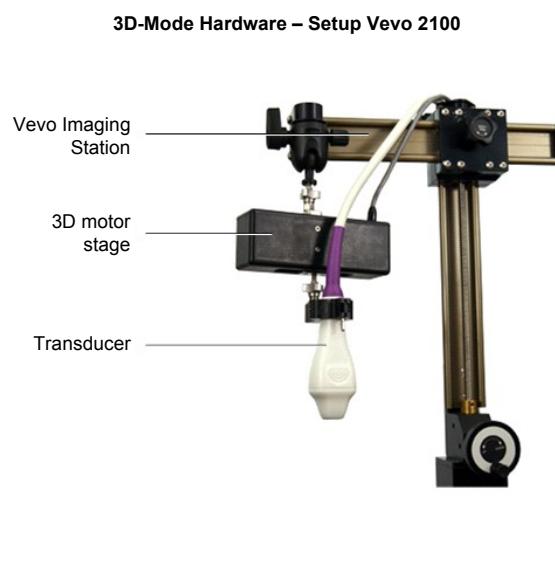
### In this chapter

Vevo Imaging Station setup.....	70
---------------------------------	----

## Vevo Imaging Station setup



The following illustrations show typical Vevo Imaging Station setups.



### Setup components

- **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.



**CAUTION:** 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 and ensure that the motor can move freely and is not obstructed.

- **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.
- **Integrated rail base** Provides the stable rail for attaching, sliding and securing the animal platform system and transducer mounting system. You can interchange these systems and set them up for left-handed or right-handed users.

- **Advanced Physiological Monitoring Unit** 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.
- **Vevo Infusion Pump (not shown in the Vevo Imaging System setup)** Automated image-guided precision micro-injection system that provides a simple and efficient method for injection procedures.

# Quick Start tutorial for ultrasound sessions



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 Imaging System any user must read and observe the Safety Warnings and Precautions in *Safety* (page 720).

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

1. On the back of the cart, set the power switch to the on (!) position.
2. On the left side of the cart press the **Computer Standby** toggle. The computer operating system starts and then the Vevo Imaging System software starts.
3. Initialize the transducer and select the application.
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 series and the new time-stamped images. You can now analyze the image data.
  11. In the **Name** column, 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 image management panel.
  15. In the measurement packages list box:
    - d. Click the appropriate measurement package for your study. For example, click **Cardiac Package**. The system displays the list of available measurement protocols.

**NOTE:** Vevo 1100 supports one measurement package: **Cardiac Package**.

- 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 the measurement
  - saves the cine loop
  - 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. (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
  - c. In the **Options** section, complete any changes you want to make.
  - d. Click **OK**.

The system exports your report.

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

#### Related information

- *Vevo Imaging System workspaces* (page 75)
- *Managing your studies* (page 217)
- *Acquiring image data* (page 257)
- *Analyzing image data* (page 286)

## Section 2

# Software workspaces



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

### In This Section

User Management Mode login window workspace.....	76
Mode window workspace.....	78
Image management panels .....	84
Study Browser window workspace .....	92
Study Information window workspace.....	96
Preferences window workspace.....	98
Analysis Browser window workspace .....	100
Export and Copy To window workspace .....	103

# User Management Mode login window workspace



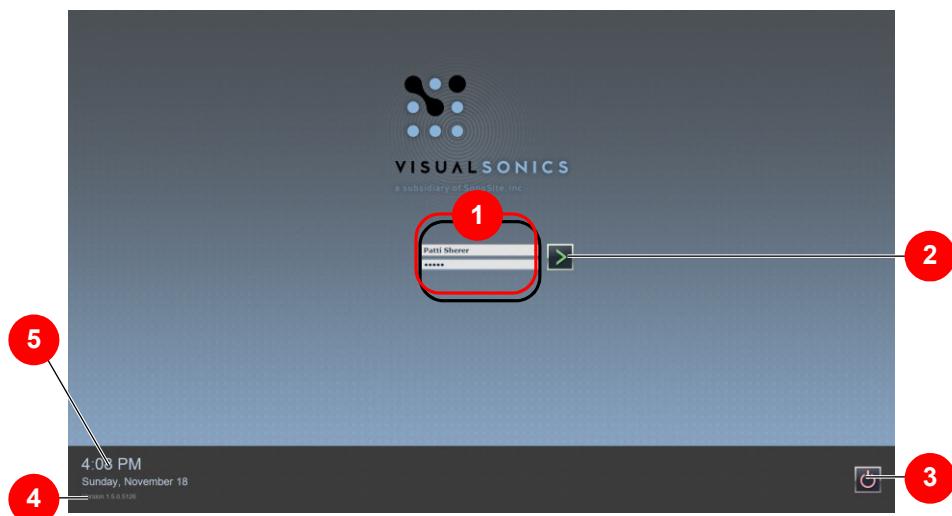
When User Management Mode has been enabled, you must individually log in and out of the system. The login window workspace provides features you can use to:

- Log in to the system with your user name and password
- Shut down the Vevo Imaging System
- Check the system status
- Identify the software version

## ► To view the User Management Mode login window:

- If User Management Mode is enabled and the system is powered down, press the computer on/off switch, located on the side of the ultrasound cart, next to the DVD drive. The system powers on and the login window appears.
- If User Management Mode is enabled and you are acquiring or analyzing images, in the upper-right area of the monitor, click **Log Out**. The login window appears.
- If Standard Mode is on you can switch to User Management Mode and access the login window, but only if you are an administrator.

The following illustration describes the login window workspace.



## **① User name/password login**

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

**CAUTION: 10-TRY LIMIT FOR INCORRECT PASSWORDS.** The system then temporarily disables your account. Contact your administrator to reset your password, or reboot the system and try up to 10 more passwords again.

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

## **② Log in**

Click after you select the user and type the password.

## **③ Computer shut-down (Vevo Imaging System)**

Click to start a managed shut-down of the Vevo Imaging System. This shut-down initiates a staged routine that automates the shut-down process in order to protect both the system electronics as well as your study data.

## **④ Version stamp**

Helpful for quick reference when you are communicating with VisualSonics technical support.

## **⑤ Time and status indicator**

When the : hour/minute separator flashes, the system is functioning. When it is not flashing, contact VisualSonics technical support.

## **Related information**

- *Switching from Standard Mode to User Management Mode (page 191)*

Chapter 7

# 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 data.
  - From the Study Browser, expand a study row, select a series in the study. Next, either double-click one of the thumbnails or expand one of the series and double-click one of the image rows.
  - From a displayed image, click the Browse Images tool , scroll through images without returning to the Study Browser

The following illustration describes the Mode window workspace.



## **① Image area**

This large area:

- Displays image data
- Displays physiological data for the animal (if recorded during image acquisition)
- Provides cine loop range controls for acquired cine loops
- Provides a Browse Images tool for scrolling through an inset gallery of images without having to return to the Study Browser

If you export an image and select Image as your export type, the system includes the image area content along with header information.

## **② Image data**

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.

## **③ Focus depth scale**

Indicates the distance from the transducer face where the system maximizes image resolutions. The triangular arrow indicates the focal length(s) of the transducer. When you acquire image data, use the **Image Depth** control on the control panel to increase or decrease the depth that you can see.

## **④ Focal depth indicator**

When you acquire data, use the **Focal Zones** control on the control panel to add up to three focal zones (note that only one focal zone is available on the Vevo 1100). The number of focal zones depends on the imaging mode you are imaging in.

## **⑤ Transducer orientation indicator**

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 for your preference, you can click the indicator to flip the image horizontally.

## **6** Dynamic range bar

Indicates the dynamic range of the display. When you acquire data, use the **Dynamic Range** control on the control panel to change the range.

## **7** Physiological data trace panel

Displays the animal's dynamic heart rate, temperature, respiration rate and blood pressure data. This data is gathered by the Advanced Physiological Monitoring Unit that connects to the Vevo Imaging Station.

## **8** Physiological data values

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. This data is gathered by the Advanced Physiological Monitoring Unit that connects to the Vevo Imaging Station. For more information, see *Vevo Imaging Station description* (page 69), *Physiological preferences tab* (page 141) and *Setting up to acquire physiological data* (page 269).

## **9** 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. To only display the image frames in that range, drag the left and right vertical markers. For more information, see *Working with cine loops* (page 288).

## **10** Status bar

Displays:

-  3D motor position, when the 3D motor is initialized (where 3D-Mode is supported)
- Monitored physiological values in real time during image acquisition

**PREREQUISITES:** Live physiological data is only available a) when you enable the inputs in the Physiological tab of the Preferences window; and b) when the animal is connected to the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station.

For more detailed information on physiological monitoring, see *Vevo Imaging Station description* (page 69), *Physiological preferences tab* (page 141) and *Setting up to acquire physiological data* (page 269).

- Percentage of **free space** to store image data so you can see when you should start to back up your image data to free up space on the system

-  User name, in blue, when **User Management Mode** is enabled (where User Management Mode is supported)
-  Elapsed session time when you hover over the displayed blue user name when User Management Mode is enabled.

## 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.
- Confirmation messages when you store an image.
- The updated parameter and system information when you make adjustments on the control panel.
- Control options in the acquisition mode you are using. To select, either a) cursor to the option and then click; or b) turn the **Screen Keys** dial to display the option, then press the dial.

## ⑫ Image mode management panel

Displays a unique set of controls and information sections depending on the control key you press, or the image management panel tab you click:

- 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 (where ECG Trigger is supported).
- Press **Image Process** to set the panel to display the controls for brightness, contrast, baseline, priority, display maps, display layouts, loading into 3D and TGC loading and saving.
- Press **Mode Settings** to set the panel to display the Mode settings. This is the default panel when you open a Mode window.
-  In PA-Mode, when you are reviewing a PA-Mode (NanoStepper) image, click the  Laser Control tab to display the Laser Control and Wavelength controls you can use to control the operation of the laser in the Vevo LAZR cart and the wavelength values.

-  When you are reviewing a PA-Mode (NanoStepper) image, click the Multiplexer Control tab  to access a set of tools you can use to assign color and other visual properties to each wavelength image series in your NanoStepper acquisition so you can view layers as individual or combined views of the data.

#### **User details**

- Displays your institution name if you added it in the **Preferences** window.
- Displays your user name if you selected it for your session.
- Identifies the transducer that is acquiring image data (if you are in an image acquisition session) or the transducer that acquired the data (if you are in an image analysis session).

#### **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 acquisition imaging mode (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 or image label.
- **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.
-  **Regenerated.** The AM-Mode image was derived from a B-Mode image or from data loaded into 3D-Mode.
- 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.
- **Transducer Disabled.**

#### Related information

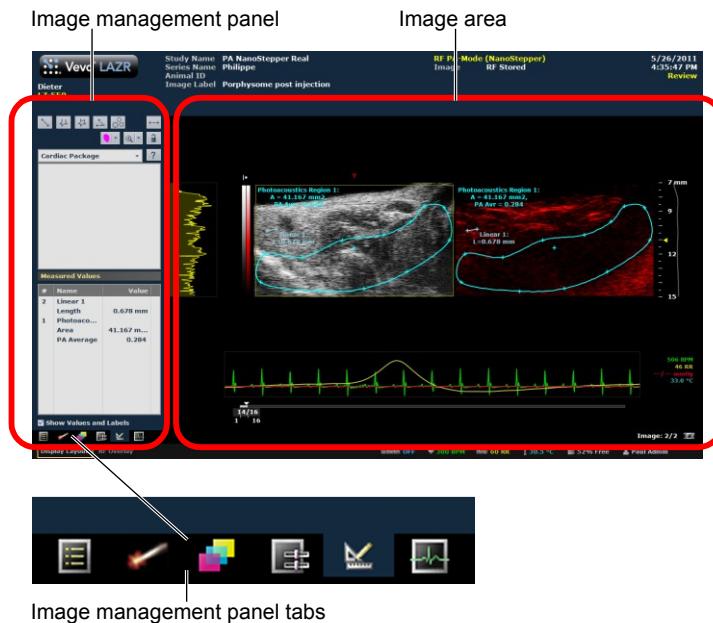
- *Control panel* (page 105)
- *Setting up the Vevo Imaging System* (page 258)
- *Working with physiological data* (page 269)
- *Acquiring image data* (page 281)

## Chapter 8

# Image management panels

Vevo 1100   Vevo 2100   Vevo LAZR

Image management panels provide tools or information lists that help you work with the image that is displayed in the image area.



The image management panel tabs display the available panels that are available, based on the image mode and whether you are acquiring an image or reviewing an image.

### In this chapter

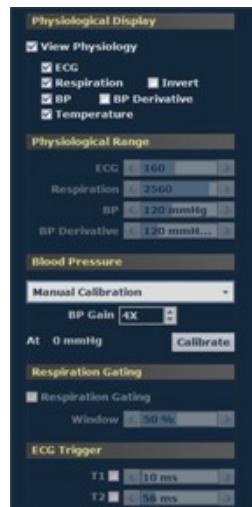
Physiological data options panel.....	85
Measurement tools panel .....	86
Mode settings panel.....	86
Image processing tools panel.....	87
Region graph tools panel.....	87
Laser control tools panel .....	88
Multiplexer control tools panel .....	88
3D-Mode tools panels .....	89

## Physiological data options panel

Vivo 1100 Vivo 2100 Vivo LAZR

Provides controls for how and when the physiological data inputs are displayed. The controls in the Physiological Range, Respiration Gating and ECG Trigger sections are only available during image acquisition.

**NOTE:** ECG Trigger is not available on the Vivo 1100.



### To display the Physiological data options panel:

- On the control panel, press **Physio Settings**.
- In the image management panel tabs (below the panel) click the **Physiological** tab

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

## Measurement tools panel



Provides tools for adding measurements to an image. Tools are only available when you are reviewing an individual frame and you pause the playback. During image acquisition, the tools are not available.



### To display the Measurements panel:

- On the control panel, press **Measure**.
- In the image management panel tabs (below the panel) click the **Measurements** tab .

## Mode settings panel



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

Application Preset	General Imaging PA
<b>Transmit</b>	
Frequency	40 MHz
2D Power	100 %
PA Power	100 %
<b>Acquisition</b>	
PA Gain	47 dB
2D Gain	12 dB
Depth	15.00 mm
Width	14.08 mm
Sensitivity	1
Resp Gate	Off
Extended Buffer	Off
Persistence	Off
PA Acquisition	NanoStepper
Wavelength 1	680 nm
Wavelength 2 *	750 nm
Wavelength 4	850 nm
Wavelength 5	970 nm
Energy Corr.	On
Correct Energy	On
<b>Display</b>	
Display Map	PA1
Priority	99 %
Brightness	50
Contrast	50

### To display the Mode Settings panel:

- On the control panel, press **Mode Settings**.
- In the image management panel tabs (below the panel) click the **Mode Settings** tab .

## Image processing tools panel



Provides tools for modifying the visual properties of your image.



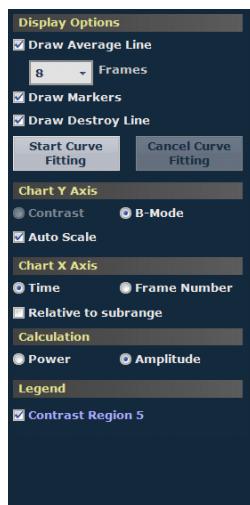
### To display the Image Processing panel:

- On the control panel, press **Image Process**.
- In the image management panel tabs (below the panel) click the **Image Processing** tab .

## Region graph tools panel



Provides tools for modifying a region graph.



### To display the Region Graph panel:

Right-click a measurement that includes a graph feature and select **Region Graph**.

#### Related information

- Contrast region measurement* (page 603)
- Cardiac region measurement* (page 601)
- PA region measurement* (page 620)
- Pressure-Volume relationship graphs* (page 345)

---

## Laser control tools panel



Provides tools for controlling the operation of the laser in the Vevo LAZR cart and the wavelength values. Only available in PA-Mode.



### To display the panel:

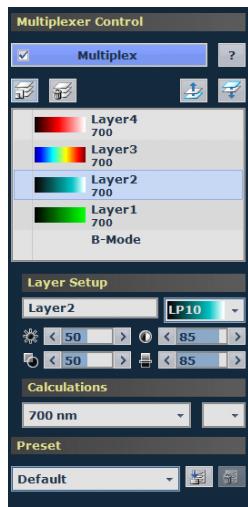
- On the control panel, press **Mode Settings** twice.
- In the image management panel tabs (below the panel) click the **Laser Control** tab .

---

## Multiplexer control tools panel



Provides tools for assigning color and other visual properties to each wavelength image series in a NanoStepper acquisition.



### To display the panel:

With a NanoStepper image open, click the **Multiplexer Control** tab .

## 3D-Mode tools panels



When you review 3D-Mode images, the image panel provides a set of four complete tool panels.

### ► To display the 3D-Mode tool panels:

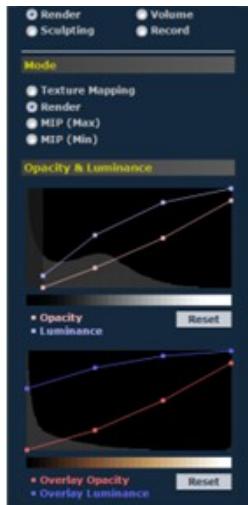
1. Open the 3D image and click the modes settings icon at the bottom of the image management panel to display the 3D settings. The 3D-Mode tools panel appears. The top of the panel displays the links to the four tool panels.



2. Click the label of the panel you want to work with.

### 3D-Mode rendering tools panel

Provides tools for displaying the full 3D image. You can only use this tool when you are viewing a 3D image in the Cube view.



#### To display the panel:

At the top of the panel click **Render**.

### 3D-Mode sculpting tools panel

Provides tools for cutting away superfluous image data so you can view volumes of interest more easily. You can only use this tool when you are viewing a 3D image in the Cube view.

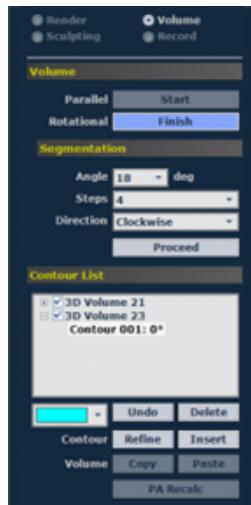


### To display the panel:

At the top of the panel click **Sculpting**.

### 3D-Mode volume tools panel

Provides tools for accurately measuring object volumes within an image.

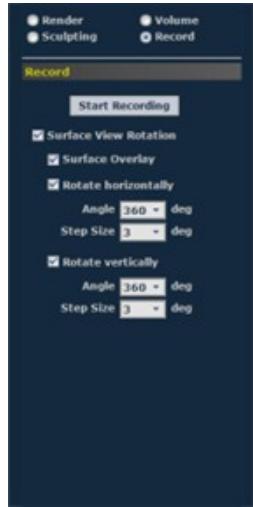


### To display the panel:

At the top of the panel click **Volume**.

### 3D-Mode session recording tools panel

Provides tools for creating a real-time AVI file or GIF files of actions you perform on 3D image data in the active pane.



### To display the panel:

At the top of the panel click **Record**.

## Chapter 9

# Study Browser window workspace

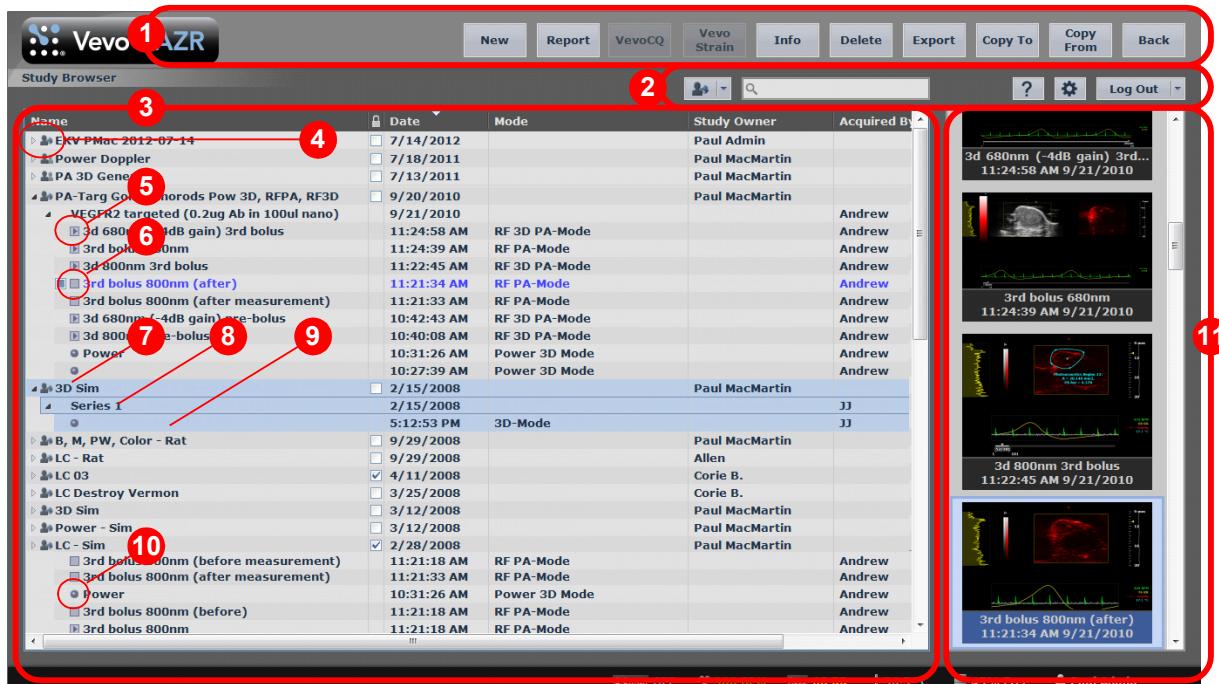


The Study Browser window is the exploration workspace you use to manage your studies, series and individual images. Use the Study Browser to:

- View the list of available studies
- Search for content in the Study Browser grid and the study/series info pages
- Expand a study row to view the contained series
- Expand a series row to view the contained images
- Double-click an image row or image thumbnail to view the image in a Mode window

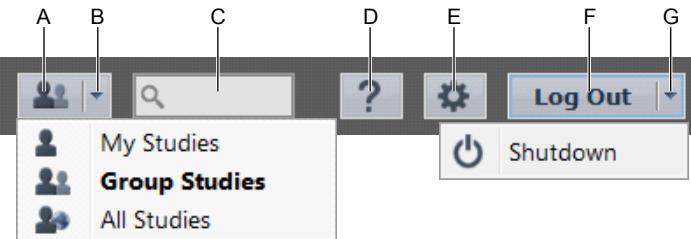
### ► To open the Study Browser:

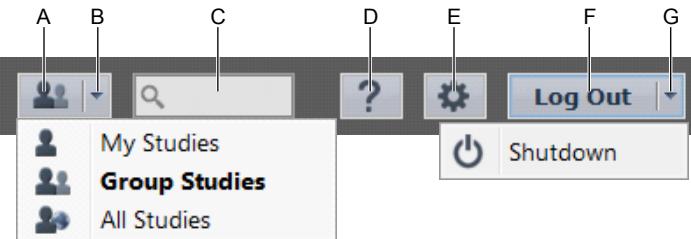
Press **Study Management**. The system displays the Study Browser window. The following illustration describes the Study Browser window workspace.



**NOTE:** Area 2, the toolbar area, includes different tools, depending on whether User Management Mode is on or off. The following table details these differences.

**1** Study Browser window commands.

**2**  Toolbar (when User Management Mode is on). Provides the following tools.



**A - Study sharing level selector.** Each time you click, the grid displays the list of studies that match the study sharing level. Only appears when User Management Mode is enabled.

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

**B - Directly select study sharing level.** Click the down arrow and then select the study sharing level. The grid displays the list of studies that match your selection. Only appears when User Management Mode is enabled.

**C - Search box.** Searches for any content in all columns in the study grid. To search the grid, type your search phrase in the box. The system auto-displays the matching results with each character you type. To return to the full grid, click  in the search box.

**D - Help.** Opens the Help information options.

**E - Preferences.** Opens the Preferences window.

**F - Log Out.** Logs you out and displays the User Management Mode log in window. Only appears when User Management Mode is enabled.

**G - Expand arrow to Shutdown the Vevo Imaging System.** Click the down arrow and then click Shutdown. The system initiates a staged routine that automates the shut-down process in order to protect both the system electronics as well as your study data.

**2**  Toolbar (when User Management Mode is off). Provides the collection of tools explained in the following keyed illustration.



**A - Grid search box.** Searches for any content in all columns in the study grid. To search the grid, type your search phrase in the box and then press **ENTER** to display the results.

**B - Help.** Opens the Help options.

**C - Preferences.** Opens the Preferences window.

**D - Vevo Imaging System power off.** Click the power shutdown button to start a managed power-off of the Vevo Imaging System. This initiates a staged routine that automates the shut-down process in order to protect both the system electronics as well as your study data.

---

**3** **Studies grid.** Lists the available studies and the series that contain the images.

- **To sort the grid by column**, click the column header. Click again to toggle the sort order between ascending/descending.
  - **To re-position any column except Name**, drag it to the left or right side of another column.
  - **To resize the width of a column**, drag the right-side column divider left or right.
  - **To hide a column**, right-click anywhere in the header row and click the column title to remove the check mark.
  - **To show a hidden column**, right-click anywhere in the header row and click the column title to apply the check mark.
- 

**4**  **Study sharing level icon.** Indicates the study sharing level when in User Management Mode as described in the toolbar description table above.

---

**5**  **Cine loop image icon.** Double-click the icon to play the cine loop.

---

**6**  **Image frame icon.** Double-click the icon to view the image frame.

---

**7** **Study row** in the study grid. To display the notes that have been added for the study or any series in the study, click the study row.

Right-click a study for options to:

- Change the measurement package for the study
  -  Change the study access level (only available when User Management Mode is on)
  - Delete the study
- 

**8** **Series row** within a study. To display a series, double-click or expand the study, then select the series.

Right-click a study for options to:

- Change the measurement package for the series
  - Move the series to another study
  - Delete the series
- 

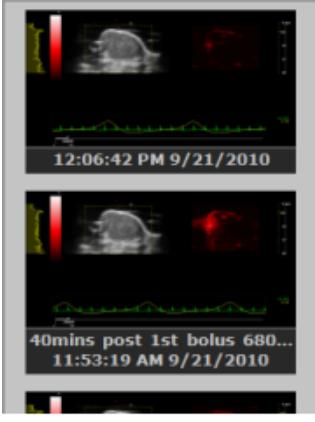
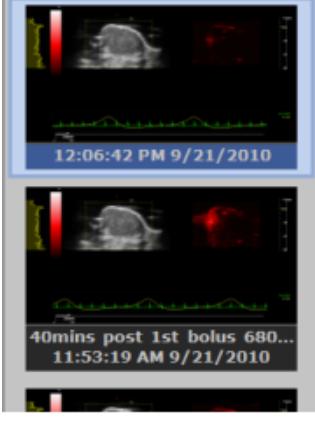
**9** **Image row** within a series. To view an image, expand the study then expand the series, then double-click the image row or double-click the image thumbnail in the right panel.

Right-click a study for options to:

- Change the measurement package for the image
  - Delete the image
- 

**10**  **3D-Mode image icon.**

- ⑪ Notes/thumbnails panel.** Displays the content that relates to the grid row you have selected, as described in the following table.

Grid row selected	Preview panel
<p><b>When you select the study row,</b> the panel displays study notes if any have been entered in the Study Notes field of the Study Info window.</p> <p>Summary details of each series are displayed after notes.</p>	 <p>Main B-Mode Thrombosis Events</p> <p>Notes: Visible anomalies between groups B and D.</p> <p>Series: 2 Size: 176 MB</p> <p>Thrombosis - Color</p> <p>Acquired By: Paula MacDonald Date: 6/20/2012 Images: 2 Size: 31 MB</p> <p>Series 1</p> <p>Acquired By: Paula MacDonald Date: 6/20/2012 Images: 5 Size: 145 MB</p>
<p><b>When you select the series row,</b> the panel displays all thumbnails of the images in the series.</p> <p>Double-click a thumbnail to open the image.</p>	 <p>12:06:42 PM 9/21/2010</p> <p>40mins post 1st bolus 680... 11:53:19 AM 9/21/2010</p>
<p><b>When you select the image row,</b> the panel highlights the image thumbnail.</p> <p>Double-click the thumbnail to open the image.</p>	 <p>12:06:42 PM 9/21/2010</p> <p>40mins post 1st bolus 680... 11:53:19 AM 9/21/2010</p>

## Related information

- *Creating a study* (page 219)
- *Creating a series* (page 230)

# 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 describes the Study Information window workspace.

- 1** **Study Information** window commands.

**NOTE:** For information on the **Previous Info** command button see the procedure "*To simplify the addition of second and subsequent series in a study*" in *Creating a new series* (page 230).

- 2** **Study Information** section. Includes the information boxes that describe a study. When User Management Mode is on, this area includes a **Sharing** field to display the sharing level that has been selected for the study.
- 3** **Series Information** section. Includes the information boxes that describe a series within a study.

## Related information

- *Customizing study information details* (see page 222)

# Preferences window workspace



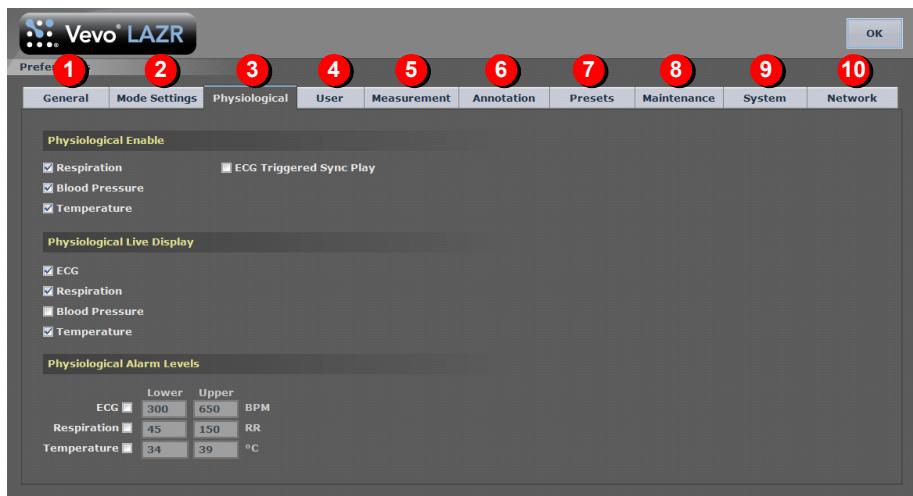
The **Preferences** window provides a series of tabs you can use to configure default values for a range of operational settings.

Use the **Preferences** window to configure defaults that are available to all users 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 Vevo LAB, click the  icon in the image tools icon panel.

The following illustration describes the Preferences window workspace.



- 1** **General.** Use this tab primarily to specify your acquisition settings.
- 2** **Mode Settings.** Use this tab to configure a collection of preferences that apply to features of individual image acquisition modes.
- 3** **Physiological.** Use this tab to configure the settings that manage the respiration, blood pressure and temperature signal inputs.
- 4** **User.** Use this tab to enable/disable User Management Mode and to add, modify, export and delete users.
- 5** **Measurement.** 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.

- 6** **Annotation.** Use this tab to customize the way you view and add annotations when you analyze the image data that you have acquired.
- 7** **Presets.** Use this tab to create custom acquisition presets, custom applications and preset groups.
- 8** **Maintenance tab.** Use this tab to manage system level features.
- 9** **System.** Use this tab to manage the network and system configurations of the cart system.
- 10** **Network.** Use this tab to connect to a new workgroup in the network domain you are on, connect to a completely different network or map your system to a network drive.

## Related information

- *Preferences* (page 129)

## Chapter 12

# Analysis Browser window workspace

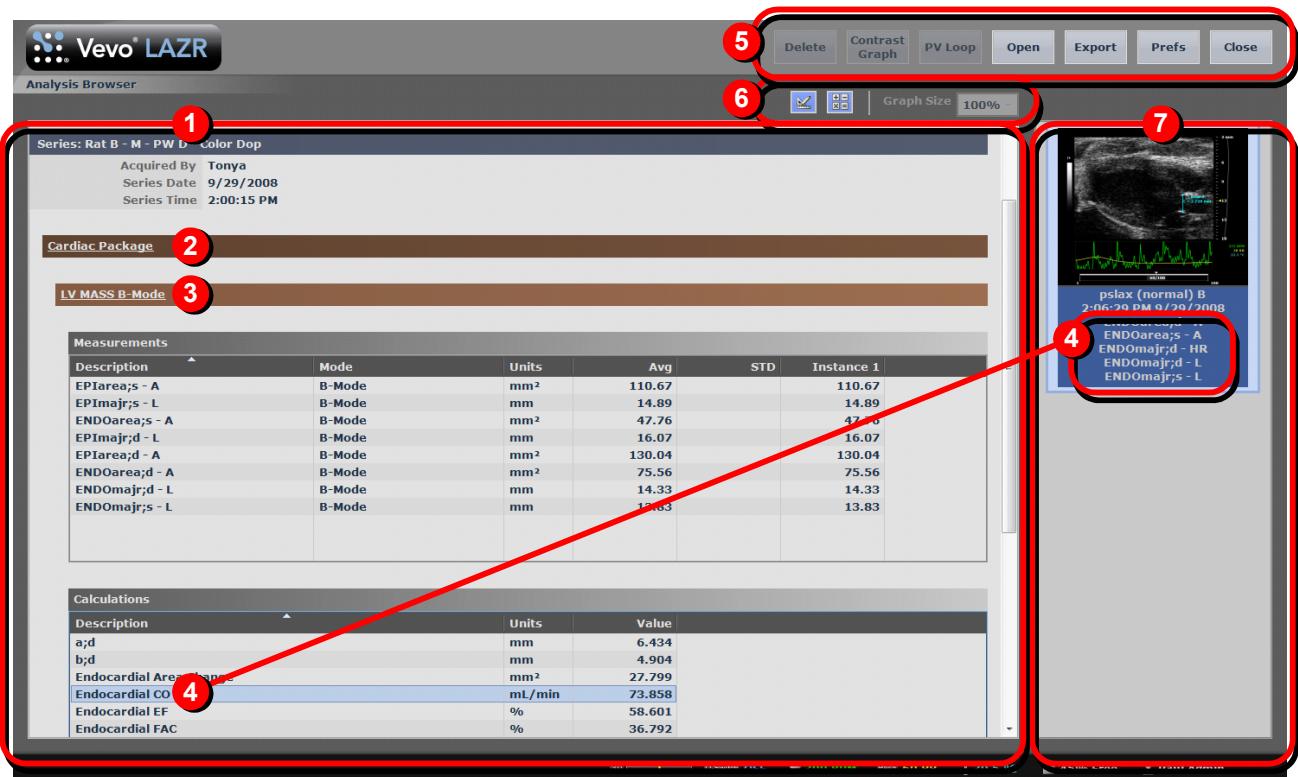


The **Analysis Browser** window displays a report of the measurements and calculations for one or more studies or just the series you select in the **Study Browser**.

### ► To open the Analysis Browser window:

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

The following illustration describes the Analysis Browser workspace.



### ① Report details

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

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

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

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

### ② Hyperlink to the measurement package help content

When you click the measurement package label (in this example, Cardiac Package), the help topic for the measurement package appears.

### ③ Hyperlink to the measurement description

When you click the measurement label (in this example, LV MASS B-Mode), the help topic for the description appears.

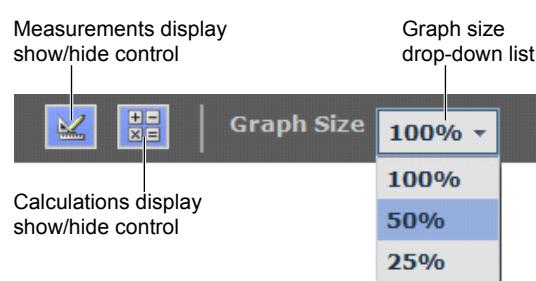
### ④ Individual calculation display

When you click a calculation description in the **Calculations** table, the thumbnail description area displays the constituent measurements on that image that create the displayed calculation.

### ⑤ Analysis Browser window commands

Delete, Contrast Graph, PV Loop, Open, Export, Prefs, Close.

### ⑥ Analysis Browser toolbar



- **Measurements/Calculations display controls.** Click either or both controls to show or hide the data. Blue icon = report *shows* the data. Gray icon = report *hides* the data.

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

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

## 7 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 analysis report* (page 321)

## Export and Copy To window workspace



The system provides a common workspace environment for transferring data from your Vevo 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 Study To window:**

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

► **To open the Export Image window:**

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

► **To open the Export Report window:**

1. Open the **Study Browser**.
2. Select one or more studies and/or series and click **Report**. The system displays the **Analysis Browser**.
3. Click **Export**.

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



#### Area Description

- 1** **Folder browser.** Functions the same way your Explorer window works on your Windows PC: browse the folders to find your destination folder.

**2** **File transfer information and options.**

- The **Export Type** section only appears when you are exporting 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
- The **Options** section includes fields for specifying a file name, file type and other options

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 from the Study Browser* (page 240)
- *Exporting an analysis report* (page 321)

## Section 3

# Control panel workspace



This section describes the physical controls on the Vevo Imaging System control panel.



### In This Section

Control panel groupings by image mode .....	106
Working with the TGC sliders.....	107

## Control panel groupings by image mode



The keys, dials, toggles, sliders and rocker switches on the control 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 693)
- *Control panel controls for B-Mode* (page 329)
- *Control panel controls for PA-Mode* (page 365)
- *Control panel controls for M-Mode and AM-Mode* (page 409)
- *Control panel controls for PW Doppler Mode* (page 436) (includes PW Tissue Doppler Mode controls)
- *Control panel controls for Color Doppler Mode* (page 493)
- *Control panel controls for 3D-Mode* (page 464)
- *Control panel controls for Power Doppler Mode* (page 510)
- *Control panel controls for Linear Contrast Mode and Nonlinear Contrast Mode* (page 527)

**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."

## Chapter 15

# Working with the TGC sliders



Time gain compensation (TGC) 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.

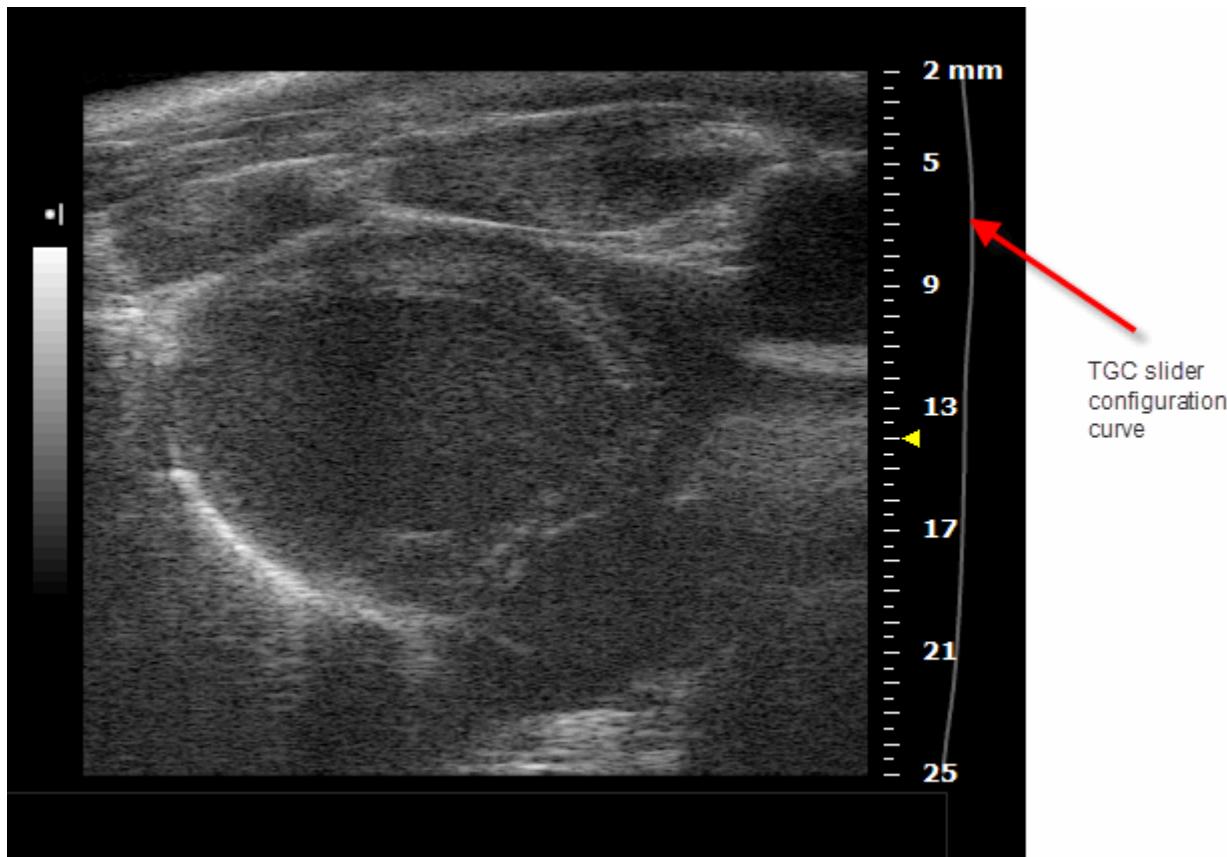
### In this chapter

Saving and loading TGC slider settings.....108

## Saving and loading TGC slider settings

Vevo 1100   Vevo 2100   Vevo LAZR

If you have created a TGC control configuration curve that you like, you can save it as an individual profile and then reload it in any mode before you acquire new image data.

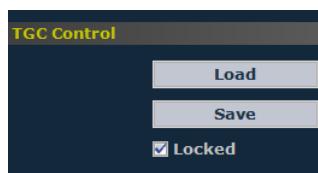


The **TGC Control** tools section is located in the **Image Processing** panel. You can only access these tools from the ultrasound cart.

### ► To access the **TGC Control** tools:

- On the control panel, press **Image Process**.
- In the image management panel tabs (below the panel) click the **Image Processing** tab .

The **TGC Control** tools section appears near the bottom of the panel.



► **To save TGC settings during image acquisition:**

1. While acquiring or reviewing an image on the ultrasound cart, press **Image Process** or click . The image processing controls appear in the image management panel. The **TGC Control** section appears near the bottom of the image management panel.
2. In the **TGC Control** section click **Save**. The **Save TGC Control** dialog box appears.



3. Type the name for your profile and then click **Save**.

► **To save TGC settings from a stored image:**

1. Open the saved image that contains the curve you want to save.
2. In the TGC Control section click **Save** and create a new profile.

► **To load a saved TGC slider settings profile:**

1. Start acquiring data, press **Image Process** and in the **TGC Control** section click **Load**. The **Load TGC Control** box appears.
2. Select the profile from the list and click **Load**. The system applies the settings and sets the **Locked** check box to the selected state. This prevents any changes to the TGC configuration. To confirm that the system has applied the settings you chose, press **Mode Settings**. In the **Acquisition** section, the TGC settings profile appears as the **TGC** setting.



**NOTE:** When you create a new series, any saved and applied TGC settings are cleared and the system applies the settings values of the physical sliders on the ultrasound cart control panel.

► **To unlock a loaded TGC profile:**

In the image processing panel, in the **TGC Control** section, clear the **Locked** check box. The system unloads, or cancels, any previously loaded profile and reverts back to the current values of the physical TGC sliders.

When you create a new series, any saved and applied TGC settings are cleared and the system applies the settings values of the physical sliders on the ultrasound cart control panel.

► **To manually lock the TGC settings:**

Select the **Locked** check box. The system ensures that the current gain profile is not changed.

## Section 4

# Basics



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

### In This Section

How the Vevo Imaging System works .....	112
Turning the system on and off .....	120
Logging in and out.....	125

# How the Vevo Imaging System works

 Vevo 1100  Vevo 2100  Vevo LAZR

The Vevo Imaging System integrates four core systems:

- Image acquisition modes
- Application packages
- Studies, series and images
- Users



**WARNING:** Before using the Vevo Imaging System, any user must read and observe the safety warnings and precautions in *Safety* (page 720).

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

## In this chapter

Image acquisition modes.....	112
Application packages.....	118
Studies, series and images.....	119
Users .....	119

---

## Image acquisition modes

 Vevo 1100  Vevo 2100  Vevo LAZR

The Vevo Imaging System provides a range of imaging modes to achieve different imaging objectives.

## Frame-based modes and time-based modes

 Vevo 1100  Vevo 2100  Vevo LAZR

Because many Vevo Imaging System features apply to multiple imaging modes, you will find frequent references in this manual to frame-based modes and time-based modes. The following table describes the two groups.

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

## PA-Mode overview



PA-Mode (photoacoustic mode) is a method for obtaining optical contrast from biological tissues and detecting it with ultrasound. By illuminating tissue with pulsed laser light, a thermoelastic expansion occurs and this expansion creates an ultrasound wave which can be detected with an ultrasound transducer.

### Related information

- *Mode window workspace* (page 78)
- *Acquiring PA-Mode images* (page 359)
- *Analyzing PA-Mode images* (page 395)

## 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.

You also:

- Use B-Mode in other imaging modes as the background orientation image over which the active mode data is applied.
- Use B-Mode as a real-time orientation window in other imaging mode windows so you can visually guide the transducer to the right location to acquire the most useful data in your active imaging mode.

### Related information

- *Acquiring B-Mode images* (page 325)
- *Analyzing B-Mode images* (page 341)

## 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 is a frame-based image that uses multiple scanning beams to create its image, M-Mode is a time-based image that uses just one beam.

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

- *Acquiring M-Mode images* (page 404)
- *Analyzing M-Mode images* (page 416)

## AM-Mode overview



Anatomical M-Mode, or *AM-Mode*, is a modification to standard M-mode typically used in echocardiography; anatomical M-mode is a tool you can use to steer the sample volume to any angle, rather than positioning the sample volume in a strict vertical position.

### Related information

- *Acquiring Anatomical M-Mode images* (page 424)
- *Analyzing Anatomical M-Mode images* (page 429)

## PW (Pulsed Wave) Doppler Mode overview

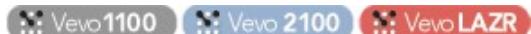


PW Doppler Mode (Pulsed Wave Doppler) is an ultrasound mode you can use to measure the velocity and direction of flow. The Vevo software presents the detected PW Doppler signal as both a spectral image in the display window as well as an audio output through the system speakers.

### Related information

- *Acquiring PW Doppler Mode images* (page 431)
- *Acquiring PW Tissue Doppler Mode images* (page 447)
- *Analyzing PW Doppler Mode images* (page 449)

## Color Doppler Mode overview



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.

This mode is useful for blood flow applications such as:

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

### Related information

- *Acquiring Color Doppler Mode images* (page 488)
- *Analyzing Color Doppler Mode images* (page 501)

## 3D-Mode overview



3D-Mode provides a three-dimensional view of an area of interest from frame-based imaging modes, excluding PA-Mode (Spectro) and EKV Mode. The system acquires the 3D data by a) creating a rapid series of B-Mode slices, and then b) combining these slices into a whole image. You can then view the structures you are interested in by using the analysis and measurement tools.

### Related information

- [Acquiring 3D-Mode images \(page 457\)](#)
- [Analyzing 3D-Mode images \(page 470\)](#)

## Power Doppler Mode overview



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

### Related information

- [Acquiring Power Doppler Mode images \(page 505\)](#)
- [Analyzing Power Doppler Mode images \(page 519\)](#)

## Linear Contrast Mode overview



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

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

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

### Related information

- [Acquiring Linear Contrast Mode images \(page 523\)](#)
- [Analyzing Linear Contrast Mode images \(page 540\)](#)

## Nonlinear Contrast Mode overview



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

During acquisition the system modulates the amplitude of the ultrasound pulses, enabling a nonlinear response to microbubbles.

To acquire images in this mode you must use one of the following transducers: MS-200, MS-201, MS-250, MS-250S or LZ250.

### Related information

- [Acquiring Nonlinear Contrast Mode images \(page 544\)](#)
- [Analyzing Nonlinear Contrast Mode images \(page 548\)](#)

## EKV Mode overview



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

By acquiring data over multiple heart cycles and extracting data at specific time points, EKV-mode produces a cine loop that is representative of a typical heart cycle.

EKV Mode is not a source image acquisition mode. Rather, EKV Mode takes the cine loop data that you acquire in a source imaging mode and then processes it into the representative one-heart-cycle cine loop.

To analyze an EKV Mode image, you use the same analysis tools that you would use to analyze an image in the source image acquisition mode.

### Related information

- [Acquiring EKV Mode images \(page 581\)](#)
- [Analyzing EKV Mode images \(page 588\)](#)

## RF-Mode overview



Digital RF-Mode provides data in RF, Raw and IQ format for further analysis. Digital RF-Mode allows users to acquire, digitize and view the raw RF data from the high-frequency ultrasound signal.

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

### Related information

- [Acquiring RF-Mode images \(page 590\)](#)
- [Analyzing RF-Mode images \(page 593\)](#)

## Application packages



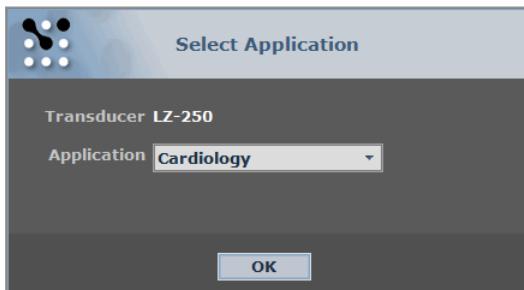
Application packages are predefined groups of image acquisition settings. This way you can quickly get an optimal image to work with, and when you are ready to take measurements, you can quickly cycle through the pre-ordered measurements protocol for your application.

The system includes two default application packages:

- General imaging
- Cardiology

**NOTE:** Only the Cardiology package is available on the Vevo 1100.

When you start the 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.

#### Related information

- [Creating a custom application \(page 164\)](#)

---

## Studies, series and images



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

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

#### Related information

- [Creating a study \(page 219\)](#)
- [Creating a series \(page 230\)](#)
- [Acquiring data in an image mode \(page 281\)](#)

---

## Users



Users are people who use the system. Two levels of user accounts work on the system:

- Standard users
- Administrators

The system provides two user access modes:

- **Standard Mode (no log-in required).** This is the default access mode and provides minimal user restrictions.

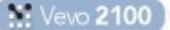
-  **User Management Mode (log-in required).** This is an administration option (not an image acquisition mode) that activates advanced user account controls, user groups, user-assignable study sharing levels and Usage Log availability.

### Related information

## Chapter 17

- *Managing user access* (page 186)

# Turning the system on and off

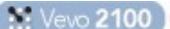
 Vevo 1100    Vevo 2100    Vevo LAZR

This chapter describes how to power on and off Vevo Imaging System as well as Vevo LAZR.

### In this chapter

Turning Vevo Imaging System on and off.....	120
Turning Vevo LAZR on and off .....	123

## Turning Vevo Imaging System on and off

 Vevo 1100    Vevo 2100    Vevo LAZR

Before you power up Vevo Imaging System, ensure that the AC power cord is plugged into the wall outlet using the proper plug. See *Plug* (page 43) 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: toll-free in North America at 1-866-416-4636; or toll-free in Europe at +800 0751 2020; or by email at support@visualsonics.com.



**WARNING:** Do not move the system when the plug is connected to the power outlet.

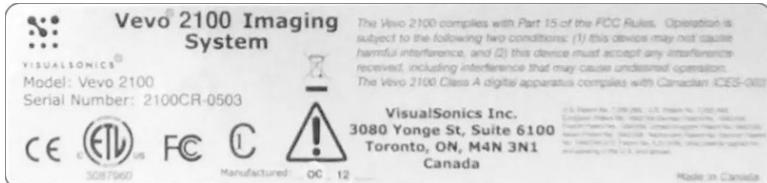


**WARNING:** Before connecting the system ensure that the voltage is correct. Ensure the power cable is undamaged before plugging the system directly into the wall outlet. Do not connect the system's power supply to an MPSO or extension cord. The voltage is specified on the rear panel of the system on the composite safety warning label, directly above the warning symbol.

#### Configuration A



#### Configuration B



#### Veo 1100



### ► To turn Vevo Imaging System on:

1. On the rear panel, set the power switch to the on (!) position. This connects the system to the power source and turns on the internal fans, but it does not turn on the control panel.
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.

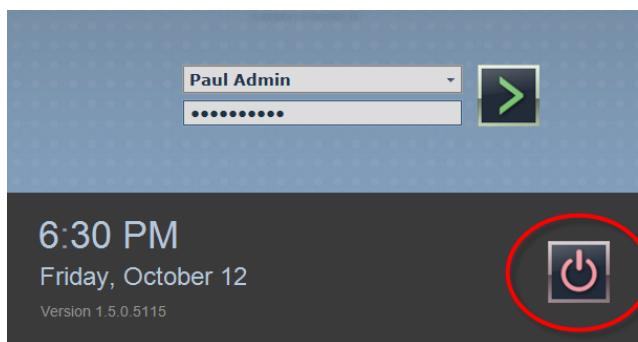
The system starts the control panel backlights, the display monitor and the computer operating system.

► **To turn Vovo Imaging System off:**

**Option 1: From the login window or the Study Browser:**

Use one of the following controls:

-  **Computer power off.** From the User Management Mode login window, click the power shutdown button to start a managed power-off of the Vovo Imaging System. This initiates a staged routine that automates the shut-down process in order to protect both the system electronics as well as your study data.



- From the **Study Browser** window, if you want to shut down the system:
  - In Standard User Mode, click the power shutdown button.



- In User Management Mode, click the down arrow on the right side of the **Log Out** button and select **Shutdown**.



The system initiates a staged routine that automates the shut-down process in order to protect both the system electronics as well as your study data.

**Option 2: Using the hardware controls:**

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. On the rear panel, set the power switch to the off (O) position.

---

## Turning Vevo LAZR on and off

### Step 1: Check the laser cart power cables and power connections

Before you power up the laser cart, ensure that the AC power cable is plugged into the wall outlet using the proper plug.



**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: toll-free in North America at 1-866-416-4636; or toll-free in Europe at +800 0751 2020; or by email at support@visualsonics.com.



**WARNING:** Do not move the system when the plug is connected to the power outlet.



**WARNING:** Before connecting the system ensure that the voltage is correct. Ensure the power cable is undamaged before plugging the system directly into the wall outlet. Do not connect the system's power supply to an MPSO or extension cord.

## Step 2: Turn on the laser cart and the LAZRTight



**WARNING:** Use only power cords provided by FUJIFILM VisualSonics with the laser system: 15A rating for 100V/120V supply voltage, 10A rating for 230V supply voltage.

**CAUTION:** Before you turn on the system, ensure that the water reservoir is filled. Only distilled water may be added to the water reservoir.

► **To turn the laser cart on and off:**

1. On the front of the laser cart press **POWER**. The laser cart powers up.
2. To turn the laser cart off, press **POWER** again.

► **To power the LAZRTight on and off:**

1. Plug the female end of the LAZRTight power adapter cable into the **POWER** connector on the right panel of the LAZRTight and then plug the male end of the adapter cable into the wall outlet. The LAZRTight is now powered.

To turn off power to the LAZRTight, pull the plug out of the wall outlet.

### Related information

- *Laser cart warnings* (page 61)
- *Connecting the Vevo LAZR system powered components* (page 66)
- *Plug* (page 43)

# Logging in and out



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

## In this chapter

Starting the system in Standard Mode .....	125
Starting a session in Standard Mode .....	126
Logging in to a session in User Management Mode.....	126
Logging out of a session in User Management Mode .....	127

## Starting the system in Standard Mode



Follow this procedure when you work in Standard Mode. This is also the procedure that you use when you are the first person ever to start the system. This is because in both cases no-one has added an administrator.

### ► To start the system in Standard Mode:

1. On the rear panel turn on the power.
2. On the left side of the control panel module turn on the **Computer Standby** switch. The control panel's blue backlighting turns on and the system starts.
3. Initialize the transducer and select the application. You can now start a new acquisition session.

**BEST PRACTICE:** If you are starting the system for the first time, add an administrator as soon as you can and then add the users.

## Next steps

- *Adding an administrator* (page 194)
- *Adding a standard user* (page 195)

## Related information

- *Logging in for a typical session* (page 126)
- *Application packages* (page 118)

---

## Starting a session in Standard Mode



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

### ► To log in for a typical session:

1. On the rear panel turn on the power.
2. On the left side of the control panel module turn on the **Computer Standby** switch.
  - The control panel's blue backlighting turns on.
  - The software starts and displays the dialog box for selecting 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.

## Related information

- *Logging in to a session in User Management Mode* (page 126)
- *Adding a user in Standard Mode* (page 195)
- *Adding a user in User Management Mode* (page 201)

---

## Logging in to a session in User Management Mode



User Management Mode is an administration option (not an image acquisition mode) that activates advanced user account controls, user groups, user-assignable study sharing levels and Usage Log availability.

## Permissions and conditions

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

- A user must have a password-protected account to log in to the system when User Management Mode is enabled.
- To enable an existing user to access the system in User Management Mode, an administrator must add a password to the user's account (page 197).

► **To log in for a typical session in User Management Mode:**

1. If the monitor is off and the control panel is not backlit:
  - a. Check the rear panel of the ultrasound cart to ensure that the power is on.
  - b. On the left side of the control panel module turn on the **Computer Standby** switch. The control panel's blue backlighting turns on and the User Management Mode login screen appears.
2. Select your user name in the top field and then type your password in the lower field.
3. Press **ENTER** or click the login icon . The **Study Browser** window appears.

#### Related information

- *Indicators that User Management Mode is enabled* (page 190)
- *Managing user passwords* (page 197)

## Logging out of a session in User Management Mode



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

#### Indicators that User Management Mode is enabled

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

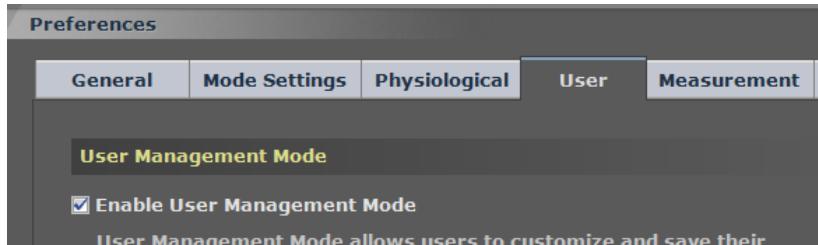
- The user icon and your user name appears in the status bar in the bottom-right corner of the window:



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

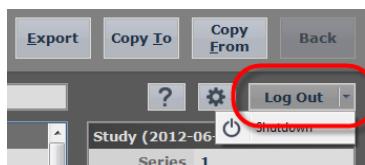


- In the **User** tab of the **Preferences** window, the **Enable User Management Mode** check box is selected.

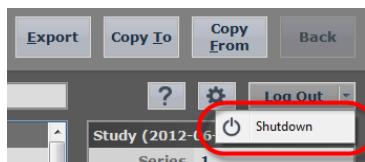


#### ► To log out of a User Management Mode session:

- If you want to log out and leave the system on, from the **Study Browser** click **Log Out**.



- If you want to log out and shut down the system, click the down arrow on the right side of the **Log Out** button and then click **Shutdown**.



The system initiates a staged routine that automates the shut down process in order to protect both the system electronics as well as your study data.

## Section 5

# Preferences



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

### To view the Preferences window:

- If you are in the **Study Browser**, in the toolbar click .
- If you are acquiring or reviewing an image, on the control panel, press **PREFS**.

#### In This Section

General preferences tab .....	130
Mode Settings preferences tab .....	136
Physiological preferences tab .....	141
User preferences tab .....	146
Measurement preferences tab .....	148
Annotation preferences tab .....	159
Presets preferences tab .....	162
Maintenance preferences tab .....	172
System preferences tab .....	179
Network preferences tab .....	181

## General preferences tab

 Vivo 1100  Vivo 2100  Vivo LAZR

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

### In this chapter

General preferences .....	130
Cine Loop Size preferences.....	131
Auto SAVE preferences.....	133
Image Export preferences.....	134
Study Browser lock preferences .....	135

---

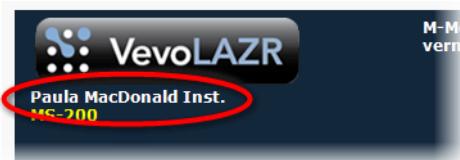
## General preferences

 Vivo 1100  Vivo 2100  Vivo LAZR

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**, click the Preferences icon  and then click the **General** tab.
2. In the **Institution** box, type the name of your institution and then click **OK**. The system displays the name beneath the logo when you are acquiring or reviewing image data.



## Cine Loop Size preferences

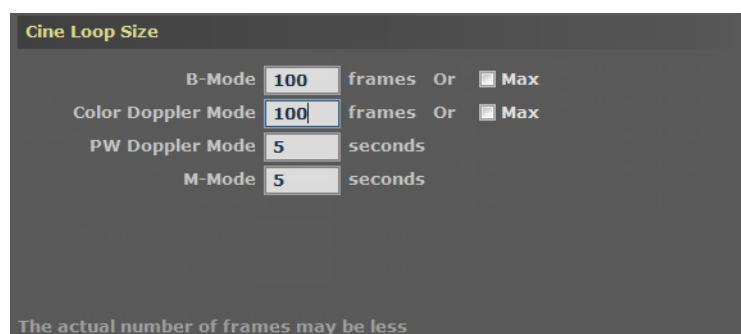


Use the **Cine Loop Size** section to specify the amount of continuous image data you want the system to keep in memory when you acquire a cine loop.

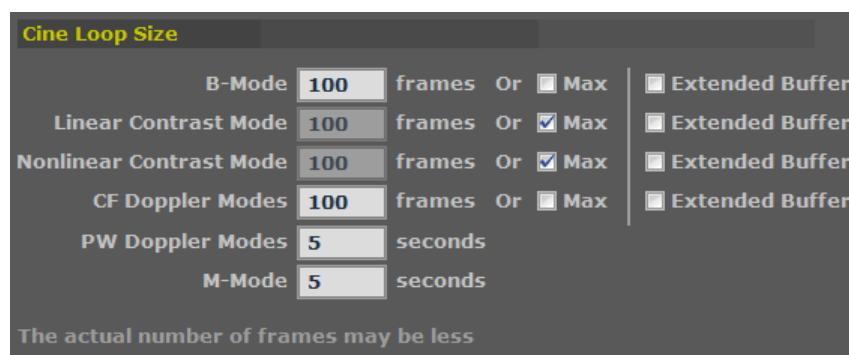
### How the system calculates the loop size

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.

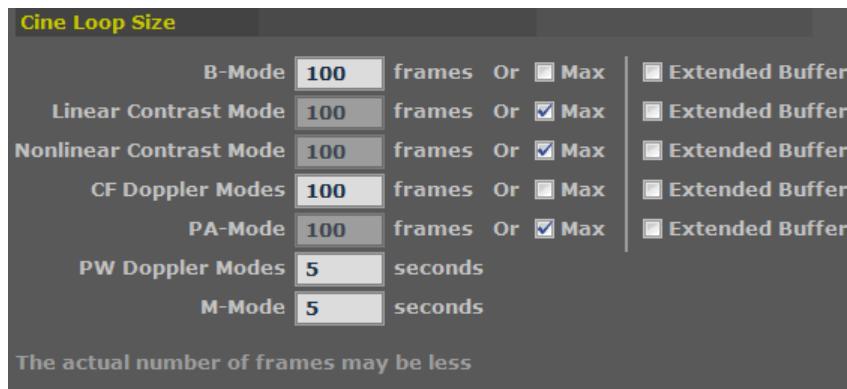
#### Cine Loop Size options - Vevo 1100



#### Cine Loop Size options - Vevo 2100



## Cine Loop Size options - Vevo LAZR



### Examples:

- If you set the 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 the 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**, click the Preferences icon and then click the **General** tab.
2. In the **Cine Loop Size** section, type a value in the appropriate box.
3. (Optional) If you select **Max** for B-Mode, PA-Mode, Linear Contrast Mode, Nonlinear Contrast Mode or CF Doppler Mode, the system:
  - overrides the default value for the imaging mode
  - evaluates the effect of the configuration of the imaging parameters, including focal zones and persistence, on the potential length of the cine loop
  - sets the cine loop to acquire the maximum number of image frames based on the configuration of the imaging parameters specified above
4. (Optional) If you select **Extended Buffer**, the system:
  - overrides the default value for the imaging mode
  - evaluates the effect of the configuration of the imaging parameters, including focal zones and persistence, on the potential length of the cine loop

- sets the cine loop to acquire the maximum number of image frames based on the configuration of the imaging parameters specified above for applications where you need to extend the size of the cine buffer or cine loop.

5. Click **OK**. The system saves your preferences.

## Extended buffer capability



The B-Mode default settings ensure optimum image quality for most applications that benefit from high frequency ultrasound imaging.

**NOTE:** Extended buffer capability is only available for frame-based modes, and only when the General Imaging application is selected.

For applications where the size of the cine buffer or cine loop need to be extended, users have the ability to adjust these settings when necessary.

### ► To adjust these settings:

- Set **Focal Zones** to 1
- Set **Persistence** to OFF
- Press **Prefs**, select the **General** tab, and then in the **Cine Loop Size** section:
  - set the desired number of frames or select the **Max** check box
  - select the **Extended Buffer** check box

**IMPORTANT:** These settings are important to image quality. We recommend that you adjust them *only* when you cannot increase the size of the cine loop by adjusting the image width. You can save these settings as part of the custom defined presets.

---

## 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:

- From the **Study Browser**, click the Preferences icon and then click the **General** tab.

2. In the **Auto SAVE** section, set your preference settings as described in the following table.

Preference	Description
Image to Auto SAVE	<p>Specifies what type of image the system saves automatically after you label your image. In the drop-down list, select either <b>Entire Cine Loop</b> or <b>Current Frame</b>.</p> <ul style="list-style-type: none"> <li>▪ To set the system to automatically save the image when you add any label to an image, select the <b>On Image Label</b> check box.</li> <li>▪ To set the system to automatically save the image when you have completed an image scan, select the <b>On Scan Completion</b> check box.</li> </ul>
Auto SAVE 3D on Scan Completion	 Automatically saves the 3D image after your 3D scan ends.
Auto SAVE on Pretrigger and Image Sequence	 Automatically saves the image after you press <b>Pre Trigger</b> and <b>Image Sequence</b> .  <b>NOTE:</b> Vevo 1100 does not include the Image Sequence feature.
Auto SAVE EKV on Scan Completion	 Automatically saves the EKV cine loop after your EKV scan ends.

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**.

---

## 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**, click the Preferences icon  and then click the **General** tab.

- 2. In the **Image Export** section click the **Show Date/Time on Image Header** check box and click **OK**.
- 

## Study Browser lock preferences

 Vevo 1100    Vevo 2100    Vevo LAZR

► **To set the Study Browser lock preferences:**

- If you want to prevent studies from being deleted but still let users review them and modify them, select **Lock Delete Only**.
- If you want to prevent studies from being deleted or modified but still let users review them, select **Lock All**.

# Mode Settings preferences tab



Use the **Mode Settings** preferences tab to configure a collection of preferences that apply to features of individual image acquisition modes.

## In this chapter

Frame Based Mode Screen Layout preferences.....	136
Spectrum Based Mode Screen Layout preferences .....	136
PW Doppler Scale preferences.....	137
Contrast Modes preferences .....	138
EKV Post Processing preferences .....	138
PA-Mode 3D Acquisition Method (Oxy-Hemo and NanoStepper) preferences .....	139
PA-Mode Oxy-Hemo Settings preferences .....	140

---

## Frame Based Mode Screen Layout preferences



Use the **Frame Based Mode Screen Layout** preference to change the size of the mode data window when you are acquiring image data in B-Mode, PA-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode and EKV-Mode.

► **To set the Frame Based Mode Screen Layout preferences:**

1. From the **Study Browser**, click the Preferences icon and then click the **Mode Settings** tab.
2. In the Mode Screen Layout section, click the appropriate layout graphic and click **OK**.

---

## Spectrum Based Mode Screen Layout preferences



Use the **Spectrum Based Mode Screen Layout** preference to change the relative size of the B-Mode scout window to the mode data window when you are acquiring image data in M-Mode, AM-Mode, PW Doppler Mode and PW Tissue Doppler Mode.

► **To set the Spectrum Based Mode Screen Layout preferences:**

1. From the **Study Browser**, click the Preferences icon  and then click the **Mode Settings** tab.
2. In the Mode Screen Layout section, click the appropriate layout graphic and click **OK**.

---

## PW Doppler Scale preferences

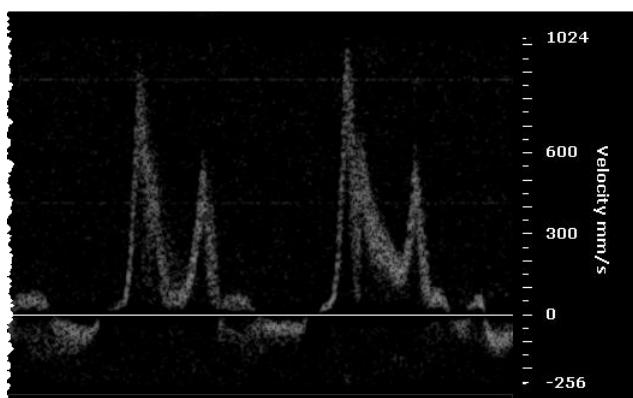


Use the **PW Doppler Scale** preference section to select the scale type for the spectral display (either velocity or frequency) when you acquire or analyse PW Doppler image data.

► **To set the PW Doppler scale:**

1. From the **Study Browser**, click the Preferences icon  and then click the **Mode Settings** tab.
2. In the **PW Doppler Scale** section, select the scale you want to work with:
  - 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 Modes preferences



Use the **Contrast Modes** 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**, click the Preferences icon and then click the **Mode Settings** tab.
2. In the **Contrast Modes** section, configure the settings as described in the following table and click **OK**:

Preference	Description
Destruction	From the drop-down list select one of the following two options. <ul style="list-style-type: none"><li>▪ <b>Internal.</b> The system applies the ultrasound burst through the array that you connect to the front panel of Vevo Imaging System</li><li>▪ <b>External.</b> The system applies the burst through the <i>external</i> Vevo SoniGene transducer that you connect to the <b>Parallel</b> port on the rear panel of Vevo Imaging System</li></ul>
Seconds	From the drop-down list select the appropriate length of the destruction burst. <ul style="list-style-type: none"><li>▪ For internal bursts, you can select 0.1, 0.25, 0.5, 1.0 seconds</li><li>▪ For external bursts, you can select 1, 2.5, 5, 10, 15 seconds</li></ul>
Sequence Destroy Position	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.

---

## EKV Post Processing preferences



Use **EKV Post Processing** to ensure that the EKV Post Processing option in the image processing panel is selected by default when you are acquiring an EKV Mode cine loop. By default, this option is not selected.

► **To apply the EKV Post Processing preference:**

1. From the **Study Browser**, click the Preferences icon  and then click the **Mode Settings** tab.
2. In the **EKV Post Processing** section, select the **Save Data for EKV Post Processing** check box and then click **OK**.

---

## **PA-Mode 3D Acquisition Method (Oxy-Hemo and NanoStepper) preferences**



Use the **PA-Mode 3D Acquisition Method (Oxy-Hemo and NanoStepper) preferences** section to specify the image acquisition process you want the system to use to compile the 3D image when you are creating 3D images in Oxy-Hemo sub-mode or NanoStepper sub-Mode.

► **To specify the 3D image acquisition process for Oxy-Hemo and NanoStepper sub-modes:**

1. From the **Study Browser**, click the Preferences icon  and then click the **Mode Settings** tab.
2. Select the image process you want the system to use as described in the following table and click **OK**:

Process	Description
Sequential Wavelengths	<b>3D motor movement:</b> Acquires all of the frames from the first wavelength. Continues making full distance passes at each wavelength until all the acquired wavelengths have been acquired. <b>Result:</b> High quality 3D image. Comparatively faster process than Alternating Wavelengths. <b>If you pause during acquisition:</b> No image is acquired.

**NOTE:** In Oxy-Hemo, when acquiring image data at the 750nm wavelength, the system does not display photoacoustic data. Photoacoustic data begins to display at the 850nm wavelength.

Process	Description
Alternating Wavelengths	<p><b>3D motor movement:</b> At each distance step, acquires one frame at each wavelength. Continues to acquire series of wavelength frames at each distance step until the motor completes the full scan distance.</p> <p><b>Result:</b> Highest quality 3D image. Comparatively slower process than Sequential Wavelengths.</p> <p><b>If you pause during acquisition:</b> Retains any acquired data.</p> <p><b>NOTE:</b> Using <b>Persist</b> to increase the persistence level also increases the image acquisition time.</p>

3. Click **OK**.

## PA-Mode Oxy-Hemo Settings preferences



Oxy-Hemo sub-mode acquires PA-Mode image data at two wavelengths. In the Mode Settings preferences tab (**Prefs** > **Mode Settings** tab) you can select one of two default wavelength values (734 nm or 750 nm) for Wavelength 1. Wavelength 2 is always 850 nm. The blue overlay displays deoxygenated blood. The red overlay displays oxygenated blood.

- **To set the default PA-Mode Oxy-Hemo Settings preferences:**
1. From the **Study Browser**, click the Preferences icon and then click the **Mode Settings** tab.
  2. In the **PA-Mode Oxy-Hemo Settings** section:
    - a. Select the **Custom Wavelength 1** check box. The options for the first of the two wavelengths sliders become available.
    - b. Select either **734 nm** or **750 nm**.
  3. Click **OK**.

**NOTE:** When the Custom Wavelengths option is not selected, the default values are applied. Default Wavelength 1 = 750 nm; Default Wavelength 2 = 850 nm.

# Physiological preferences tab

 Vevo 1100    Vevo 2100    Vevo LAZR

Use the **Physiological** preferences tab to configure the settings that manage the respiration, blood pressure and temperature signal inputs.

## In this chapter

Physiological Enable preferences .....	141
Physiological Live Display preferences.....	143
Physiological Alarm Levels .....	144

---

## Physiological Enable preferences

 Vevo 1100    Vevo 2100    Vevo LAZR

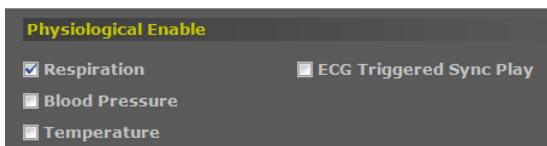
Use the **Physiological Enable** options to globally enable or disable the system's ability to save the Respiration, Blood Pressure and Temperature physiological signal inputs along with the ultrasound image.

### 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.

You configure these inputs in the **Physiological Enable** preferences section.



**NOTE:** ECG Triggered Sync Play is not available on Vevo 1100.

### Left column: Respiration, Blood Pressure and Temperature inputs

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 Physiological 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.)

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 image management 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**, click the Preferences icon and then click the **Physiological** tab.
2. In the **Physiological Enable** section select or clear the appropriate check box.



## Right column: ECG Triggered Sync Play

By default, when you are acquiring data the system is configured to give you the trigger 1 (T1) and trigger 2 (T2) slider controls only in the **ECG Trigger** section of the **Physio Settings** image management panel. This enables you to select the start and end point of a comparatively static period during the heart cycle so the system can acquire data only during that period in order to build the cine loop. This provides a virtually static tissue image that makes it easier to add and analyze measurements.

However, if you want to acquire all image data over one or more complete heart cycles, select **ECG Triggered Sync Play** here. You can now use the **ECG Trigger** slider controls in the **Physio Settings** panel to select the number of cycles you want to record.

### Related information

- *Physiological Live Display preferences* (page 143)
- *Physiological Alarm Levels* (page 144)
- *ECG Trigger section* (on page 278)

---

## 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**, click the Preferences icon and then click the **Physiological** tab.
2. In the **Physiological Live Display** section, select or clear the required check boxes as described in the following table.

Preference	Description
View ECG	Displays the green numeric beats-per-minute value

Preference	Description
View Respiration	Displays the yellow numeric respiratory value
View Blood Pressure	Displays the red numeric blood pressure value
View Temperature	Displays the blue numeric temperature value

3. Click **OK**.

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



#### Related information

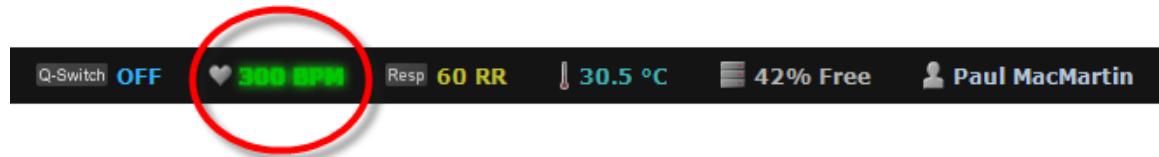
- *Physiological Enable preferences* (page 141)
- *Physiological Alarm Levels* (page 144)

---

## Physiological Alarm Levels

Vevo 1100   Vevo 2100   Vevo LAZR

Use the **Physiological Alarm Levels** preferences section to set the low and high physiological data limits beyond which the system displays the pulsing number value for any of the live physiological signals.



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

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

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

#### Related information

- *Physiological Enable preferences* (page 141)
- *Physiological Live Display preferences* (page 143)

# User preferences tab

 Vevo 1100  Vevo 2100  Vevo LAZR

The **User** tab is the workspace you use to create and manage the user profiles for the people who use the Vevo Imaging System.

- For instructions and information on managing users in Standard Mode, see *Managing users in Standard Mode* (page 194).
-  For instructions and information on managing users in User Management Mode, see *Managing users for User Management Mode* (page 199).
-  For instructions and information on enabling and disabling User Management Mode, see *Enabling User Management Mode* (page 191) and *Disabling User Management Mode* (page 192).
-  For instructions and information on enabling and disabling Usage Log, see *Usage Log* (page 208).

## In this chapter

Importing and exporting user preferences .....	146
--	-----

---

## Importing and exporting user preferences

 Vevo 2100  Vevo LAZR

User preferences are the settings that are configured in the Preferences tabs and Study Browser settings. Each user's preferences are stored as an importable and exportable file.

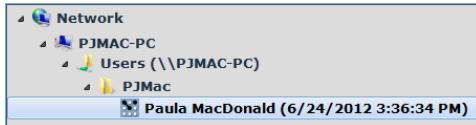
### Permissions and restrictions

- This task can only be completed when User Management Mode is enabled.
- Only an administrator can import another user's preferences.
- No user can import their own preferences.
- A standard user can export their preferences, but not import them.

### ► To import the preferences file of a user:

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

2. In the **User** section, click the user and then click **Import**. The **Import User** window appears.
3. In the explorer area, browse to the folder that contains the user file you want to import. The file does not appear with the VBAK extension but appears as a date stamped user name. For example:



4. Select the user and then click **OK**. If the user name exists, the **Import User** dialog box appears and prompts you to overwrite the user preferences. Click **Yes** if you want to overwrite the user with the external preferences file. The user appears in the list of users.

Name	Type	Group
Adam Nonadmin	Standard	
Allen	Standard	PA Eval 1
Corie B.	Standard	
Miranda	Standard	
Patti Sherer	Administrator	PA Eval 1
Paul Admin	Administrator	
Paul MacMartin	Administrator	Mouse Group 3
<b>Paula MacDonald</b>	<b>Standard</b>	<b>Annaplois</b>
Roman	Administrator	
Tom Thurman	Standard	

#### ► To export the preferences file of a user:

1. From the **Study Browser**, click the Preferences icon and then click the **User** tab.
2. In the **User** section, click the user and then click **Export**. The **Export User** window appears.
3. In the explorer area browse to the folder where you want to store the user preferences file and select the folder.
4. (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
5. Click **OK**. The system exports the preferences as a .Vbak file.

#### Related information

- *Managing user passwords* (page 197)
- *User Management Mode* (page 188)

## Measurement preferences tab



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

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

**NOTE:** Vevo 1100 includes only the Cardiac Package.

### In this chapter

Measurement Package preferences.....	148
Measurement Parameters preferences .....	153
Measurement Display preferences .....	155
Histogram preferences .....	157
Heart Rate for Calculations preferences.....	158
Legacy Calculations .....	158

## 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**, click the Preferences icon and then click the **Measurement** tab.
2. In the **Measurement Package** section select a measurement package that closely relates to the type of analysis you routinely perform for the respective imaging.
3. Click **Save As**, type a name for your new package in the **New Measurement Package** box and then click **OK**.
  - 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 image management panel.
4. In the middle panel:
  - a. Select or clear the check boxes to set the protocols you want the system to display in the measurement tools panel (page 293).
  - 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.
5. 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.
6. 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**, click the Preferences icon  and then click the **Measurement** tab.
2. In the **Measurement Package** drop-down list, select the package you want to modify.
3. In the middle panel:
  - a. Select or clear the check boxes to set the protocols you want the system to display in the measurement tools panel (page 293).
  - 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.
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**, click the Preferences icon  and then click the **Measurement** tab.
2. In the **Measurement Package** section, in the drop-down list select the custom measurement package you want to export and then click **Export**.
3. In the **Export Package File** window, browse to the location where you want to export your selected measurement packages, select the folder and then click **OK**.

► **To import a custom measurement package:**

1. From the **Study Browser**, click the Preferences icon  and then click the **Measurement** tab.
2. In the **Measurement Package** section, click **Import**.
3. In the **Import 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 image management panel.

## Sharing custom applications and presets

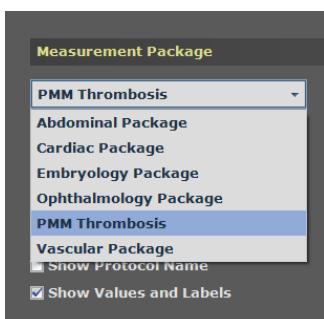


When **User Management Mode** is enabled, any custom applications and presets you create are only available to you.

When **Standard Mode** is enabled, any custom applications and presets you create are available to everyone.

► **To view the available applications:**

1. From the **Study Browser**, click the Preferences icon  and then click the **Measurements** preferences tab.
2. In the **Measurement Package** section click the drop-down list.



## 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.

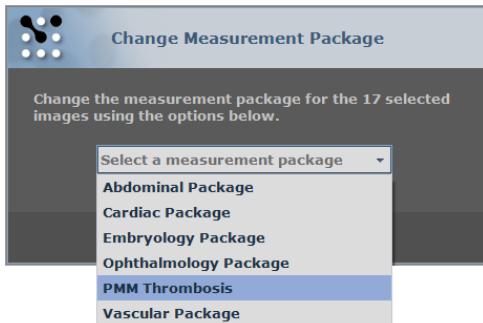
## Batch changing measurement packages for multiple images



You can use the Change Measurement Package command to apply a measurement package to as many images as you would like, in a batch.

- ▶ **To batch change measurement packages for multiple images:**
  1. In the Study Browser, select any combination of studies, series and images.
    - To select one item, click it
    - To select a collection of individual items, press and hold **CTRL** and then click to select each item

- To select a consecutive group of items, click to select the first item, press and hold **SHIFT** and then click to select the last item in the range
2. Right-click one of the selections and click **Change Measurement Package**. The **Change Measurement Package** box appears.
  3. In the drop-down list select the measurement package you want to apply to all the selected images and then click **Save**.



The system applies the selected measurement package to the selected images.

## Showing/hiding measurement packages in a mode window

Vevo 1100   Vevo 2100   Vevo LAZR

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

1. From the **Study Browser**, click the Preferences icon 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 image management panel.

**NOTE:** To view measurements on an image, press **Measure** and at the bottom of the image management panel select the **Show Values and Labels** check box. If you clear this check box the measurement is identified with the index number but not the name label and measurement value.

## Measurement Parameters preferences

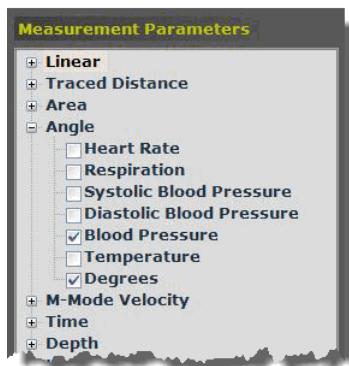
Vivo 1100 Vivo 2100 Vivo LAZR

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**, click the Preferences icon  and then click the **Measurement** tab.
2. Expand the appropriate measurement and then select the parameter check boxes that you want the system to display.



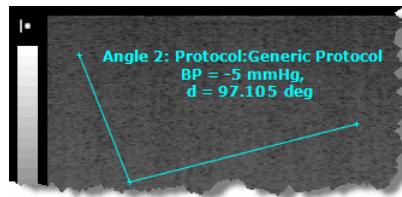
In this example, for the **Angle** measurement, the user selects the following parameters:

- *Blood Pressure*
- *Degrees*

3. Set the parameters for any other measurements you want to customize and 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



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

Measured Values		
I	Name	Value
1	Angle 2 - d	97.105
1	Angle 2 - BP	-5

## Related information

- Modifying the properties of a measurement* (page 300)

---

## Measurement Display preferences

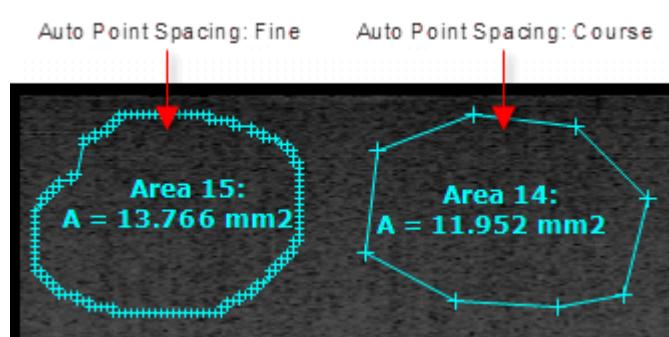
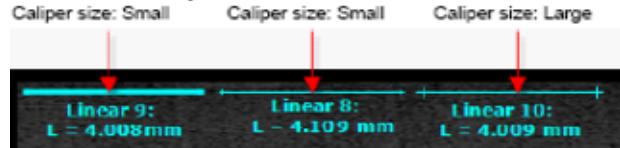
Vevo 1100   Vevo 2100   Vevo LAZR

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:**

- Press **Prefs** and then click the **Measurement** tab.
- In the **Measurement Package** section, in the drop-down list select the custom measurement package you want to customize.
- In the **Measurement Display** section configure the measurement display style options as described in the following table.

Preference	Description			
Show Measurements	<p><b>When you select the check box..</b> The system makes the list of measurement protocols available so you can add measurements to your image.</p> <p><b>When you clear the check box...</b> The system:</p> <ul style="list-style-type: none"> <li>▪ Hides any measurements that have already been made in the image but not in the list of measured values.</li> <li>▪ Dims the list of measurements so you can see the list items but you cannot work with them.</li> </ul>			
<b>IMPORTANT:</b> You must select this check box to add measurements to your image data.				
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.			
Show Values and Labels	By default, this option is selected and the name of the measurement and its parameters are displayed when the measurement is placed on an image. If this option is not selected, the system identifies measurements with sequential index numbers.			
Show Embryo Index	<input checked="" type="checkbox"/> Displays the embryo index information. This option is only available when <b>Embryo Package</b> is displayed in the <b>Measurement Package</b> drop-down list.			
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	<table style="width: 100%; text-align: center;"> <tr> <td>Line thickness: Heavy Caliper size: Small</td> <td>Line thickness: Thin Caliper size: Small</td> <td>Line thickness: Thin Caliper size: Large</td> </tr> </table> 	Line thickness: Heavy Caliper size: Small	Line thickness: Thin Caliper size: Small	Line thickness: Thin Caliper size: Large
Line thickness: Heavy Caliper size: Small	Line thickness: Thin Caliper size: Small	Line thickness: Thin Caliper size: Large		
Color	Sets the default color for your measurements.			
Font	These two drop-down lists control the style of text that appears on your image when you add a measurement or an annotation.			
Font Size				

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 300)

## Histogram preferences



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

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

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

**NOTE:** In Power Doppler Mode, the system applies the Image Data preference at all times, even when you select Raw Data.

- **Image Data** calculates the histogram from a combination of the original image data plus any modifications you make after you press **Image Process**. For example, if you modify the Brightness value, the system creates the histogram based on the original image data plus the modified brightness.

► **To select the Histogram preference:**

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

---

## Heart Rate for Calculations preferences



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

---

## Legacy Calculations



To display the Cardiac Package calculations as they were displayed in *v1.1.x* software versions, select the **Show v1.1.x legacy calculations (Cardiac Package)** check box.

## Chapter 24

# Annotation preferences tab



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

### In this chapter

Measurement Package preferences.....	159
Annotation Display preferences.....	159
Annotation preferences .....	160

---

## 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 148).

---

## 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**, click the Preferences icon  and then click the **Annotation** tab.
2. In the **Measurement Package** section, in the drop-down list, select the custom measurement package you want to customize and set the color, font and font size.
3. In the **Annotation Display** section, configure the style preferences as described in the following table.

Preference	Description
Show Annotations	<p><b>When you select the check box...</b> You can press <b>Update</b> and select or create an annotation.</p> <p><b>When you clear the check box...</b> The system:</p> <ul style="list-style-type: none"><li>▪ Hides any annotations that have already been made</li><li>▪ Cannot make any annotations</li></ul> <p><b>IMPORTANT:</b> You must select this check box to add annotations to your image data.</p>
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**.

---

## Annotation preferences



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

### Permissions and conditions

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.

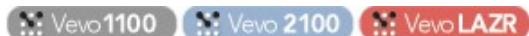
► **To customize the list of available annotations for a custom measurement package:**

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

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

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

# Presets preferences tab



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

## In this chapter

Transducer preferences .....	162
Applications preferences.....	164
Mode Settings Presets preferences.....	166
Preset Settings section.....	171

## 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 the transducers that the Vevo Imaging System supports.

### ► To specify the default application for a transducer:

1. From the **Study Browser**, click the Preferences icon 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.

### Vevo Imaging System transducers

Transducer	Description
MS200	Rat cardiovascular and abdominal (>400g), rabbit (cardiovascular)
MS201	Rat cardiovascular and abdominal (>400g), rabbit (cardiovascular)

Transducer	Description
MS250	Rat cardiology and abdominal (<400 g), large tumor imaging (up to 23 mm in diameter), all contrast applications
MS250S	Rat abdominal (<300 grams), mouse cardiology for aortic banding models, mouse abdominal; small tumor imaging (up to 15 mm in diameter); all contrast applications
MS400	Optimized for mouse cardiovascular, rat abdominal, rabbit eye, all vascular (mouse, rat, rabbit)
MS550D	Mouse abdominal, reproductive, mouse/rat embryology, tumor imaging (up to 14 mm in diameter), mouse vascular, small rat vascular, some abdominal (kidney)
MS550S	Optimized for mouse/rat embryology, mouse abdominal, reproductive, epidermal imaging, tumor imaging (up to 13 mm in diameter), mouse vascular, small rat vascular, some abdominal (kidney), ophthalmology
MS700	Mouse embryology, epidermal imaging, superficial tissue, subcutaneous tumors (< 9 mm), mouse vascular, ophthalmology

### Vevo LAZR transducers

Transducer	Description
LZ250	Broadband Frequency: 13-24 MHz. Image Width: 23 mm, Image Depth: 30 mm. Image Axial Resolution: 75 µm
LZ550	Broadband Frequency: 32-55 MHz. Image Width: 14.1 mm, Image Depth: 15 mm. Image Axial Resolution: 40 µm

In the **Applications** list click the button beside the name of the application you want to be the default.

**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.

3. 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 219)
- Create a new series (page 230)
- Connect a new transducer (page 260)

---

## 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

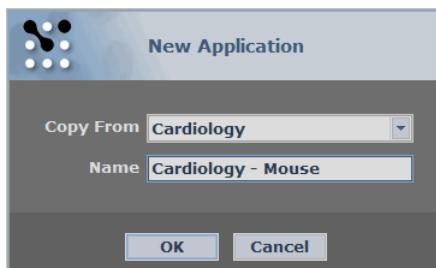


Each transducer includes factory default applications that contain the imaging Mode presets you use to instantly optimize your image during an acquisition session.

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**, click the Preferences icon and click the **Presets** tab.
2. In the **Applications** section below the list, click **New**.
3. In the **New Application** box:
  - 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.



- 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 make the custom transducer application available:**

- See *Connecting and disconnecting transducers* (page 260)

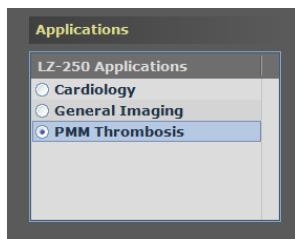
## Custom applications availability

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

When Standard Mode is enabled, any custom applications and presets you create are available to everyone.

### ► To view the available applications:

1. From the Study Browser, click the Preferences icon .
2. Click the Presets preferences tab. The list of available applications appears in the Applications section.



## Exporting a transducer application

### ► To export a transducer application:

1. From the Study Browser, click the Preferences icon  and then click the Presets tab.
  2. Select the transducer from the Transducer list.
  3. In the Applications list click to highlight the label of application you want to export.
- NOTE:** You must select and highlight the name. Do not select the button.
4. Click Export. The Export Presets window appears.
  5. Browse and select the folder that will contain the presets you are exporting.
  6. (Optional) To add a subfolder, click New Folder, name the folder and then click OK.
  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 transducer applications

Vivo 1100 Vivo 2100 Vivo LAZR

### ► To import a transducer application:

1. From the **Study Browser**, click the Preferences icon  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. Browse to the folder that contains the application and then select it. Application files appear with the VisualSonics symbol.



5. Click **OK**. The application you imported appears in the Applications window list, in alphabetical order.

## Deleting a custom transducer application

Vivo 1100 Vivo 2100 Vivo LAZR

### ► To delete a custom transducer application:

1. From the **Study Browser**, click the Preferences icon  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.

**NOTE:** You cannot delete a factory default application.

---

## Mode Settings Presets preferences



A mode preset is a way to capture a set of acquisition parameters that you have customized so you can save it and then apply it whenever you want.

You do not create custom mode settings in the Presets tab. You create them while you are acquiring data as described in Setting up Mode settings presets (page 265).

The **Mode Presets Settings** preferences section of the Presets tab manages how you will work with the existing presets. Use this section to:

- Set the default preset for an imaging mode
- Enable and disable existing presets for a mode
- Create auto-selected groups of presets across modes
- Reorder the list of presets for a mode
- View the parameters you can save as a mode preset

### Setting 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 a user begins scanning in that mode.

The system assigns default preset status to the first active preset in the list of presets for a mode.

#### ► To set the default preset for a mode:

1. From the **Study Browser**, click the Preferences icon 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** list, 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** list, if the first active (check box selected) preset in the list is not the preset you want as the default, select in the row of the preset you want and then click **Move Up** to move the preset up one place in the list until it becomes the first active preset in the list.

6. Click **OK**.
- **To activate the default preset:**
- Create a new study (page 219)
  - Create a new series (page 230)
  - Connect a new transducer (page 260)

#### Related information

- *Selecting a preset during image acquisition* (page 267)
- *Creating a custom Mode settings preset* (page 266)
- *Modifying a custom Mode settings preset* (page 267)

## Activating and de-activating existing presets



When a preset is active, it appears in the list of available presets when you push the **Presets** toggle.

- **To activate an existing preset:**
1. From the **Study Browser**, click the Preferences icon 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** list, 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** list, activate or deactivate a preset by selecting or clearing the check box in the preset row.
  6. Click **OK**.

## Creating preset groups for multi-mode acquisition sessions



A preset group is a way to set your system to automatically apply a selected preset in multiple-mode image acquisition sessions.

## How preset groups work

- You create a preset group in the **Presets** tab of the **Preferences** window.
- You name and apply it to each mode you work with in a particular multiple-mode session sequence such as you would follow in a protocol SOP.
- You can assign only one group to a preset. If you need to use a preset in a second preset group so you can use the same acquisition preset configuration for another group, create a copy of that preset as described in *Creating a custom Mode settings preset* (page 266) and then add that preset to the new group.
- You can assign only one preset to the same group for a given mode.
- You activate a preset group during an acquisition session. For complete information, see *Activating a preset group* (on page 268).

### ► To create a preset group:

1. From the **Study Browser**, click the Preferences icon  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.

In the **Select a Mode** list, 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.

4. Select a preset, click **Set Group**, type a name for the group in the **Set Group Name** box and then click **OK**.

### ► To assign a preset group to a preset in another mode:

1. In the **Select a Mode** list, select the mode you want to work with.
2. In the **Mode Presets** list, select the preset you want to add to the group, click **Set Group**, select the group from the drop-down list and click **OK**.
3. Assign the group to any other mode presets in your image acquisition sequence, then click **OK**.

### ► To rename a preset group:

1. Select any preset that is assigned to the group and click **Set Group**.
2. Rename the group and click **OK**.

**IMPORTANT:** For the group to be active as part of your acquisition sequence you must rename the group in each participating Mode.

- ▶ **To remove a preset group assignment from a specific mode:**
  1. Select any preset that is assigned to the group and click **Remove Group**.
  2. Repeat step 1 for the preset group assignment in each applicable mode.

## Reordering the list of presets for a mode



- ▶ **To reorder the list of presets for a mode:**
  1. From the **Study Browser**, click the Preferences icon 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.  
In the **Select a Mode** list, 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.
  4. Select the preset you want to move and then click **Move Up** or **Move Down** and click **OK**.

## Deleting a mode settings preset



You can delete any preset in any custom application, but you cannot delete a factory preset.

- ▶ **To delete a mode settings preset:**
  1. From the **Study Browser**, click the Preferences icon 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.

# Maintenance preferences tab



Use the **Maintenance** preferences tab to manage system level features.

## In this chapter

Upgrade.....	172
Monitor preferences.....	175
Systems Log preferences .....	175
Backup and Restore preferences .....	176

---

## Upgrade



When VisualSonics issues a software upgrade that you can install, the company sends you a CD-ROM disk that contains the upgrade files.

**NOTE:** Vevo 1100 does not include a CD/DVD drive. Upgrades files are added by using a thumb drive through a USB connection.

### Related information

- *Installing a software upgrade* (page 172)
- *Installing a Vevo LAZR drivers upgrade* (page 174)

## Installing a software upgrade



### Permissions and restrictions

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

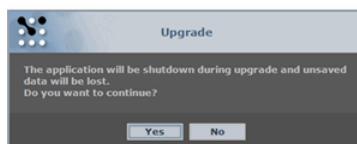
**NOTE:** On the Vevo 1100, software upgrade files are supplied on a USB drive that you insert in a USB connector on the rear panel.

► **To install a software upgrade:**

1. Insert the **Vevo Imaging System Upgrade Version** data:
  - For Vevo 1100, insert the USB drive into a USB port on the rear panel
  - For Vevo 2100 and Vevo LAZR, insert the CD-ROM disk into the DVD drive on the left side of the system
2. From the **Study Browser**, click the Preferences icon  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 the appropriate drive:
  - For Vevo 1100, select the drive that is connected through the USB port. The upgrade label appears in the **Available Upgrades** section.
  - For Vevo 2100 and Vevo LAZR, click the DVD drive (in the example above, you would click **DVD RW Drive (E:) PN 12332**). The upgrade label appears in the **Available Upgrades** section.
5. In the upgrades list, click the upgrade and then 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.The system installs the upgrade.
7. Restart the system.

**NOTE:** This installation and restart process could continue for up to 30 minutes.

## Related information

- *Rear panel connections* (page 32)

## Installing a Vevo LAZR drivers upgrade

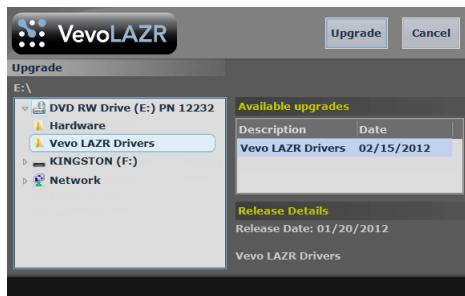


### Permissions and restrictions

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

#### ► To install a driver upgrade:

1. Insert the **Vevo Imaging System Upgrade Version** CD-ROM disk into the DVD drive on the left side of the system.
2. From the **Study Browser**, click the Preferences icon 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:
  - a. Expand the DVD drive (in the example above, you would expand **DVD RW Drive (E:) PN 12332**).
  - b. Click the **Vevo LAZR Drivers** folder. The folder name appears in the **Available Upgrades** section.

5. In the upgrades list, click **Vevo LAZR Drivers** and then 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. The system installs the upgrade and then restarts.

**NOTE:** This installation and restart process could continue for up to 30 minutes.

---

## Monitor preferences



Use the **Monitor** preferences section to calibrate the settings on the system's wide-screen display.

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 screen text steps you through the procedure to calibrate your monitor properly.

---

## Systems Log preferences



The Vevo 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**, click the Preferences icon 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 and select the folder where you want to export the log and then click **OK**.

► **To delete a system log file:**

**Permissions and restrictions**

- This task can only be completed by an administrator when User Management Mode is enabled.
1. In the **System Log** section, select the error log you want to export and then click **Delete**.
  2. In the confirmation window, click **Yes**.

## Backup and Restore preferences



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

- Custom applications and presets
- Custom measurement packages
- The state of configurable preferences
- ~~VEVO 1100~~ The active user mode state (Standard Mode or User Management Mode)
- ~~VEVO 1100~~ The active usage log mode state (enabled/disabled)

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

**Permissions and conditions**

- In Standard Mode, anyone can backup and restore
- ~~VEVO 1100~~ In User Management Mode, only an administrator can restore, import, export or delete a backup
- ~~VEVO 1100~~ In User Management Mode, anyone can backup, but only an administrator can restore, export, import or delete a backup

► **To create a backup:**

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

**NOTE:** When you switch from one user mode state to the other (Standard Mode/User Management Mode), the system creates an automatic backup. This backup restores the system to the user mode state that was active before the switch.

► **To restore from a backup:**

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



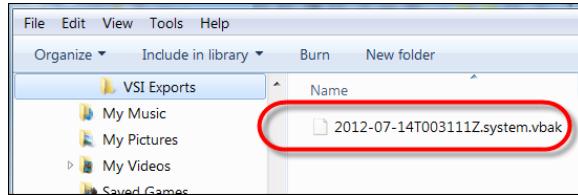
2. Click **Restore**. The system first completes an automatic backup of the current settings and then completes the restore. The **Restore System Settings** dialog box confirms the restore. Click **OK**.

**NOTE:** When you switch from one user mode state to the other (Standard Mode/User Management Mode) the system creates an automatic backup. This backup restores the system to the user mode state that was active before the switch.

► **To export a backup:**

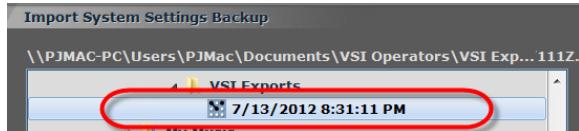
1. Select the time-stamped backup you want to export and then click **Export**.

2. In the **Export System Settings File** window, browse to the location where you want to export the backup, select the folder and then click **OK**. If you are using the Vevo LAB software, you can see that the backup is saved as a VBAK file.



► **To import a backup:**

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



3. Select the backup file you want to import, click **OK** and then in the confirmation dialog box click **Yes**.

► **To delete a backup:**

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

## System preferences tab



Use the **System** tab to manage the network and system configurations of the cart system.

### In this chapter

Date and Time preferences .....	179
Display preferences.....	179

---

## Date and Time preferences



The **Date and Time** preferences provide controls you can use to modify the date, time, time zone and daylight saving time settings that the system applies to logged actions.

**PERMISSION RESTRICTION:** This task can only be completed by an administrator when User Management Mode is enabled.

### ► To modify the date, time and time zone values:

1. From the **Study Browser**, click the Preferences icon and then click the **System** tab.
2. In the **Date and Time** section, modify the values as required and then click **OK**.

---

## Display preferences



The **Display** preferences is a button that opens the system's NVidia control panel. You will typically use this control to configure your system to use a second monitor.

**PERMISSION RESTRICTION:** This task can only be completed by an administrator when User Management Mode is enabled.

► **To adjust the display preferences:**

1. From the **Study Browser**, click the Preferences icon  and then click the **System** tab.
2. In the **Display** section click **Display Settings**.
3. In the NVidia control panel, complete your configuration changes.
4. In the **Preferences** window, click **OK**.

# Network preferences tab

 Vevo 1100    Vevo 2100    Vevo LAZR

Use the **Network** tab to:

- Connect Vevo Imaging System to a domain
- Change Vevo Imaging System workgroup, IP address or DNS settings
- Map a network drive to your system

## In this chapter

Connecting Vevo Imaging System to a domain .....	181
Changing the Vevo Imaging System workgroup .....	183
Changing the Vevo Imaging System IP address .....	183
Changing the Vevo Imaging System DNS settings .....	184
Network Maps preferences.....	184

## Connecting Vevo Imaging System to a domain

 Vevo 1100    Vevo 2100    Vevo LAZR

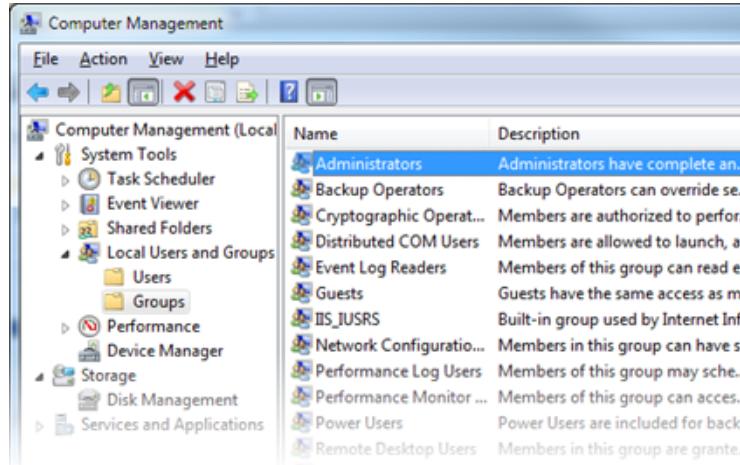
### Permissions and conditions

- This task can only be completed by a domain administrator

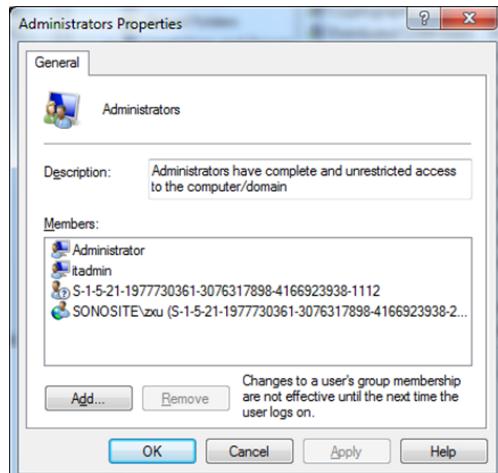
#### ► To connect Vevo Imaging System to a domain:

1. From the **Study Browser**, click the Preferences icon  and then click the **Network** tab.
2. In the **Network** section, click **Domain** and then click **OK**. The **Domain Logon** box appears.
3. Add your user name and password, click **OK** and then, at the prompt to reboot the system, click **Yes**.
4. After the reboot, press **CTRL+ALT+DEL** to log in and log in as **domain account**.

5. Break the shell and log in as local administrator [**computer name**]\[account]
6. In Windows, navigate to **Computer Management > Local Users and Groups > Administrators.**



7. Right-click **Administrators** and select **Add to Group**. The **Administration Properties** box appears.



8. Add a standard domain user account into the local administrator group.
9. Reboot and then use the new local domain administrator account to log in and use Vevo Imaging System.

---

## Changing the Vevo Imaging System workgroup

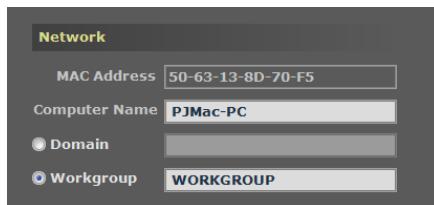


### Permissions and conditions

- This task can only be completed by a local system administrator

► **To change the Vevo Imaging System workgroup:**

- From the **Study Browser**, click the Preferences icon and then click the **Network** tab.
- In the **Network** section, click **Workgroup** and then type the name of the workgroup.



- Click **OK**.

---

## Changing the Vevo Imaging System IP address

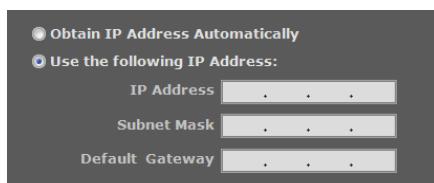


### Permissions and conditions

- This task can only be completed by a local system administrator

► **To change the Vevo Imaging System IP address:**

- From the **Study Browser**, click the Preferences icon and then click the **Network** tab.
- In the **Network** section, click **Use the following IP address** and then complete the address in the **IP Address**, **Subnet Mask** and **Default Gateway** fields.



3. Click **OK**.

---

## Changing the Vevo Imaging System DNS settings



### Permissions and conditions

- This task can only be completed by a local system administrator

► **To change the Vevo Imaging System DNS settings:**

1. From the **Study Browser**, click the Preferences icon and then click the **Network** tab.
2. In the **Network** section, click **Use the following DNS server address** and then complete the address in the **Preferred DNS Server** and **Alternate DNS Server** fields.



3. Click **OK**.

---

## Network Maps preferences



Use the **Network Maps** section in the Network preferences tab to connect to external drives on your organization's network.

A network drive is a file folder located on a remote system that has been configured for sharing over a network. It functions as a shortcut link to the remote location.

When you map a remote location, it appears as lettered drive on your system, just like your C: drive or D: drive. Your mapped drive can only connect to the mapped drive when your system is connected to the network.

**PERMISSION RESTRICTION:** This task can only be completed by an administrator when User Management Mode is enabled.

► **To map a network drive to your system:**

1. From the **Study Browser**, click the Preferences icon  and then click the **Network** tab.
2. In the **Network Maps** section, click **Map Network Drive**. The **Add Network Map** page appears and loads the network structure into the network directory list.
3. Select the network location you want to map. You can do this in one of two ways:
  - In the **Add Network Map** page, on the left side, in the explorer area, expand the network and select the folder or drive you want to map.
  - In the **Type in the network location or select from the tree** field, type the name of the shared location. You must type this name exactly.
4. In the **Specify the drive letter for the new network map** drop-down, select the letter you want to assign to the mapped location.
5. (Optional) Specify the behaviors for the connection to the mapped drive.
  - By default, the system attempts to reconnect any mapped drives the next time you log on. If you do not want this to happen (for example, if you want the mapped drive to be active only for your current session), clear the **Reconnect at Logon** check box.
  - By default, you are connected to the remote location with the logon credentials that you are currently using. If you want to use other credentials, select the **Connect using different credentials** check box and then, when prompted, type the appropriate user name and password to connect to this network resource.
6. Click **OK**. The mapped drive appears on the **Network** preferences tab in the **Network Maps** list.

► **To delete a mapped network drive:**

1. In the Network Maps list select the drive you want to delete and click **Delete Network Drive**.
2. Click **OK**.

## Section 6

# Managing user access



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

### In This Section

User access modes.....	187
Managing users in Standard Mode.....	194
Managing users in User Management Mode.....	199
Usage Log.....	208

# User access modes



The system provides two user access modes:

- **Standard Mode (no log-in required)**. This is the default access mode and provides minimal user restrictions.
- ~~Vevo 1100~~ **User Management Mode (log-in required)**. This is an administration option (not an image acquisition mode) that activates advanced user account controls, user groups, user-assignable study sharing levels and Usage Log availability.

This chapter describes the roles of users and administrators in each user access mode and how to switch between them.

## In this chapter

Standard Mode .....	187
User Management Mode .....	188
Enabling User Management Mode .....	191
Disabling User Management Mode .....	192

---

## Standard Mode



When the Vevo Imaging System is installed, Standard Mode is the default user access mode. Each user maintains full administrator rights until someone assigns administrator rights either to themselves or to someone else.

This mode is practical for a system installation that is used by a team that requires minimal user administration.

### Related information

- *Managing users in Standard Mode* (page 194)
- *User Management Mode* (page 188)

---

## User Management Mode



User Management Mode is an administration option (not an image acquisition mode) that activates advanced user account controls, user groups, user-assignable study sharing levels and Usage Log availability.

This mode is practical for a system installation that is used by multiple teams.

This section describes the primary features of this user access mode.

### Related information

- *Managing users in User Management Mode* (page 199)
- *Standard Mode* (page 187)

## Administrative user controls



On Vevo 1100, only an administrator can:

- Add or delete users
- Modify other user accounts
- Change lock state
- Upgrade the system
- Export, import and delete backups
- Restore the software



On Vevo 2100 and Vevo LAZR, only an administrator can:

- Control whether User Management Mode is enabled or disabled
- Add or delete users
- Modify other user accounts
- Export and import settings for other users
- Change study owners
- Modify user access to studies
- Change lock state
- Upgrade the system
- Export, import and delete backups

- Restore the software
- Change the Usage Log state
- Purge existing Usage Log session entries

**Best practice: Create an administrator as one of the first tasks with your Vevo Imaging System**

Because each user 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 Imaging System.

**Related information**

- *Adding an administrator in User Management Mode* (page 199)
- *Turning User Management Mode on* (page 191)
- *Turning User Management Mode off* (page 192)

## User groups



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

**Related information**

- *Adding a group to a user* (page 204)

## Study sharing levels



When User Management Mode is enabled, a user can apply one of the following three sharing levels to their own study to control who accesses it:

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

## Related information

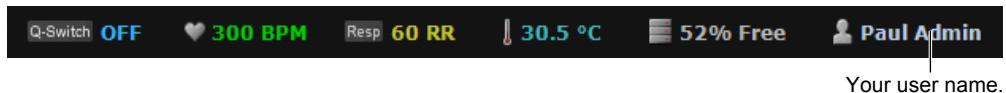
- *Setting default study sharing levels for new studies* (page 224)
- *Applying study sharing levels to existing studies* (page 225)

## Identifiers that User Management Mode is enabled



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

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



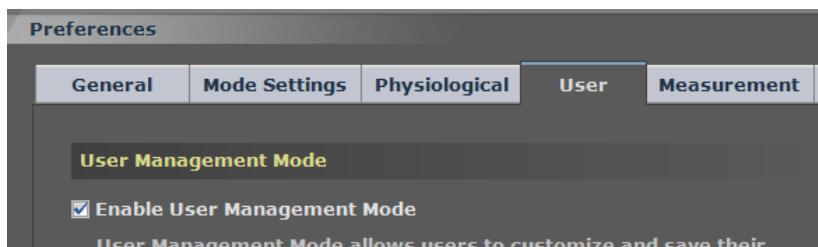
Hover over the name to display the elapsed time of your session.



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



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



## Enabling User Management Mode

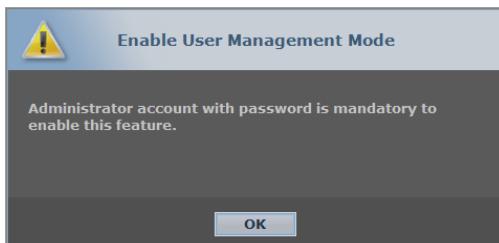


### Permissions and conditions

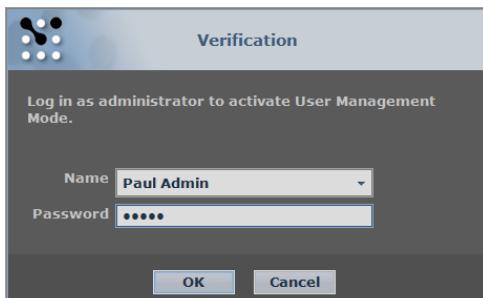
- This task can only be completed by an administrator.
- User Management Mode can only be enabled when all series are closed and when a password-protected administrator exists.
- When the feature is enabled, only password-protected users can log in.
- The login window for User Management Mode appears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

### ► To enable User Management Mode:

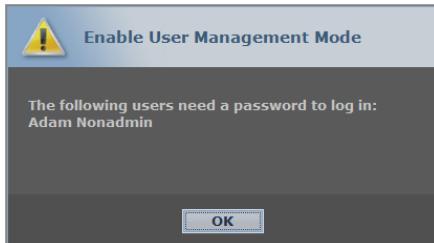
1. From the **Study Browser**, click the Preferences icon , click the **Users** tab and then in the **User Management Mode** section select the **Enable User Management Mode** check box. If no password-protected administrator account exists, the system reminds you that an administrator must exist in order to enable User Management Mode.



To start the activation process again, add an administrator (page 194) and select the **Enable User Management Mode** check box. When at least one password-protected administrator account exists, the **Verification** dialog box appears.



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



3. Note the list of names so you can inform these people if needed, and then click **OK**.
4. In the upper-right corner of the window click **OK**. The system enables User Management Mode and creates an automatic backup. This backup restores the system to Standard Mode along with the saved settings.

#### Related information

- *Indicators that User Management Mode is enabled* (page 190)

---

## Disabling User Management Mode

Vevo 2100 Vevo LAZR

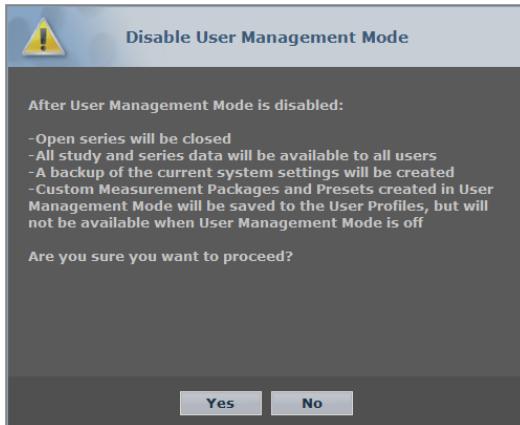
#### Permissions and conditions

- This task can only be completed by an administrator

► **To disable User Management Mode:**

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

2. In the **User Management Mode** section clear the **Enable User Management Mode** check box. The **Disable User Management Mode** dialog box appears to remind you of the operating conditions that are affected when you disable.



3. Click **Yes**. The Verification dialog box appears.
4. Type your password and click **OK**.
5. In the upper-right corner of the window click **OK**. The system disables User Management Mode and creates an automatic backup. This backup restores the system to User Management Mode along with the saved settings.

# Managing users in Standard Mode



In Standard Mode, a user is any person who works with the image data on the system. A user profile is the access and privilege settings that apply to a user.

This chapter shows you how to set up a profile in Standard Mode for each person who can use the system.

## In this chapter

Adding an administrator in Standard Mode .....	194
Adding a user in Standard Mode.....	195
Modifying a user in Standard Mode.....	196
Deleting a user in Standard Mode .....	197
Changing passwords in Standard Mode.....	197

---

## Adding an administrator in Standard Mode



### Best practice: When to create an administrator

In Standard Mode, because each user has full administrator rights until someone assigns themselves or someone else as an administrator, you should add an administrator as quickly as possible after VisualSonics installs your Vevo Imaging System.

### Before you begin

Ensure that User Management Mode is disabled (page 192).

### Permissions and conditions

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

► **To add an administrator:**

1. Open the **Preferences** window, click the **User** tab and then in the **Users** section click **Add**.
2. In the **Add User** dialog box:
  - a. In **Name**, type the name for the user. Typically this is the user's personal name.
  - b. In **Type** select **Administrator**, in **Password** type the password, in **Retype Password** type it again and then click **Save**.
3. In the **Verification** dialog box, type your password as an administrator and then click **OK**.

#### Related information

- *Adding a standard user* (page 195)
- *Guidelines for study passwords and study locks* (page 223)

---

## Adding a user in Standard Mode



#### Permissions and conditions

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

#### Before you begin

Ensure that User Management Mode is disabled (page 192).

► **To add a user in Standard Mode:**

1. Open the **Preferences** window, click the **User** tab and then in the **Users** section click **Add**.
2. In the **Add User** dialog box:
  - a. In **Name**, type the name for the user. Typically this is the user's personal name.

- b. In **Type**, select **Standard**.
  - c. If you want to give this user password protection to prevent non-administrators from deleting their locked studies, select the **Password Protected** check box. The password boxes become available. In **Password**, type the password, in **Retype Password** type it again and then click **Save**.
3. In the administrator **Verification** dialog box, type your administrator password and then click **OK**.

#### Next step

- *Adding an administrator* (page 194)

#### Related information

- *How passwords and study locks work* (page 223)

---

## Modifying a user in Standard Mode



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

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

#### Before you begin

Ensure that User Management Mode is disabled (page 192).

#### Permissions and conditions

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

#### ► To modify a user profile:

1. Open the **Preferences** window, click the **User** tab and then, in the list of users, select the user you want to modify and click **Modify**. The **User Properties** dialog box appears.

2. Modify the properties and click **Save**.
  3. In the **Verification** dialog box, type your password as an administrator and then click **OK**.
- 

## Deleting a user in Standard Mode



In Standard Mode, when you delete a user, the system only deletes the user profile. The user's studies are not affected in any way.

### Permissions and conditions

- When administrators have been added to the system, only an administrator can delete another user or administrator

#### Before you begin

Ensure that User Management Mode is disabled (page 192).

#### ► To delete a user:

1. Open the **Preferences** window and then click the **User** tab.
  2. In the list of users, select the user you want to delete and click **Delete**.
  3. In **Delete Confirmation**, type your password as an administrator and then click **OK**.
- 

## Changing passwords in Standard Mode



User passwords prevent non-administrators from deleting studies that were created and locked by another user. If you have a password and you select the lock check box for your studies, only you or an administrator can modify, unlock or delete those studies.

#### Before you begin

Ensure that User Management Mode is disabled (page 192).

### **Permissions and conditions**

- When administrators have been added to the system, only an administrator can create or modify a password for another user
- You can modify your own password

#### ► **To create a password for a user:**

1. Open the **Preferences** window, click the **User** tab, select the name of the user and then click **Modify**.
2. In the **User Properties** window:
  - a. Select the **Password Protected** check box. The password boxes appear.
  - b. In **Password**, type the new password, in **Retype Password** type it again and then click **Save**.
  - c. In the **Verification** dialog box, type your password as an administrator and then click **OK**.

#### ► **To change a user's password:**

1. Select the name of the user and then click **Modify**.
2. In the **User Properties** window:
  - a. In **Password**, type the new password, in **Retype Password** type it again and then click **Save**.
  - b. In the **Verification** dialog box, type your password as an administrator and then click **OK**.

#### ► **To remove password access for a user:**

1. Select the name of the user and then click **Modify**.
2. In the **User Properties** window:
  - a. Clear the **Password Protected** check box and then click **Save**.
  - b. In the **Verification** dialog box, type your password as an administrator and then click **OK**.

### **Related information**

- *Changing passwords in User Management Mode* (page 206)
- *Locking a study* (page 222)
- *How passwords and study locks work* (page 223)

# Managing users in User Management Mode



User Management Mode is an administration option (not an image acquisition mode) that activates advanced user account controls, user groups, user-assignable study sharing levels and Usage Log availability.

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

## In this chapter

Adding an administrator in User Management Mode .....	199
Adding a standard user in User Management Mode .....	201
Modifying a standard user in User Management Mode .....	202
Disabling a standard user .....	203
Deleting a user or administrator in User Management Mode .....	204
Adding a group to a user .....	204
Deleting a user group .....	205
Changing passwords in User Management Mode.....	206

---

## Adding an administrator in User Management Mode



### Before you begin

In the **Preferences** window, click the **User** tab and ensure that User Management Mode is enabled (page 190).

### Permissions and conditions

- Only an administrator can add another administrator
- You can create any number of administrators, but remember that each administrator can modify the settings of another administrator, so be careful
- You cannot type the same user name for two users
- User names are not case sensitive

- You cannot modify the name after you have added a user, so be sure to type the name correctly
- Administrators cannot delete their own accounts

► **To add an administrator in User Management Mode:**

1. In the **Users** section (**Preferences** window > **User** tab), click **Add**.
2. In the **Add User** dialog box:
  - a. In **Name**, type a name for the user. Typically this is the user's personal name.
  - NOTE:** You cannot type the same name for two users. Also, you cannot modify the name after you have added the user, so make sure you type the correct name.
  - b. In **Password** (mandatory), type the password, then tab to the **Confirm Password** box and retype it.
  - c. In **Copy Settings From**, if you want to apply the Preference tabs settings of another user, select the name of the user in the drop-down list. The system applies the settings. This can be a significant time saver, especially when you are adding a user whose tasks on this system will be similar to the tasks of an existing user.
  - d. If the user belongs to a group that has been created in the system, in **Group**, select the name of the group.
  - e. If the user belongs to a group that has not been created in the system, click the add-group icon , in **New Group**, type the name of the group and click **OK**.
  - f. In **Default Sharing For New Studies**, if you don't change the default selection, the study sharing level **Share with Everyone** will apply to every new study created by the user. The three default options are described in the following table.

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

- g. In **Type**, select **Administrator**.

3. Press **OK**. The system creates the new administrator and displays it in the **Users** list.
4. Click **OK**.

---

## Adding a standard user in User Management Mode



### Before you begin

In the **Preferences** window, click the **User** tab and ensure that User Management Mode is enabled (page 190).

### Permissions and conditions

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

### ► To add a standard user in User Management Mode:

1. In the **Users** section (**Preferences** window > **User** tab), click **Add**.
2. In the **Add User** dialog box:
  - a. In **Name** (mandatory), type a name for the user. Typically this is the user's personal name.

**NOTE:** You cannot type the same name for two users. Also, you cannot modify the name after you have added the user, so make sure you type the correct name.
  - b. In **Password** (mandatory), type the password, then tab to the **Confirm Password** box and retype it.
  - c. In **Copy Settings From**, if you want to apply the Preference tabs settings of another user, select the name of the user in the drop-down list. The system applies the settings. This can be a significant time saver, especially when you are adding a user whose tasks on this system will be similar to the tasks of an existing user.
  - d. If the user belongs to a group that has been created in the system, in **Group**, select the name of the group.

- e. If the user belongs to a group that has not been created in the system, click the add-group icon  in **New Group**, type the name of the group and click **OK**.
- f. In **Default Sharing For New Studies**, if you don't change the default selection, the study sharing level **Share with Everyone** will apply to every new study created by the user. The three default options are described in the following table.

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

- g. In **Type**, select **Administrator**.
- 3. Press **OK**. The system creates the new user and displays it in the **Users** list.
- 4. Click **OK**.

## Modifying a standard user in User Management Mode



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

- The identity of a user
- The type of user (standard or administrator)
- The user's password
- The assigned group
- The default study sharing level

### Before you begin

In the **Preferences** window, click the **User** tab and ensure that User Management Mode is enabled (page 190).

### Permissions and conditions

- Only an administrator can modify the profile of another user
- A standard user can only modify their password and their default study sharing level

► **To modify a user in User Management Mode:**

1. In the **Users** section (**Preferences** window > **User** tab), in the list of users, select the user and click **Modify**. The **Modify User** dialog box appears.
2. Modify the properties, where needed, and click **Save**.

---

## Disabling a standard user



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

### Before you begin

In the **Preferences** window, click the **User** tab and ensure that User Management Mode is enabled (page 190).

### Permissions and conditions

- This task can only be completed by an administrator
- You can only disable a standard user; you cannot disable an administrator

► **To disable a standard user:**

1. In the **Users** section (**Preferences** window > **User** tab), in the list of users, select the user and click **Modify**. The **Modify User** dialog box appears.
2. Select **Change Password**, in **Your Password** enter your administrator password and leave the other password fields empty, then click **Save**.

► **To re-enable a disabled standard user:**

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

### Related information

- *Changing passwords in User Management Mode* (page 206)

---

## Deleting a user or administrator in User Management Mode



### Before you begin

In the **Preferences** window, click the **User** tab and ensure that User Management Mode is enabled (page 190).

### Permissions and conditions

- This task can only be completed by an administrator.
- An administrator can delete another administrator but cannot delete their own account. If you are an administrator and need to delete your account, ask another administrator to delete it, or modify a user account to an administrator account and ask them to delete it, or create another administrator account and log on as that administrator and then delete your original administrator account.

#### ► To delete a user or administrator in User Management Mode:

1. In the **Users** section (**Preferences** window > **User** tab), select the user or administrator you want to delete and then click **Delete**.
2. In **Confirm Delete User**, click **Yes**.

---

## Adding a group to a user



### Before you begin

In the **Preferences** window, click the **User** tab and ensure that User Management Mode is enabled (page 190).

### Permissions and conditions

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

#### ► To add a group to a user:

1. In the **Users** section (**Preferences** window > **User** tab), open the user properties dialog box in one of two ways:

- Click **Add** to open the **Add User** dialog box when you create a new user
  - Select an existing user and then click **Modify** to open the **Modify User** dialog box.
2. Add the group to the user in one of two ways:
    - To add an existing group to the user, in **Group**, select the name of the group.
    - To create a new group and add it to the user, click the add-group icon  in **New Group**, type the name of the group and click **OK**.
  3. Click **Save**. In the list row of the user, the name of the assigned group appears in the **Group** column.

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

#### Related information

- *Turning User Management Mode on* (page 191)
- *Indicators that User Management Mode is enabled* (page 190)

## Deleting a user group



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

#### Before you begin

In the **Preferences** window, click the **User** tab and ensure that User Management Mode is enabled (page 190).

#### ► To delete a user group:

- Modify each user that includes the group's name in the **Group** column and change the group assignment to display the blank selection.
- Delete a user that happens to be the only user in a particular group. When you delete the user, the system also deletes the group.

## Related information

- *Modifying a user in User Management Mode* (page 202)
- *Deleting a user or administrator in User Management Mode* (page 204)

# Changing passwords in User Management Mode



## Before you begin

In the **Preferences** window, click the **User** tab and ensure that User Management Mode is enabled (page 190).

### Permissions and conditions

- A standard user can only change their own password
- An administrators can change the password of any user or administrator

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

1. In the **Users** section (**Preferences** window > **User** tab), select your name and then click **Modify**.
2. In the **Modify User** dialog box:
  - a. Select the **Change Password** check box.
  - b. In **Old Password**, type your current password.
  - c. In **New Password**, type your new password, in **Confirm Password** type it again and then click **Save**.

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

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

1. In the **Users** section (**Preferences** window > **User** tab), select the user's name and then click **Modify**.
2. In the **Modify User** dialog box:
  - a. Select the **Change Password** check box.
  - b. In **Your Password**, type your password, not the user's current password. You must add your password because you must be an administrator to change the password of a user. Adding your password validates your role.

- 
- 
- c. In **New Password**, type your new password, in **Confirm Password** type it again and then click **Save**.

#### Related information

- *Changing passwords in Standard Mode* (page 197)
- *Turning User Management Mode on* (page 191)
- *Indicators that User Management Mode is enabled* (page 190)

## Chapter 32

# Usage Log



Usage Log is a user management mode feature that tracks users who access the system, when they used it and how long they spent scanning images with a transducer.

The log consists of individual session entries and is available on the Vevo Imaging System as well as the Vevo LAB software.

- A session entry begins when the user logs in to the system
- A session entry ends when the user logs out of the system

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

### In this chapter

Usage Log Table .....	208
Enabling the usage log.....	210
Exporting usage logs.....	212
Purging usage logs.....	214

---

## Usage Log Table



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

► **To view the Usage Log Table:**

Log in, navigate to the **Preferences** window (page 129) and then click the **User** tab. The **Usage Log Table** section is on the right side of the screen.

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

A screenshot of a web-based 'Usage Log Table' application. The table has columns: Start Date, End Date, Session Time, Name, and Group. The first row shows a completed session (4/7/2013 2:12 PM to 4/7/2013 2:12 PM). The second row shows an in-progress session (4/7/2013 2:02 PM to 4/7/2013 12:55 PM). The third row shows another in-progress session (4/7/2013 12:49 PM to 4/7/2013 12:51 PM). The fourth row shows a completed session (4/7/2013 11:05 AM to 4/7/2013 12:48 PM). The fifth row shows a completed session (4/7/2013 11:19 AM to 3/22/2013 5:30 PM). Red circles with numbers 1 through 11 point to various elements: 1 points to the first row; 2 points to the second row; 3 points to the 'Start Date' header; 4 points to the 'End Date' header; 5 points to the 'Session Time' header; 6 points to the 'Name' header; 7 points to the 'Group' header; 8 points to the 'Export' button; 9 points to the 'Purge' button; 10 points to the bottom border of the table; 11 points to the 'End Date' field of the second row.

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

Export      Purge

- 1** **In-progress session entry.** Identifies that a user has logged in but has not logged out. Distinguished from the other session entries by the light gray text formatting and no values in the End Date field, as the session is still in progress.

---

**2** **Completed session entry.** Includes:

- Start date and time
- End date and time
- Session time

A session entry begins when the user logs in to the system.

A session entry ends when the user logs out of the system.

**NOTE:** When midnight occurs in the middle of a session, the system displays two session entries, each with the same **Session ID**.

- 
- 3** **Start Date and time.** The time the user logged in.

- 
- 4** **End Date and time.** Logged from the time the user logged out.

- 
- 5** **Sort column marker.** Appears in the header of the column that is sorting the information in the table.

- **To reverse the top-to-bottom order**, click the same column header.
- **To sort by a different column**, click a different column header.

- 
- 6** **Session time.** The total elapsed time during which the user is logged in to the system. The system updates the usage log table every minute, from the time the user started the session. For example, if a user logs in at 2:12 PM, the system updates the log one minute later at 2:13 PM and continues updating once per minute until the user logs out.
-

- 
- 7** **User's name.**
- 
- 8** **Group.** The name of the user's group. This is defined in the **Users** section of the **User** tab.
- 
- 9** **Export command** to produce a CSV file that includes user selected logs.
- 
- 10** **Purge command** to clear a range of session entries, from the table. Available only to an administrator.
- 
- 11** **Check mark.** Appears on a session entry that has been exported by an administrator. The check mark column is only visible to administrators.

**NOTE:** In-progress session entries cannot be exported.

#### Related information

- *Adding a group to a user* (page 204)
- *Exporting usage logs* (page 212)
- *Purging usage logs* (page 214)

## Enabling the usage log

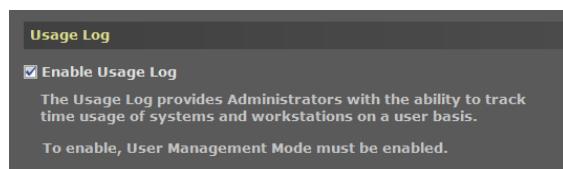


#### Permissions and conditions

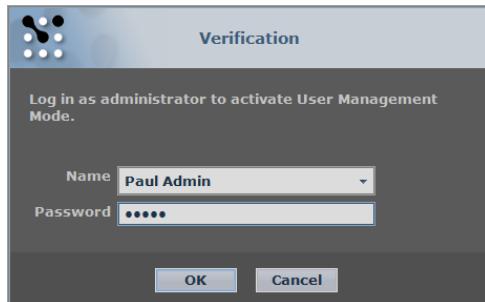
- **PERMISSION RESTRICTION:** This task can only be completed by an administrator when User Management Mode is enabled.

#### ► To enable the usage log:

1. Log in as an administrator, navigate to the **Preferences** window (page 129) and then click the **User** tab.
2. In the **Usage Log** section, select the **Enable Usage Log** check box if it is not selected.



The administrator **Verification** dialog box appears.



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

Usage Log Table				
Start Date	End Date	Session Time	Name	Group
4/7/2013 12:55 PM		0:00	Paul Admin	
4/7/2013 12:49 PM	4/7/2013 12:51 PM	00:01	Paul Admin	
4/7/2013 11:05 AM	4/7/2013 12:48 PM	01:43	Paul Admin	
3/20/2013 11:40 AM	3/20/2013 5:00 PM	06:11	Paul Admin	

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

#### ► To disable the usage log:

1. Log in as an administrator, navigate to the **Preferences** window (page 129) and then click the **User** tab.
2. In the **Usage Log** section, clear the **Enable Usage Log** check box. The administrator **Verification** dialog box appears.
3. Select your administration account, enter your password and then click **OK**. The system clears the session entries in **Usage Log Table**.

Usage Log Table				
Start Date	End Date	Session Time	Name	Group

**NOTE:** Although Usage Log Table does not display session entries when usage log is disabled, the system does continue to store any session entries that have been stored. These are displayed the next time the usage log is enabled.

#### Related information

- *Logging in to a session in User Management Mode* (page 126)

- *Enabling User Management Mode* (page 191)
- *Identifiers that User Management Mode is enabled* (page 190)

## Exporting usage logs



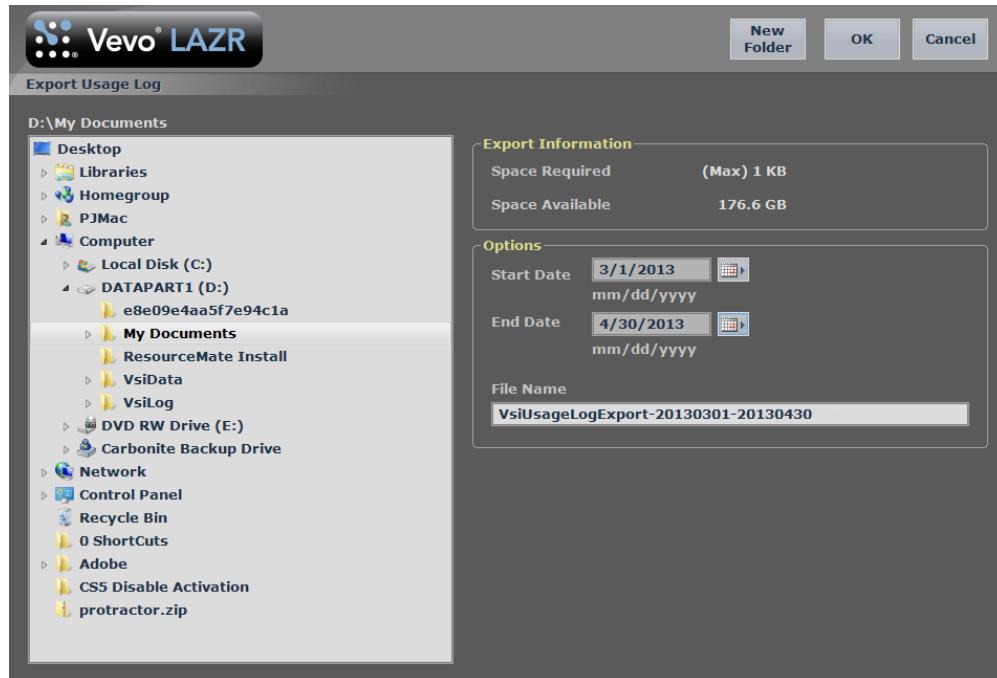
You can export usage logs as a CSV file.

### Permissions and conditions

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

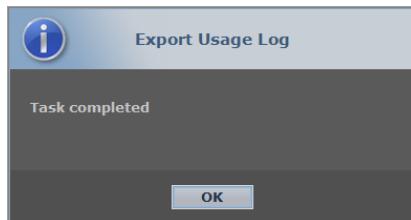
#### ► To export usage logs

1. Log in, navigate to the **Preferences** window (page 129) and then click the **User** tab.
2. In the **Usage Log Table** section click **Export**. The **Export Usage Log** window appears.



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

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



7. Click **OK**.

### Usage log CSV file data features

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

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

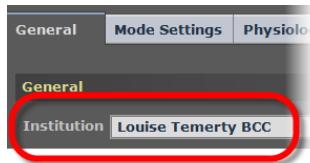
**Top Table (CSV Headers):**

	A	B	C	D
1	Vevo Usage Log			
2				
3	Start Date	3/1/2013		
4	End Date	4/30/2013		
5				
6	Institution	Louise Temerty BCC		
7	Software	V1.0.0-0037		
8	Computer	PJMAC-PC		
9	License	System		

**Bottom Table (Usage Log Data):**

	Start Date	End Date	Start Time	End Time	Session Time	Scan Time	Non-Scan Time	Name	Group	Session ID
20	3/29/2013	3/29/2013	10:37 AM	10:40 AM	0:03:25	0:00:14	0:03:10	Paul Admin	Louise Temer	S356191827941
21	3/19/2013	3/19/2013	10:36 AM	10:37 AM	0:00:56	0:00:00	0:00:56	Paul Admin		S223251824524
22										

- 1** **Institution.** This value, in cell **B6**, only appears if the user who exported the usage log has already added information in the **Institution** field in the **General** tab of the **Preferences** window.



**NOTE:** The listed Institution is the institution for the user who is currently logged in.

If no information has been added here, nothing appears in row 6 of the exported usage log CSV file.

- 2** The row of session entry data headers always starts on cell **A20** so that you can build macros based on fixed, predictable data locations.
- 
- 3** **Scan Time.** Time spent scanning using a transducer.
- 
- 4** **Non-Scan Time.** Total session time minus scan time.
- 
- 5** **Session ID.** Unique system-generated session identification number.

**NOTE:** When midnight occurs in the middle of a session, the system displays two session entries, each with the same **Session ID**.

### Backing up the usage log feature status

The system automatically includes the current state of the usage log (enabled/disabled) as one of the list of system and feature states that are backed up. This backup does not include the logs themselves.

### Related information

- *Purging usage logs* (page 214)
- *Backup and Restore preferences* (page 176)

## Purging usage logs



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

## Permissions and conditions

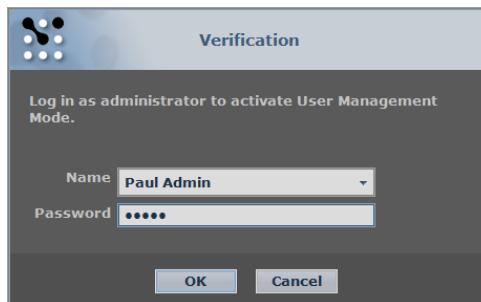
- **PERMISSION RESTRICTION:** This task can only be completed by an administrator when User Management Mode is enabled.

### ► To purge usage logs:

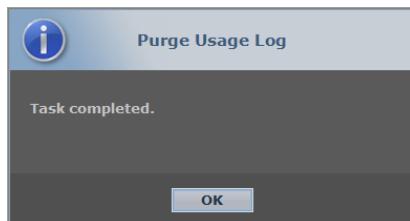
1. Log in as an administrator, navigate to the **Preferences** window (page 129) and then click the **User** tab.
2. In the **Usage Log Table** section click **Purge**. The **Purge Usage Log** box appears.



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



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



6. Click **OK**.

## Related information

- *Exporting usage logs* (page 212)

## Section 7

# Managing studies, series and images



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

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

When you acquire and save an image, the Vevo 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.

### In This Section

About studies, series and images .....	218
Working with studies .....	219
Working with series .....	230
Working with images .....	235
Exporting from the Study Browser .....	240
Copying, deleting and importing .....	252

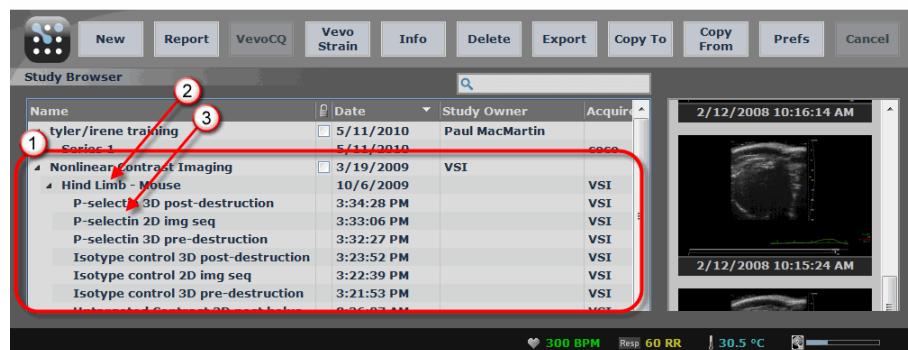
# About studies, series and images

Vevo 1100   Vevo 2100   Vevo LAZR

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.



- ① **Study.** A study contains one or more grouped image sets called series.
- ② **Series.** 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.
- ③ **Image.** An image is either a multiple frame image called a cine loop, a single image frame, or a 3D-Mode image.

## Chapter 34

# 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.

### In this chapter

Creating a study .....	219
Finding a study .....	221
Customizing study information details .....	222
Locking a study .....	222
Guidelines for study passwords and study locks .....	223
Setting default study sharing levels for new studies.....	224
Setting the sharing levels for a study .....	225
Changing study ownership.....	227

---

## Creating a study



You can create a study in one of two ways:

- After you start the system, press a mode key to start acquiring image data, then press **Scan/Freeze**
- From within an open study or when no study or series is open, from the **Study Browser** press **New** on your control panel or click **New** and then click **New Study**.

When you create a study you become the *owner* of the 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. The mode window appears and displays the system-generated study name and series name.
3. Store images to your series and then close the series.

**NOTE:** When you close a series that contains no images, the system deletes the series.

The **Study Information** window appears.

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

## 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 user 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
3. Select the measurement package that will be your default package for the images in this series.
4. In the **Study Name** box, type a name for the study.
5. (Optional) Customize additional property details (see page 222) in the boxes that are labeled in gray, then click **OK**. The system creates the study and opens the mode acquisition window in B-Mode.
6. Store images to your series and then close the series.

**NOTE:** When you close a series that contains no images, the system deletes the series.

## Finding a study



When the list of studies is long and you need to find a specific study, use the Study Browser's search box or sorting features.

### Option 1: Searching with the Study Browser search box

► **To search the Study Browser grid:**

1. Press **Study Management**. The **Study Browser** appears.
2. Type your search phrase in the box and then press **ENTER** to display the results.

### Option 2: Sorting the contents in the Study Browser grid

► **To sort the Study Browser grid:**

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 user 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 the study.

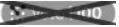
## Customizing study information details

 Vevo 1100    Vevo 2100    Vevo LAZR

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

### ► To customize study information details:

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

Box	Description
Study Name	Required. Type your information.
Owner	Read-only
Granting Institution	Optional. Type your information.
Sharing	 Optional. Select from the drop-down list.  <b>NOTE:</b> Only available when User Management Mode is on.
Study Notes	Optional. Type your information.

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

### Related information

- *Study sharing levels* (page 189)
- *Study Browser window workspace* (page 92)
- *Study Information window workspace* (page 96)

## Locking a study

 Vevo 1100    Vevo 2100    Vevo LAZR

Any user can lock any study. When you lock a study, all the users 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. If the study owner has a password, type the password.

► **To unlock a study:**

1. In the **Study Browser**, in the lock column  clear the check box for the study that you want to unlock.
2. If the study owner has a password, type the password.

► **To delete a locked study:**

1. Unlock the study, select the study and click **Delete**.
2. If the study owner has a password, type the password.

**Related information**

- *Study Browser window workspace* (page 92)
- *Guidelines for study passwords and study locks* (page 223)

---

## Guidelines for study passwords and study locks

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

**Related information**

- *Locking a study* (page 222)
- *Managing user passwords* (page 197)

## Setting default study sharing levels for new studies



### Permissions and conditions

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

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

1. From the **Study Browser**, click the Preferences icon and then click the **User** tab.
2. From the **Users** section, open the user profile dialog box:
  - If you are a user, select your name in the list and then click **Modify**. The **Modify User** dialog box appears.
  - If you are an administrator, either click **Add** to open the **Add User** dialog box or select a user in the list and then click **Modify** to open the **Modify User** dialog box.
3. In the **Default Sharing for New Studies** drop-down select the appropriate sharing level as described in the following table.

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

4. Click **Save**.

### Related information

- *Turning User Management Mode on* (page 191)
- *Indicators that User Management Mode is enabled* (page 190)

## Setting the sharing levels for a study



### Permissions and conditions

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

#### ► To set the sharing levels for a study:

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

1. In the **Study Browser**, right-click the study and click **Change Study Access**. The **Change Study Access** dialog box appears.
2. Select the **Change Study Sharing** check box. The list of study sharing levels becomes available, as described in the following table.

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

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

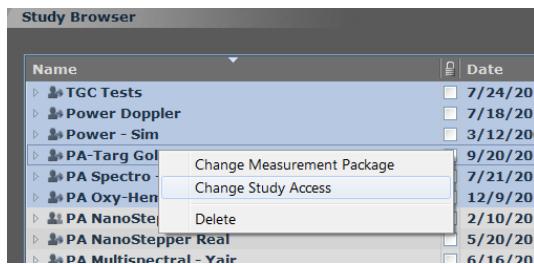


##### Option 2: Use the drop-down list in the Study Information window

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

► **To set the sharing level for multiple studies:**

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

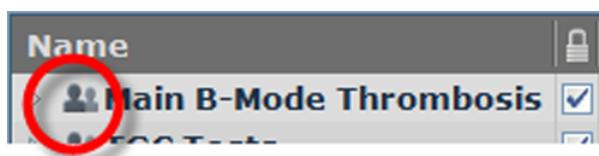


The **Change Study Access** dialog box appears.

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

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

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



#### Related information

- *Turning User Management Mode on* (page 191)
- *Indicators that User Management Mode is enabled* (page 190)

## Changing study ownership



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

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

### Changing the ownership of one study



#### Permissions and conditions

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

#### ► To change the ownership of a study:

1. From the **Study Browser**, right-click the study you want to work with and select **Change Study Access**. The **Change Study Access** dialog box appears.
2. Select the **Change Study Owner** check box. The list of users becomes available.
3. Select the new user in the drop-down list and then click **Save**.

#### Related information

- *Study Browser lock preferences* (page 135)
- *Turning User Management Mode on* (page 191)
- *Indicators that User Management Mode is enabled* (page 190)

## Changing the ownership of multiple studies

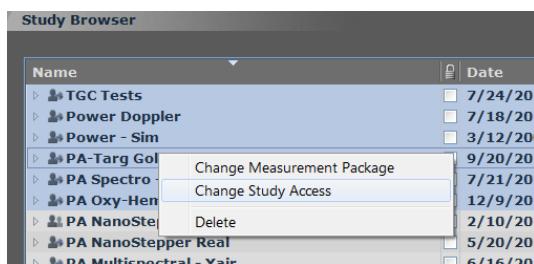


### Permissions and conditions

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

#### ► To change the ownership of a study:

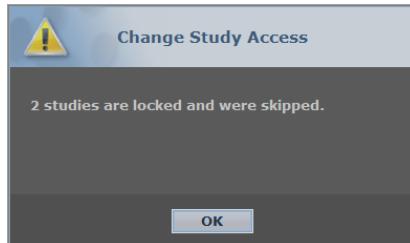
1. Open the **Study Browser** window and select the studies you want to work with.
2. Right-click one of the selected studies and select **Change Study Access**.



The **Change Study Access** dialog box appears.

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

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



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

#### Related information

- *Turning User Management Mode on* (page 191)
- *Indicators that User Management Mode is enabled* (page 190)

# 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 .....	230
Modifying the information properties of a series .....	231
Moving a series.....	232
Closing an active series.....	233
Deleting a series.....	233

---

## 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:**

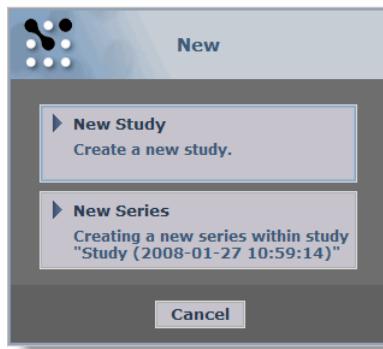
Create a new study using either of two methods:

- Create a study by acquiring image data (page 220)
- Create a study by using the New key or New button (page 220)

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.

► **To simplify the addition of second and subsequent series in a study:**

1. In the **Study Browser**, select a study or series, press **New**, then click **New Series**. The **New Series** window appears.
2. At the top-right of the window click **Previous Info**. In the **Series Information** section, the system copies the series information for nearly all the fields. The **Series Name** and **Acquired By** information is not copied because this information can be unique for each series.
3. Complete the **Series Name** and **Acquired By** fields and then click **OK**.

## 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.

Box	Description
Series Name	Required.
Acquired By	Required.
Date of Birth	Optional. Click the calendar icon and select the date that the animal was born.
Sex	When you select <b>Female</b> , the system displays the <b>Pregnant</b> option.
Pregnant	Optional. Select the check box. The system displays an optional <b>Date Mated</b> calendar field. If you want to add that data, click the calendar icon and select the date.
<b>IMPORTANT:</b> If you want to add embryology measurements to any image in the series you must select this check box.	
(All other fields)	Optional. Type in your information.

#### Related information

- *Study Information window workspace* (page 96)

## Moving a series



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

► **To move a series:**

1. From the **Study Browser** right-click the series line item and select **Move**.
2. In the **Move Selected Series** window select the study where you want to move the series and click **OK**.

3. The **Study Browser** highlights the series in its new study destination.
- 

## 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.

**NOTE:** When you close a series that contains no images, the system deletes the series.

---

## Deleting a series



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

### ► To delete a series:

1. In the **Study Browser**, select the series you want to delete:
  - To select one item, click it
  - To select a collection of individual items, press and hold **CTRL** and then click to select each item
  - To select a consecutive group of items, click to select the first item, press and hold **SHIFT** and then click to select the last item in the range

2. Click **Delete**. 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**.

# Working with images



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

## In this chapter

Opening an image .....	235
Labeling an image .....	235
Modifying an image after it is stored.....	236
Storing an image.....	237
Deleting an image .....	238

---

## Opening an image



### ► To open an image:

In the **Study Browser**, expand the study and series and then select the image you want to open:

- In the list of images, 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 Imaging System control panel):**

1. Expand the study and series and select the image you want to label.
  - In the list of images, 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 LAB):**

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.

## Modifying an image after it is stored



Image processing tools for modifying images that have already been acquired are available in the image processing Panel by clicking the **Image Process** key on the keyboard or in the Vevo LAB application.

The tools vary, depending on the imaging mode. For information on the available image processing panel tools for a mode, see the Acquisition and Display subsections in the mode settings topic for each imaging mode. These topics are listed below the following notes.

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

**NOTE:** The **Create MIP** option is not available if the previous cine loop was processed using MIP, if the loop was previously post processed with MIP, or if the loop contains less than five frames.

## Related information

- B-Mode settings (page 334)
- PA-Mode settings (page 367)
- M-Mode settings (page 412)
- PW Doppler Mode settings (page 441)
- 3D-Mode provides a range of unique post-storage tools. See:
  - 3D-Mode visualization tools (page 470)
  - Manipulating 3D-Mode image data (page 472)
  - Thresholding color-mapped 3D images (page 484)
- Color Doppler Mode settings (page 496)
- Power Doppler Mode settings (page 513)
- Linear Contrast Mode settings (page 529)
- EKV Mode image refinement tools (page 584)

---

## Storing an image



You can store a cine loop or individual frame 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** for a single-frame image in B-Mode, Color Doppler Mode, PA-Mode, Power Doppler Mode and Linear Contrast Mode.

For M-Mode, AM-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 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.

## Deleting an image



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

### ► To delete an image from the Study Browser:

1. In the **Study Browser**, expand the series that contains the image you want to delete and then select the images you want to delete:
  - To select one item, click it
  - To select a collection of individual items, press and hold **CTRL** and then click to select each item
  - To select a consecutive group of items, click to select the first item, press and hold **SHIFT** and then click to select the last item in the range
2. 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.

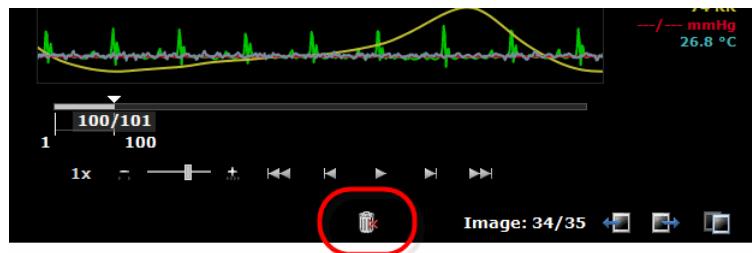
3. Click **Yes**.

**NOTE:** You can only delete an image from a series that is backed up.

### ► To delete an image while you are reviewing images:

1. Open an image.
2. Delete the image.
  - If you are working on the ultrasound cart control panel, press **DEL**.

- If you are working on Vevo LAB, click .



► **To delete images you have created during an image acquisition session:**

Press **DEL** multiple times. The system deletes any previous images you created in a series and displays a message that tells you when all the images you stored during your session have been deleted.

**Related information:**

- *Opening an image* (page 235)
- *Storing an image* (page 237)

# Exporting from the Study Browser



The **Export** function:

- a. Translates your images from the proprietary Vevo 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 Imaging System.

## In this chapter

Exporting cine loops from the Study Browser.....	240
Exporting image frames from the Study Browser.....	243
Exporting physiological data from the Study Browser .....	246
Exporting images to DICOM from the Study Browser .....	247
Exporting the Study Browser list view as a text file .....	249

---

## Exporting cine loops from the Study Browser



### Before you begin

Ensure that the Vevo 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 loaded 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.

**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.

- To select one item, click it
- To select a collection of individual items, press and hold **CTRL** and then click to select each item
- To select a consecutive group of items, click to select the first item, press and hold **SHIFT** and then click to select the last item in the range

3. Press **Export**. The **Export Image** window appears.
4. Browse to, and then select, the folder that will contain the export.
5. (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
6. In the **Export Type** section click **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.

AVI format	Description
Uncompressed AVI	Largest file size. Original image quality.
Animated GIF	Medium file size. Fair image quality.
Compressed AVI MS Video 1	Smallest file size. Good image quality.
Compressed AVI MS Media Video 9	Smaller file size. Best image quality.  <b>Attention: Apple Macintosh users</b> - Use this format to export as compressed AVI.
RAW Data	Saves the video as a raw.xml file.

- c. (Optional) Select the **Hide measurements and annotations** check box to export your cine loop with image data only.
- d. In the **Quality** row, click **High** or **Medium** based on your requirements.

Quality	Description
Medium	Slightly lower resolution
High	Highest resolution

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

#### Related information

- *Export and Copy To window workspace* (page 103)
- *Rear panel connections* (page 32)

## Exporting a cine loop from the Mode window

 Vevo 1100    Vevo 2100    Vevo LAZR

If you are analyzing a cine loop 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 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 240).

## Exporting image frames from the Study Browser



### Before you begin

Ensure that the Vevo 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.

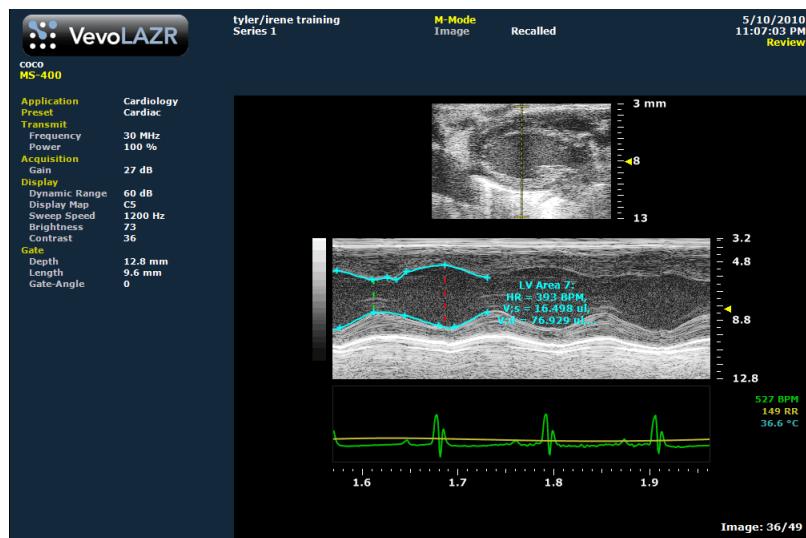
#### ► To export image frames from the Study Browser:

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

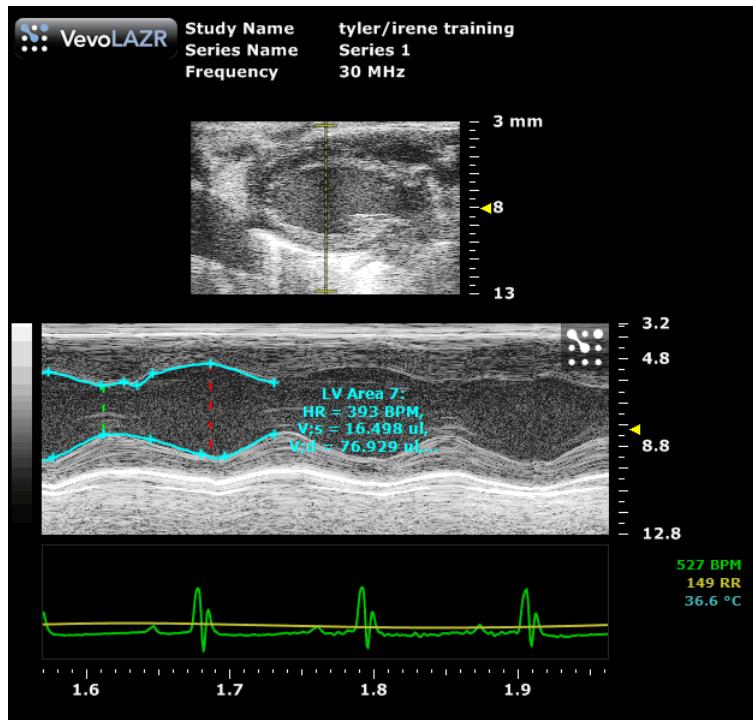
**TIP:** When you select a series or a study that includes cine loops as well as image frames, the system exports the last frame of any cine loop as an image frame. Or, if you have added a measurement, the system exports the frame that includes the measurement. This means that if you want to export the 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. (Optional) Select the **Hide measurements and annotations** check box to export your cine loop with image data only.
4. Press **Export**. The **Export Image** window appears.
5. Browse to, and then select, the folder that will contain the export.
6. (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
7. In the **Export Type** section click **Image**.
8. 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*



*Same image exported as image area BMP*

- 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
9. Click **OK**. The system exports the images to the folder you selected and then presents the **Image Export Report**.
10. Click **OK**. The system returns you to the **Study Browser**.

#### Related information

- *Export and Copy To window workspace* (page 103)
- *Rear panel connections* (page 32)

## 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 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 243).

---

## Exporting physiological data from the Study Browser



### Before you begin

Ensure that the Vevo 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 physiological data from the Study Browser:

1. In the **Study Browser**, select the cine loops and/or image frames that contain the physiological data you want to export.
  - To select one item, click it
  - To select a collection of individual items, press and hold **CTRL** and then click to select each item
  - To select a consecutive group of items, click to select the first item, press and hold **SHIFT** and then click to select the last item in the range
2. Click **Export**. The **Export Image** window appears.
3. Browse to, and then select, the folder that will contain the export.

4. (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
5. In the **Export Type** section click **Physiological Data**.
6. Click **OK**. The system exports the physiological data as a CSV file to the folder you selected and then presents the **Image Export Report**. The file name ends with *physio.csv*.
7. Click **OK**. The system returns you to the **Study Browser**.

#### Related information

- *Export and Copy To window workspace* (page 103)
- *Rear panel connections* (page 32)

---

## Exporting images to DICOM from the Study Browser

 Vevo 1100    Vevo 2100    Vevo LAZR

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

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

#### Before you begin

Ensure that the Vevo 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.
  - To select one item, click it

- To select a collection of individual items, press and hold **CTRL** and then click to select each item
  - To select a consecutive group of items, click to select the first item, press and hold **SHIFT** and then click to select the last item in the range
3. Press **Export**. The **Export Image** window appears.
  4. Browse to, and then select, the folder that will contain the export.
  5. (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
  6. In the **Export Type** section click **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.

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

- 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**.

## Exporting images to DICOM from the Mode window

 Vevo 1100    Vevo 2100    Vevo LAZR

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 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**.  
The **Export Images** window appears.
2. Complete the export procedure as detailed in *Exporting images to DICOM from the Study Browser* (page 247).

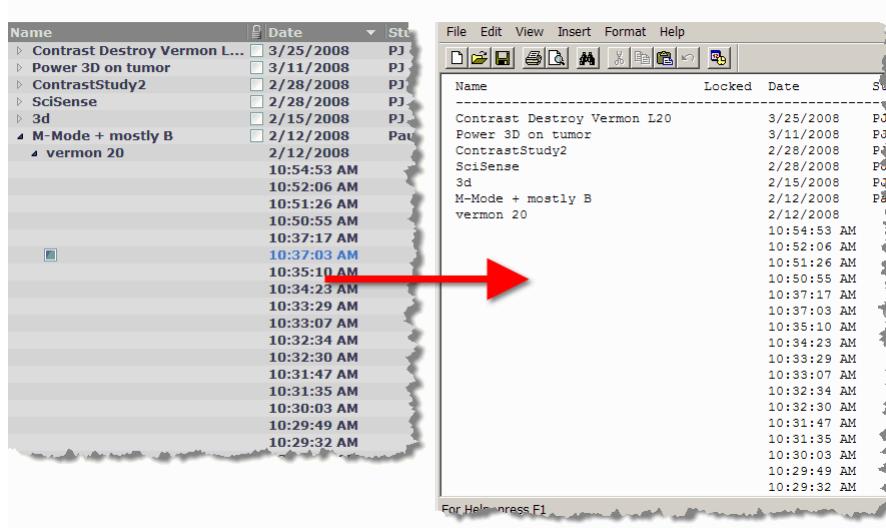
---

## Exporting the Study Browser list view as a text file

 Vevo 1100    Vevo 2100    Vevo LAZR

The export Table feature exports the Study Browser window content precisely as it appears, but as a .Txt file that you can open in a text editor.

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.

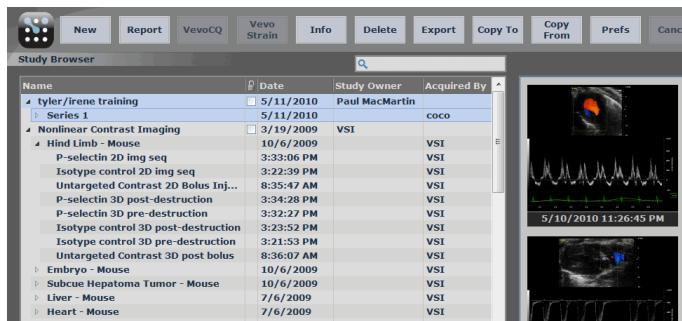


## Before you begin

Ensure that the Vevo 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. Open the **Study Browser**, expand the study rows and series rows as required to create the precise view you want to export.



2. Click **Export**. The **Export Image** window appears.
  3. Browse to, and then select, the folder that will contain the export.
  4. In the **Export Type** section click **Table**.

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

# Copying, deleting and importing



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

## In this chapter

Copying studies, series or images.....	252
Deleting studies, series or images .....	254
Importing studies.....	255

---

## Copying studies, series or images



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

### Before you begin

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

#### ► To copy a study to a folder:

1. In the **Study Browser**, select the names of the studies that you want to copy.
  - To select one item, click it
  - To select a collection of individual items, press and hold **CTRL** and then click to select each item
  - To select a consecutive group of items, click to select the first item, press and hold **SHIFT** and then click to select the last item in the range
2. 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**.

►  **To copy a study from a folder:**

1. In the Study Browser, click **Copy From**. The **Copy Study From** window appears.
2. In the folder browser, browse to the folder that contains the study you want to copy and select the check box of the study/studies you want to copy.



The study/studies appear in the **Studies Selected** list.

3. Click **OK**. The system:
  - a. Copies the study to your system.
  - b. Displays the **Data Transfer Report** box to summarize the details of the copy process. Click **OK** to complete the process.
  - c. Returns you to the **Study Browser**. The copied study appears in the list of studies.

#### Related information

- *Export and Copy To window workspace* (page 103)

- *Rear panel connections* (page 32)

---

## Deleting studies, series or images

 Vevo 1100    Vevo 2100    Vevo LAZR

In the **Study Browser** list of study, series 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.
    - To select one item, click it
    - To select a collection of individual items, press and hold **CTRL** and then click to select each item
    - To select a consecutive group of items, click to select the first item, press and hold **SHIFT** and then click to select the last item in the range
2. 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.

**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



You can import studies that were acquired on another Vevo Imaging System or from another storage location.

**NOTE:** Studies cannot be imported to Vevo 1100.

### Before you begin

Ensure that the Vevo 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 User** box, select your name from the list.
- PROCEDURE ALERT:** 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 check box for the study.

4. If you want to remove a study from the **Selected Studies** list, select the study and then click **Remove**.
5. Click **OK**. If your import includes a series that already exists on the system for which you are the owner, the system prompts you to choose one of the following actions:
  - Overwrite the series

- Skip the series
  - Create a new study for the series
6. Select the appropriate option and then click **OK**. The system displays the **Copy Study Report** box so you can review the details of the import.
  7. Click **OK**.

## Section 8

# Acquiring images



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



**WARNING:** The Vevo Imaging System 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 the Vevo Imaging System.....	258
Setting up Mode settings presets .....	265
Setting up to acquire physiological data .....	269
Acquiring image data .....	281
Saving image data .....	282

# Setting up the Vevo Imaging System



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

## In this chapter

Working with transducers .....	258
Connecting and disconnecting transducers.....	260
Working with the 3D motor stage.....	261

## 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



The Vevo Imaging System supports the following transducers:

### Vevo Imaging System transducers

Transducer	Description
MS200	Rat cardiovascular and abdominal (>400g), rabbit (cardiovascular)
MS201	Rat cardiovascular and abdominal (>400g), rabbit (cardiovascular)
MS250	Rat cardiology and abdominal (<400 g), large tumor imaging (up to 23 mm in diameter), all contrast applications
MS250S	Rat abdominal (<300 grams), mouse cardiology for aortic banding models, mouse abdominal; small tumor imaging (up to 15 mm in diameter); all contrast applications
MS400	Optimized for mouse cardiovascular, rat abdominal, rabbit eye, all vascular (mouse, rat, rabbit)

Transducer	Description
MS550D	Mouse abdominal, reproductive, mouse/rat embryology, tumor imaging (up to 14 mm in diameter), mouse vascular, small rat vascular, some abdominal (kidney)
MS550S	Optimized for mouse/rat embryology, mouse abdominal, reproductive, epidermal imaging, tumor imaging (up to 13 mm in diameter), mouse vascular, small rat vascular, some abdominal (kidney), ophthalmology
MS700	Mouse embryology, epidermal imaging, superficial tissue, subcutaneous tumors (< 9 mm), mouse vascular, ophthalmology

## Vevo LAZR transducers

Transducer	Description
LZ250	Broadband Frequency: 13-24 MHz. Image Width: 23 mm, Image Depth: 30 mm. Image Axial Resolution: 75 µm
LZ550	Broadband Frequency: 32-55 MHz. Image Width: 14.1 mm, Image Depth: 15 mm. Image Axial Resolution: 40 µm

## Next steps

- *Connecting the transducer to the laser cart* (page 67)
- *Connecting the transducer to the ultrasound cart* (page 260)

## Related information

- *Vevo LAZR transducers* (page 56)

## Storing Vevo Imaging System transducers



You can store the transducer in the transducer and gel holder on either side of the Vevo Imaging System control panel. Position the transducer nose upward with the cable directed toward the front of the cart.

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

When you move the transducer from one facility to another, always use the dedicated case.

### 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.

## Storing Vevo LAZR transducers



- Keep the Vevo LAZR transducer inside Vevo LAZRTight between imaging sessions
- Ensure that the cables are not twisted when storing the transducer
- Use the provided case to transport the transducer from one site to another

### Storing or transporting a transducer in the provided case

- Make sure that the transducer is clean and dry before you place it in the case
- Place the protective cover over the end of the laser fiber bundle optic cable before you place it in the case
- Place the transducer in the case carefully to prevent kinking of the cable or the optical fiber
- Avoid storing the transducer in areas that are subject to extreme temperatures or are situated in direct sunlight
- Store the transducer separately from other instruments to avoid inadvertent damage

---

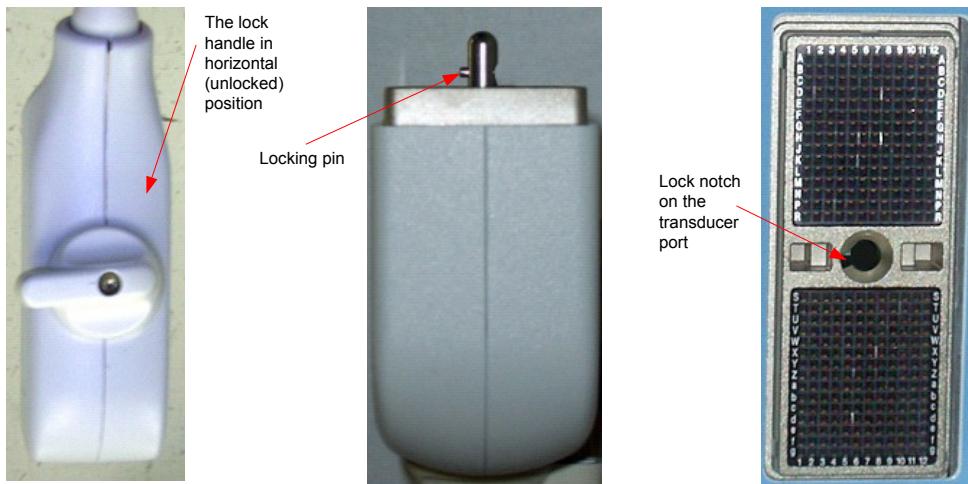
## Connecting and disconnecting transducers



### ► To connect the ultrasound transducer cable 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 ultrasound transducer cable:**

Turn the lock handle to the horizontal (unlocked) position and pull the connector out.

---

## Working with the 3D motor stage

Vevo 2100 Vevo LAZR

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

**CAUTION:** 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 Vevo Imaging System

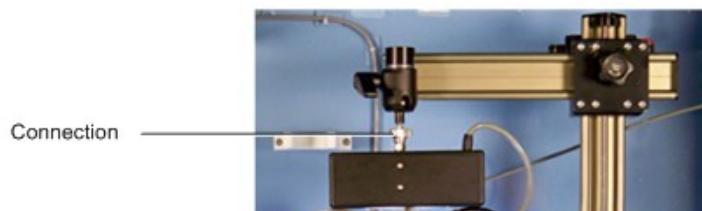


The 3D motor stage features a Quick Release post on the top to connect to the Vevo Imaging Station, and a Quick Release mount on the bottom to affix the transducer.



### ► To connect the 3D motor stage to the Vevo Imaging System:

1. Connect the quick release post to the ball joint on the arm of the Vevo 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 Imaging System.



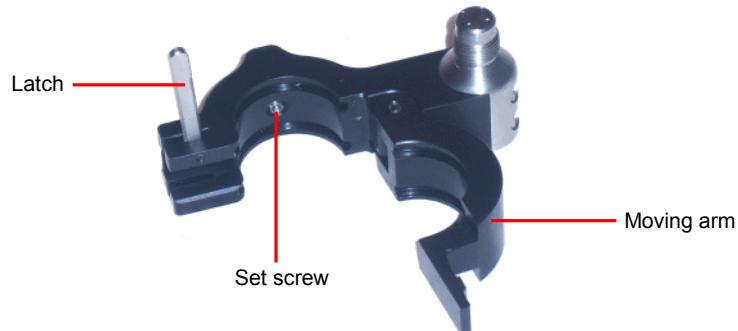
## Connecting a MicroScan transducer to the 3D motor



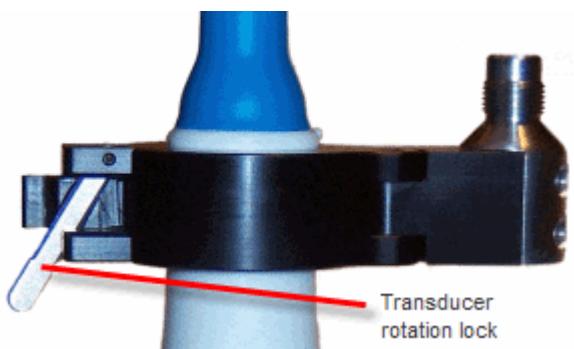
When you use a MicroScan transducer with the Vevo Imaging Station, you must secure the transducer within the transducer clamp.

### ► To connect a MicroScan transducer to the 3D motor:

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.



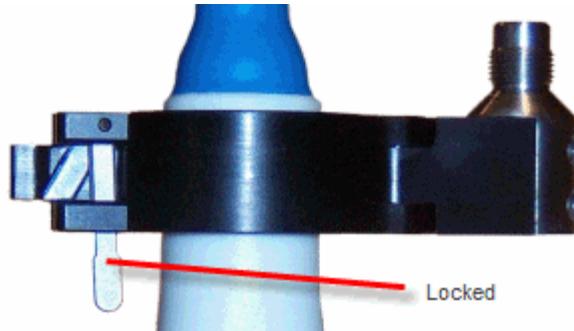
4. Close the moving arm of the clamp and then pull the latch down to the 45° notch. This transducer rotation lock setting holds the transducer but provides enough freedom for your to rotate it.



5. To set the transducer to 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.

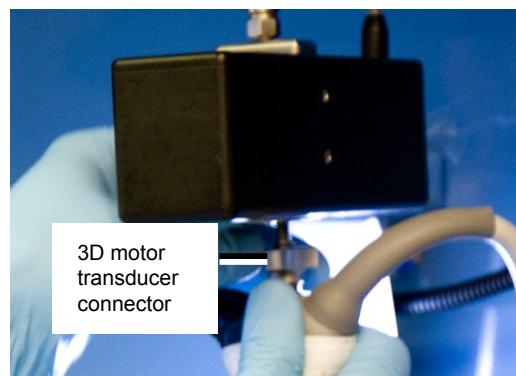


## Connecting an LZ transducer to the 3D motor



### ► To connect an LZ transducer to the 3D motor:

Insert and tighten the 3D motor transducer connector to the opening at the top of the transducer housing.



# 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

Parameters you can save to a preset .....	265
Creating a Mode settings preset .....	266
Applying a preset .....	267
Modifying a Mode settings preset .....	267
Activating a preset group .....	268

---

## Parameters you can save to a preset



The following table lists the acquisition parameters you can save to a preset in each mode.

- **To review the saveable preset parameters without opening the system help:**

1. From the **Study Browser**, click the Preferences icon and then click the **Presets** tab.
2. In the Mode Settings Presets section, in the **Select a Mode** column select the mode you want to work with.
3. The system displays the list of saveable parameters for that mode in the **Preset Settings** section.

**BEST PRACTICE:** Create your B-Mode presets first. B-Mode includes the largest number of settings that can be saved. Many other modes are based on B-Mode, including Color Doppler Mode, Linear Contrast Mode, and Nonlinear Contrast Mode. These include fewer available settings. If your study protocol moves you to any of these B-Mode based modes you will still be able to take advantage of the full range of B-Mode settings that were already set, as long as you do not manually change them.

## Creating a Mode settings preset

 Veo 1100    Veo 2100    Veo LAZR

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

**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.

### ► To create a copy of a preset, with a new name:

1. Begin acquiring image data and press **Presets** toggle to apply the preset you want to copy and then press **Save Preset**.
2. In the **Save Preset Settings** box, type a new name for the copy of the preset.
3. Click **OK**.

**BEST PRACTICE:** Create your B-Mode presets first. B-Mode includes the largest number of settings that can be saved. Many other modes are based on B-Mode, including Color Doppler Mode, Linear Contrast Mode, and Nonlinear Contrast Mode. These include fewer available settings. If your study protocol moves you to any of these B-Mode based modes you will still be able to take advantage of the full range of B-Mode settings that were already set, as long as you do not manually change them.

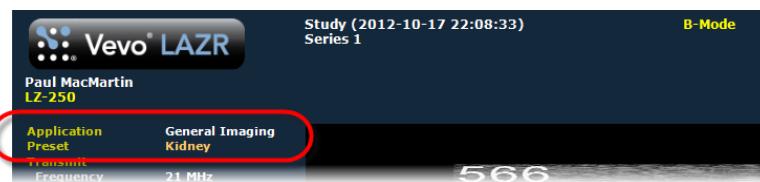
---

## Applying a preset



► **To apply a Mode settings preset:**

1. Begin acquiring data.
2. While the system is acquiring data push the **Presets** toggle up or down to scroll through the list of stored presets for the Mode you are imaging in. The preset name appears in the image management panel (press **Mode Settings** to set the image management panel to display the mode settings).



The system applies the preset to your image data.

► **To reset a preset:**

If you have modified parameters in a mode and you want to return to the original values for that preset, press **Back**.

---

## Modifying a 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.

---

## Activating a preset group

 Vevo 1100    Vevo 2100    Vevo LAZR

You activate a preset group by selecting a preset that has been previously assigned to a group in the **Preset Settings** (page 171) section of the **Presets** tab.

Use the **Presets** toggle to select the grouped preset. Once the active grouped preset for the current mode is selected, the system applies the preset for each mode that belongs to this group if applicable. If a preset is not available for the active group, the system applies the most recently used preset.

► **To apply a preset group:**

1. Begin acquiring data.
2. While the system is acquiring data, push the **Presets** toggle up or down to scroll through the list of stored presets for the Mode you are imaging in.
3. The preset name appears in the image management panel (press **Mode Settings** to set the image management panel to display the mode settings). The system activates the selected preset and preset group, and sets each mode to activate the assigned preset for the active group.

## Chapter 41

# Setting up to acquire physiological data



The Advanced Physiological Monitoring Unit, in conjunction with either the Mouse Handling Table or the Rat Handling Table, tracks the animal's heart rate, temperature, respiration rate and blood pressure (optional with a third-party blood pressure device).

**NOTE:** Vivo Imaging 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 .....	269
Connecting the blood pressure equipment.....	270
Configuring the physiology data display settings.....	271

---

## Physiological data sources



The Vivo 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.

Physiology	Description
ECG	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 Vivo Imaging System.
Respiration	The animal's respiration rate is monitored through the electrode pads on the Advanced Physiological Monitoring Unit and is derived from the ECG signal.
Blood pressure	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 Vivo system and the blood pressure trace viewed on screen within the software.

Physiology	Description
Body temperature	The animal's temperature is monitored through the rectal probe connected to the Advanced Physiological Monitoring Unit.

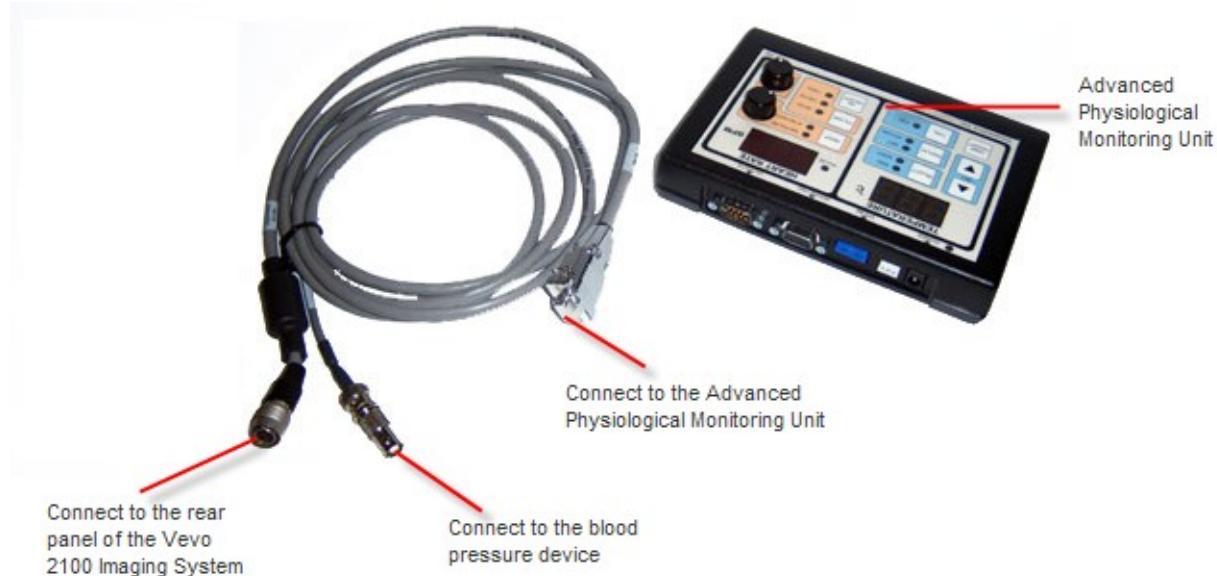
### Related information

- For detailed information on preparing the animal and the animal platform, refer to the printed *Vevo Imaging Station Operator Manual*.
- *Physiological preferences tab* (page 141)
- *Connecting the blood pressure equipment* (page 270)
- *Configuring the physiology data display settings* (page 271)

## Connecting the blood pressure equipment

 Vevo 1100    Vevo 2100    Vevo LAZR

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 Live Display section



Use the **Physiological Live Display** section in the image management 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.  
Press **Physio Settings**. The image management panel displays the physiological display setting sections.
2. In the **Physiological Live Display** section select or clear the required check boxes as described in the following table.

Preference	Check box selected	Check box cleared
View Physiology	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.	Dims all the available physiological controls in the image management panel so you cannot access them.
ECG	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 image management panel.  Displays the ECG Trigger section in the image management panel.	Hides the ECG trace line and data.  Dims the ECG waveform slider control.  Hides the ECG Triggering section.
Respiration	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.	Hides the trace line and data.  Dims the waveform slider control.

Preference	Check box selected	Check box cleared
Invert	Flips the display of the Respiration trace line vertically.	Flips back the display of the Respiration trace line vertically.
BP	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.	Hides the trace line and data.  Dims the waveform slider control.
BP Derivative	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.	Hides the trace line and data.  Dims the waveform slider control.
Temp	Displays the Temp trace line (and numerical data values when you stop imaging) in the physiological trace window.	Hides the trace line and data.

3. 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 Physiological tab of the Preferences window.

### Related information

- *Physiological Enable preferences* (page 141)

## Physiological Alarm Levels 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 Alarm Levels** 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 Live Display** section at the top of the image management 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 Physiological tab in the Preferences window.

### ► To increase or decrease the amplitude of the waveform:

1. Begin acquiring data in an imaging mode.

Press **Physio Settings**. The image management panel displays the physiological display setting sections.

2. 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

- *Physiological Live Display preferences* (page 271)
- *Physiological Enable preferences* (page 141)

## Blood Pressure section



As a best practice, calibrate the Vevo 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.

Preference	Description
Manual Calibration	Select this option if the Vevo Imaging System does not support your blood pressure instrument.
Import Calibration	Select this option if the Vevo Imaging System does support your blood pressure instrument.

## Related information

- *Manually calibrating any blood pressure instrument* (page 275)
- *Auto-calibrating your Vevo-supported blood pressure instrument* (page 274)

## Auto-calibrating your Vevo-supported blood pressure instrument

The Vevo Imaging System includes pre-configured calibration settings for the Millar PCU-2000 Pressure Control and the Data Sciences International R11CPA analog adapter.

### ► 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 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.  
Press **Physio Settings**. The image management panel displays the physiological display setting sections.
3. 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**.
4. 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

Vevo 1100

Vevo 2100

Vevo LAZR

The Vevo 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 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.

Press **Physio Settings**. The image management panel displays the physiological display setting sections.

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

5. Adjust the blood pressure monitoring system to output a known level, and note the numeric value of this level.
6. 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 **At**  **mmHg** box.
  - c. Click **Calibrate**.
7. 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

Vevo 1100 Vevo 2100 Vevo LAZR

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

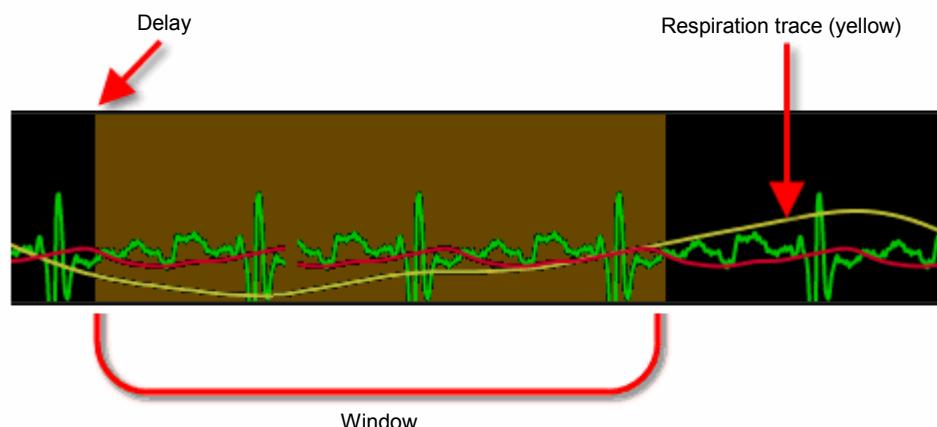
When you are acquiring image data along with physiological data, the physical movement of the subject's chest cavity may move the region of interest you want to study. This can cause artificial variations in measurements you add to saved images.

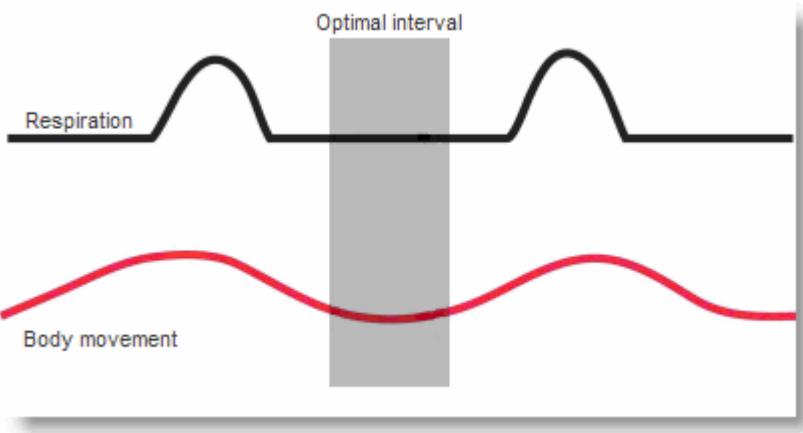
Respiration gating suppresses this effect.

### 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 **Physiological** 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.

Press **Physio Settings**. The image management panel displays the physiological display setting sections.

2. 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.
3. 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.
4. 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 281)
- *Physiological data sources* (page 269)
- *ECG Trigger section* (page 278)

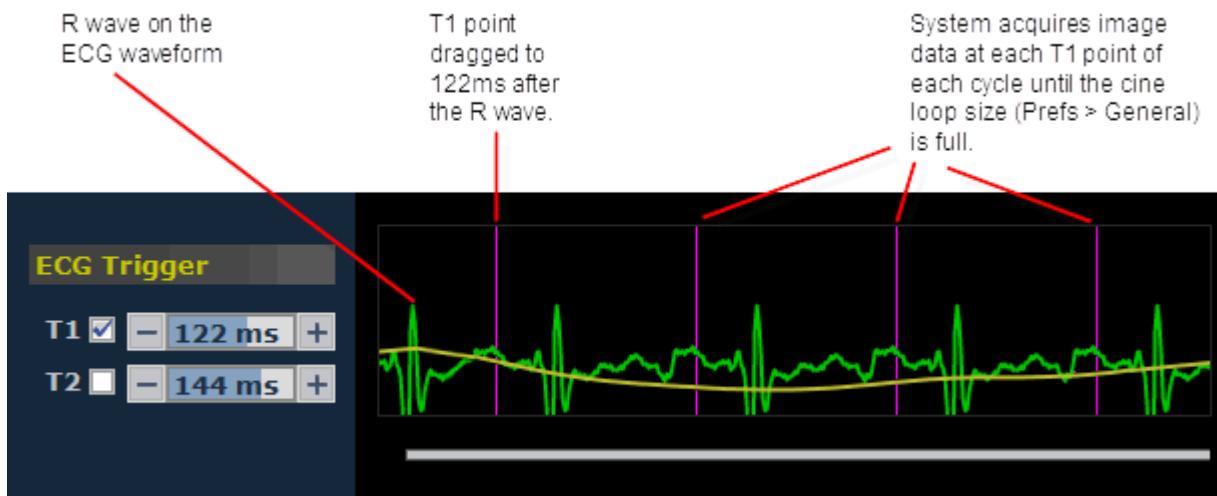
## ECG Trigger section

 Vevo 2100  Vevo LAZR

ECG triggering is a default feature you can use to make and analyze measurements more easily and gain more reliable data. Available only for frame-based imaging modes, the feature effectively suppresses the effect of the physical movement of the heart during the heart cycle.

### 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.



The result of this triggering is a cine loop of a remarkably static heart.

## Before you begin

- Your subject 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.

- When you start acquiring data, if the **T1** and **Cycles** sliders are the only controls available in the **ECG Trigger** section of the **Physio Settings** panel, this means that the **ECG Triggered Sync Play** option for complete cycle data acquisition is selected in the Preferences window.

To return to the default ECG triggering state, click **Prefs** > **Physiological** tab and in the **Physiological Enable** section clear the **ECG Triggered Sync Play** check box, then click **OK**.

### ► To set the ECG triggering:

1. Begin acquiring data.
2. Press **Physio Settings**. The image management 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.

► **To acquire all image data over one or more complete heart cycles:**

1. In **Prefs** > **Physiological** tab, in the **Physiological Enable** section ensure that the **ECG Triggered Sync Play** check box is selected.
2. Begin acquiring data.
3. Press **Physio Settings**. The image management panel displays the physiological display setting sections.
4. In the **ECG Trigger** section drag the **Cycles** slider to select the number of cycles you want to record.

**NOTE:** The system only acquires data up to the limit of the cine loop size that is defined in **Prefs** > **General** tab > **Cine Loop Size**.

5. Drag the **T1** slider to select the point in the heart cycle where you want to start acquiring data.
6. Press **Cine Store** to create your cine loop.

#### Related information

- *Acquiring image data* (page 281)
- *Physiological data sources* (page 269)
- *Respiration Gating section* (page 276)
- *Physiological Enable preferences* (page 141)

# 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**.
2. The system begins acquiring B-Mode 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 example, if you are in B-Mode, to get to M-Mode press **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 282)
- *Analyzing image data* (page 286)

## Related information

- *Connecting the transducer to the Vevo Imaging System* (page 260)
- *Logging on* (page 125)
- *Image acquisition modes* (page 112)
- *Quick start tutorial* (page 72)

# 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).....	282
Extending the cine loop size .....	284
Saving an image frame .....	284

## 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, AM-Mode, PW Doppler Mode and PW Tissue 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

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

#### Next steps

- *Labeling an image* (page 235)
- *Opening an image* (page 235)
- *Adding generic measurements* (page 296)
- *Adding protocol measurements* (page 298)

#### Related information

- *Cine Loop Size preferences* (page 131)
- *Saving an image frame* (page 284)

## Extending the cine loop size



The following procedural tip helps you modify the image acquisition settings so that you can acquire longer possible cine loops.

**IMPORTANT:** The settings in this tip marginally affect image quality. We recommend that you adjust them *only* when you cannot increase the size of the cine loop by adjusting the image width. You can save these settings as part of the custom defined presets.

### ► To modify acquisition settings to extend the cine loop size:

1. Before you begin acquiring image data, in **Prefs** > **General** tab > **Cine Loop Size** section:
  - a. Type the desired number of frames for the Mode. Or select the **Max** check box so the system will automatically calculate the maximum size.
  - b. Select the **Extended Buffer** check box.

**NOTE:** Extended buffer capability is only available for frame-based modes, and only when the General Imaging application is selected.

**NOTE:** During image acquisition, adjusting **Focal Zones**, **Persist**, **Frequency**, **Image Width**, **Depth Offset** controls may affect the cine loop size. Adjust these parameters during acquisition to maximize the cine loop size.

1. During image acquisition, push the **Focal Zones** value to 1 and push **Persist** to *Off*.

### Related information

- *Extended buffer capability* (page 133)
- *Cine Loop Size preferences* (page 131)

## 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**.
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.

## Next steps

- *Labeling an image* (page 235)
- *Opening an image* (page 235)

## Related information

- *Cine Loop Size preferences* (page 131)
- *Saving an image frame* (page 284)

## Section 9

# Analyzing images



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

### In This Section

Vevo® LAB .....	287
Working with cine loops .....	288
Measurement basics.....	293
Working with measurements .....	300
Working with annotations .....	309
Reporting your analysis results.....	319

## Chapter 44

# Vevo® LAB



VisualSonics offers optional Vevo LAB software which includes all the software tools and features that you will find on the Vevo Imaging System, excluding the image acquisition tools features.

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

# Working with cine loops

 **Veo 1100**    **Veo 2100**    **Veo LAZR**

A cine loop is the trailing series of acquired images that the system holds in its memory buffer as you acquire image data.

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

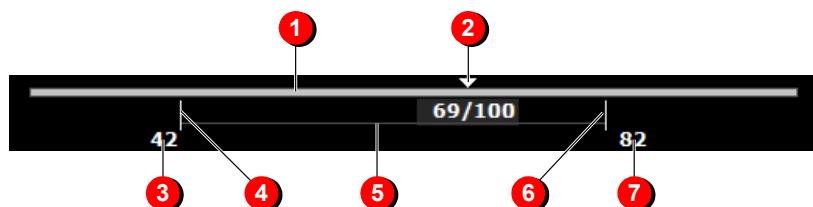
## In this chapter

Cine loop workspace.....	288
Cine loop review controls .....	289
Creating cine loops.....	291
Creating a cine loop subset from a full cine loop .....	291
Viewing saved physiological data .....	291

## Cine loop workspace

 **Veo 1100**    **Veo 2100**    **Veo LAZR**

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



- ① **Cine loop length bar.** Represents the full length of the cine loop.
- 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 display another frame in the cine loop, drag the triangular frame indicator to the desired frame number.

- 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 VIVO Imaging System control panel or the on-screen controls on VIVO LAB on a PC.

## Playing back a cine loop on VIVO Imaging System



When you play back a cine loop on the VIVO Imaging System these are the controls you use.



### ① Cine Loop Review

Controls all cine loop review functions.

#### ► 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

## 2 Trackball

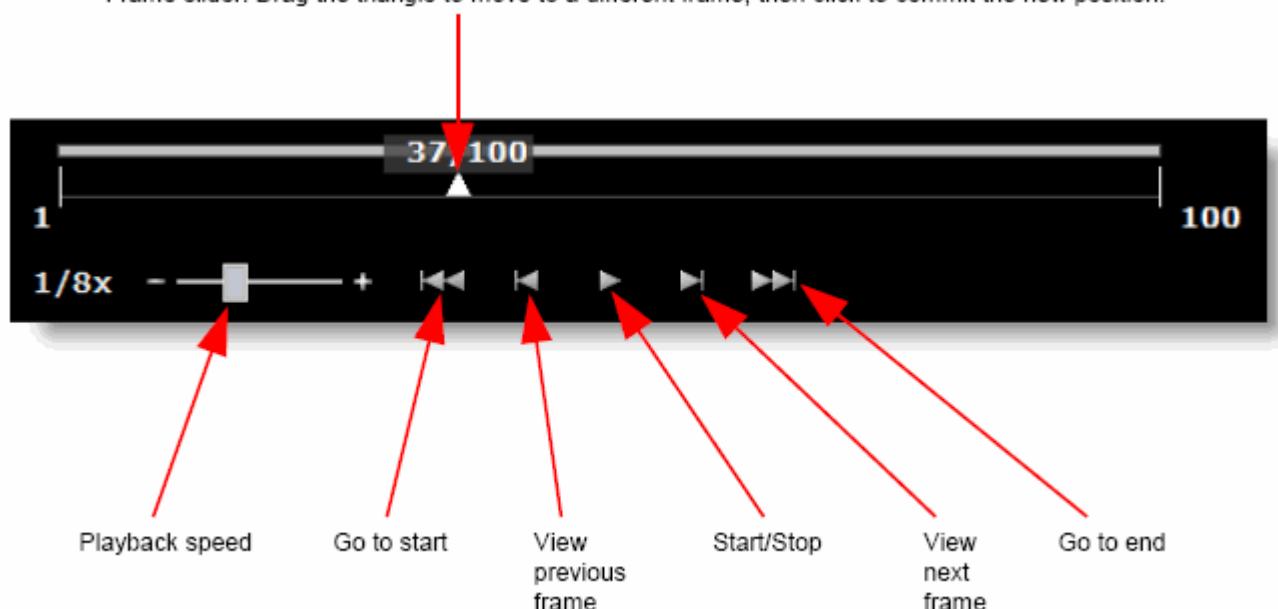
Roll the ball with your hand to:

- Move a pointer or cursor around the screen
  - Move forward or backward in a cine loop
  - Adjust the size and location of a Color, PA or Zoom box

## Playing back a cine loop on Vevo LAB

When you play back a cine loop on Vevo LAB, these are the controls you use.

Frame slider. Drag the triangle to move to a different frame, then click to commit the new position.



---

## Creating cine loops

 Vevo 1100    Vevo 2100    Vevo LAZR

► **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.
- 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.

---

## Creating a cine loop subset from a full cine loop

 Vevo 1100    Vevo 2100    Vevo LAZR

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**. The system sets the playback range in the stored data. The playback range can be changed and then stored again. The original data is unaffected.

---

## Viewing saved physiological data

 Vevo 1100    Vevo 2100    Vevo LAZR

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.



Area	Description
1	Physiological trace graph
2	Status bar data readouts
3	Current frame data values

### Before you begin

Ensure that you select the desired physiological inputs in the **Physiological Enable** section of the Physiological 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.

## In this chapter

Measurement tools panel workspace .....	293
Generic measurements .....	295
Protocol measurements .....	297
Measurement units .....	299

---

## Measurement tools panel workspace



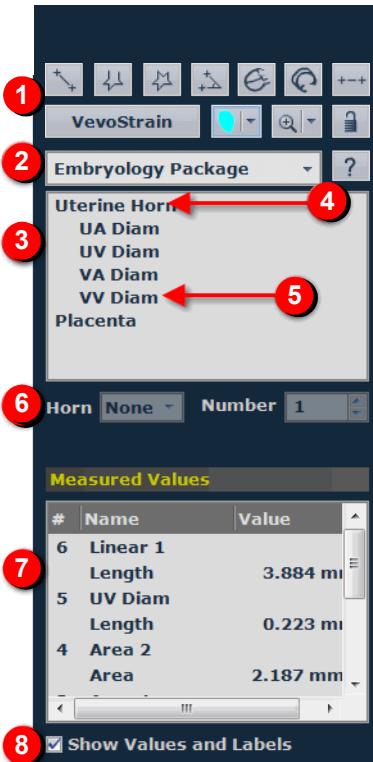
The measurement tools panel is the workspace you use when you add measurements to an acquired image.

► **To view the measurement tools panel:**

1. Open a stored image from the Study Browser or pause an image acquisition.
2. Click . The measurement tools panel appears.

## Measurement tools panel workspace

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



- ① **Generic measurement tools.** Each imaging Mode provides a unique set of tools. Click the tool and then apply the measurement on the ultrasound imaging area.
- ② **Measurement package.** Select the appropriate measurement package from the drop-down box and then expand a protocol to access the measurements you want to apply.
- ③ **Protocols list.** Displays the list of protocols related to the selected measurement package.
- ④ **Protocols list item.** Click the protocol to expand the list and display the list of measurements within that protocol.
- 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**  **Embryo Index.** Displays the index of the embryo specified by **horn: number** field when the **Show Embryo Index** check box is selected in the **Measurement** tab of the **Preferences** window.

**NOTE:** Available only when the Embryology package is selected.

- 7** **Measured 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.

- 8** **Show Values and Labels.**

**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** section in the **Measurement** tab of the **Preferences** window.

**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

#### Related information

- *Working with measurements* (page 300)
- *Creating custom measurement packages* (page 149)
- *Modifying and deleting custom measurement packages* (page 149)

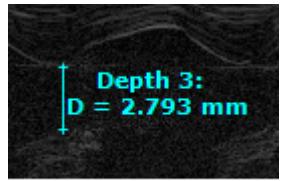
---

## Generic measurements



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

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



Depth generic measurement.

## Complete procedure for adding a generic measurement

Vevo 1100   Vevo 2100   Vevo LAZR

### ► 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 image management 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. If you selected the **Show Values and Labels** option in the measurement panel in the mode window (note that this option is on by default for all factory-set measurements), 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.

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

## Adding sequential same-type generic measurements

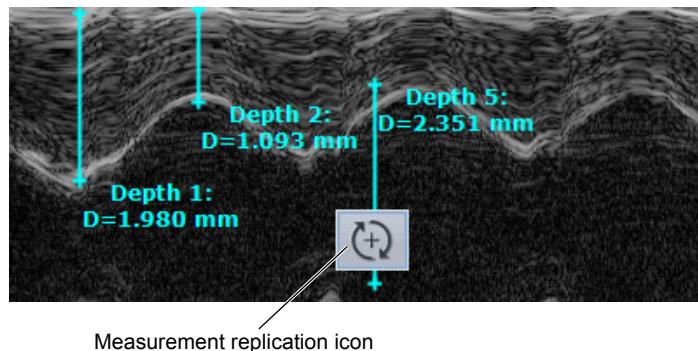
Vevo 1100 Vevo 2100 Vevo LAZR

Sequential same-type measurements is a feature that helps you save a little time when you are adding measurements.

For most generic measurement types, you can select the measurement type, add the measurement and then immediately add another measurement of that same type without selecting the measurement type again from the measurement tool panel.

### ► To add sequential same-type measurements:

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



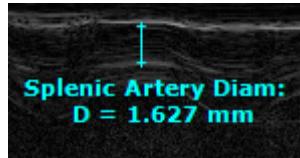
2. Before taking any other action or clicking anything else, click to add your next generic measurement of the same type.
3. Add as many measurements of the same generic measurement type as you want.

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

## Protocol measurements

Vevo 1100 Vevo 2100 Vevo LAZR

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.

**NOTE:** Vevo 1100 supports one measurement package: Cardiac Package.

## Adding protocol measurements

Vevo 1100   Vevo 2100   Vevo LAZR

Protocol measurements are labeled uniquely for a specific measurement protocol.

► **Step 1: 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**.

► **Step 2: Place the 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 measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement.

### Next step

- *Reporting your analysis results* (page 319)

### Related information

- *Analyzing image data* (page 286)
- *Protocol measurements* (page 297)

## Measurement units

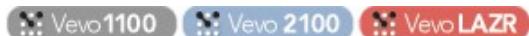


The system includes the following measurement types and units:

Measurement type	Measurement unit
Length / Distance	millimeters (mm)
Area	square millimeters ( $\text{mm}^2$ )
Velocity	millimeters per second (mm/s)
Acceleration	millimeters per second per second ( $\text{mm/s}^2$ )
Time	milliseconds (ms)
Heart rate	beats per minute (BPM)
Respiration	Respiration rate: number of breathing cycles per minute (RR)
Velocity Time Integral (VTI)	millimeters per second integrated over the time interval in seconds (mm)
Volume	millimeters cubed ( $\text{mm}^3$ )
RR Interval	milliseconds (ms)
Pressure gradient	millimeters of Mercury (mmHg)
Temperature	degrees Celsius
Radius	length of radius in millimeters (mm) - available in Ophthalmology Package

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

# Working with measurements



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

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

## In this chapter

Modifying the properties of a measurement .....	300
Coloring a measured area .....	301
Coloring areas in a VTI trace .....	302
Modifying points on a contour measurement .....	303
Modifying contour measurements.....	304
Adding embryo measurements.....	304
Adding measurement chains to B-Mode and M-Mode images .....	305
Copying and pasting measurements .....	306
Zooming into a measurement location.....	307
Locking measurements.....	308
Deleting measurements .....	308

---

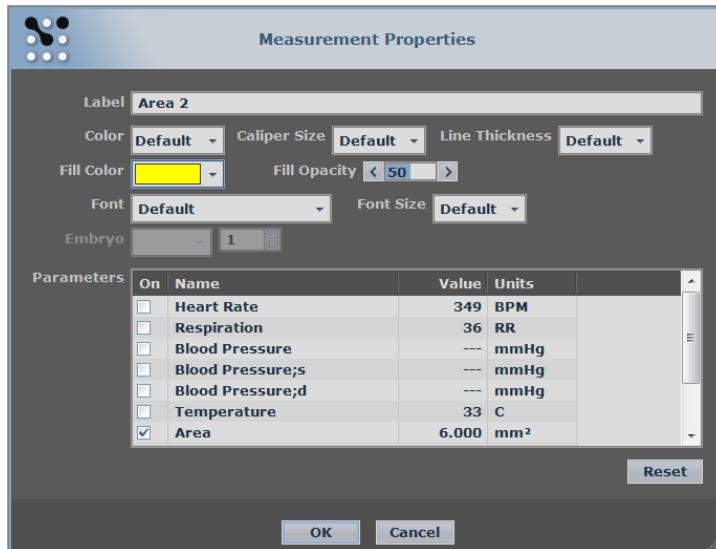
## Modifying the properties of a measurement



The properties of a measurement are initially defined by the settings you configure in the Measurement Display Options preferences (page 155) 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 155)
- *Measurement Parameters preferences* (page 153)

---

## Coloring a measured area

Veo 1100   Veo 2100   Veo LAZR

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

- PA Region
- Contrast Region
- Cardiac Region
- Traced Distance
- 2D Area
- Angle
- LV Area - Long Axis
- LV Area - Short Axis
- VTI

► **To add a color to a measurement:**

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

**Related information:**

- *VevoColor area tool* (page 317)

---

## Coloring areas in a VTI trace



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

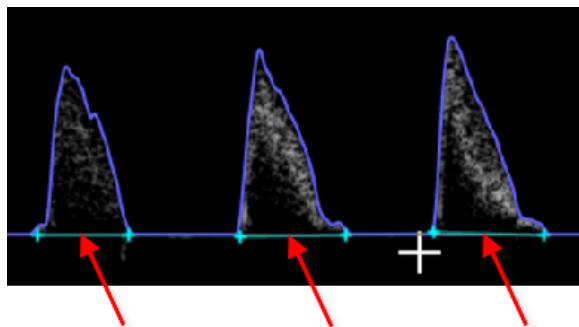
**NOTE:** You can only color areas in a VTI trace if Vevo Color is activated on your system. To determine this, press F1, click About and then in the list of System Features check to see if Vevo Color is activated:

System Features	
AM-Mode	Activated
Vevo® Multiplexer	Activated
VevoStrain™ Analysis	Activated
VevoCQ™ Analysis	Activated
LV Analysis	Activated
BB Thresholding	Activated
<b>Vevo® Color</b>	<b>Activated</b>

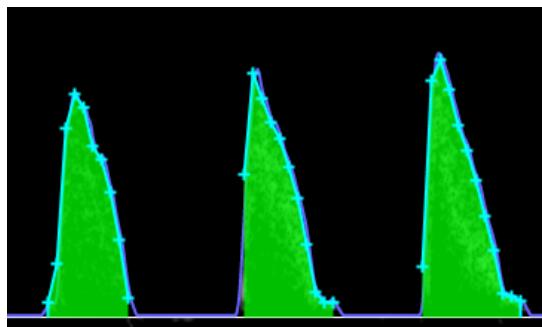
► **To add color to an area in a VTI trace:**

1. Review the cine loop, stop it where it includes the peaks you want to color and then click the **VTI** tool

2. Click at the start and finish of the peaks and right-click to commit.



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



#### Related information

- *VTI measurement with automatic frequency trace* (page 628)
- *VTI measurement without real-time frequency trace enabled* (page 629)

---

## Modifying points on a contour measurement

Vevo 1100   Vevo 2100   Vevo LAZR

► **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

---

## Modifying contour measurements

 Vevo 1100    Vevo 2100    Vevo LAZR

► **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

 Vevo 2100    Vevo LAZR

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: Left:3**.

To disable the suffix, clear the **Show Embryo Index** check box in the Measurement Display Options (page 155) preferences in the Measurement tab of the Preferences window. The change must be saved as a new custom measurement package.

► **To add an embryo measurement:**

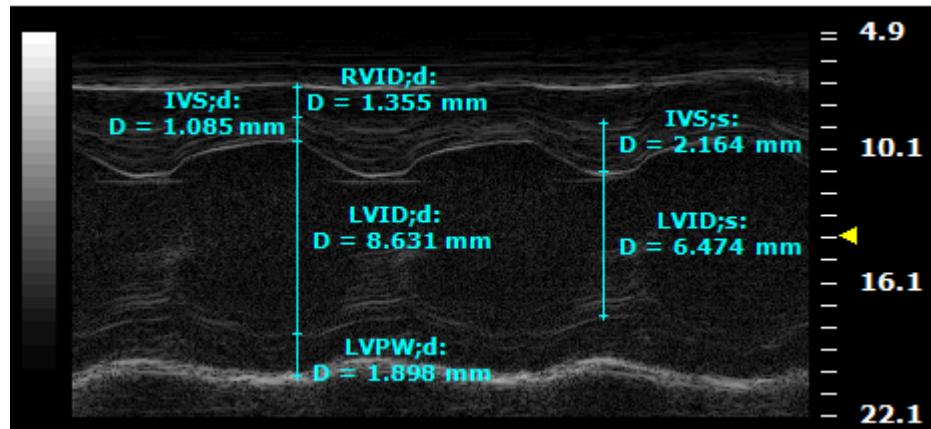
1. Ensure that the Study Information (page 96) window specifies that the animal is pregnant.
2. From the Study Browser, open the image that includes the embryo image data.
3. Click .
4. In the measurement packages list select **Embryology Package**.
5. In the protocols list click **Uterine Horn**.

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.

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

Vevo 1100   Vevo 2100   Vevo LAZR

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



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

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

The labeling for all measurements occur at the same time and only when you add the last caliper of the final measurement in the chain. 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 panel in the mode 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 and pasting measurements



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

► **To copy a Linear or Nonlinear 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.

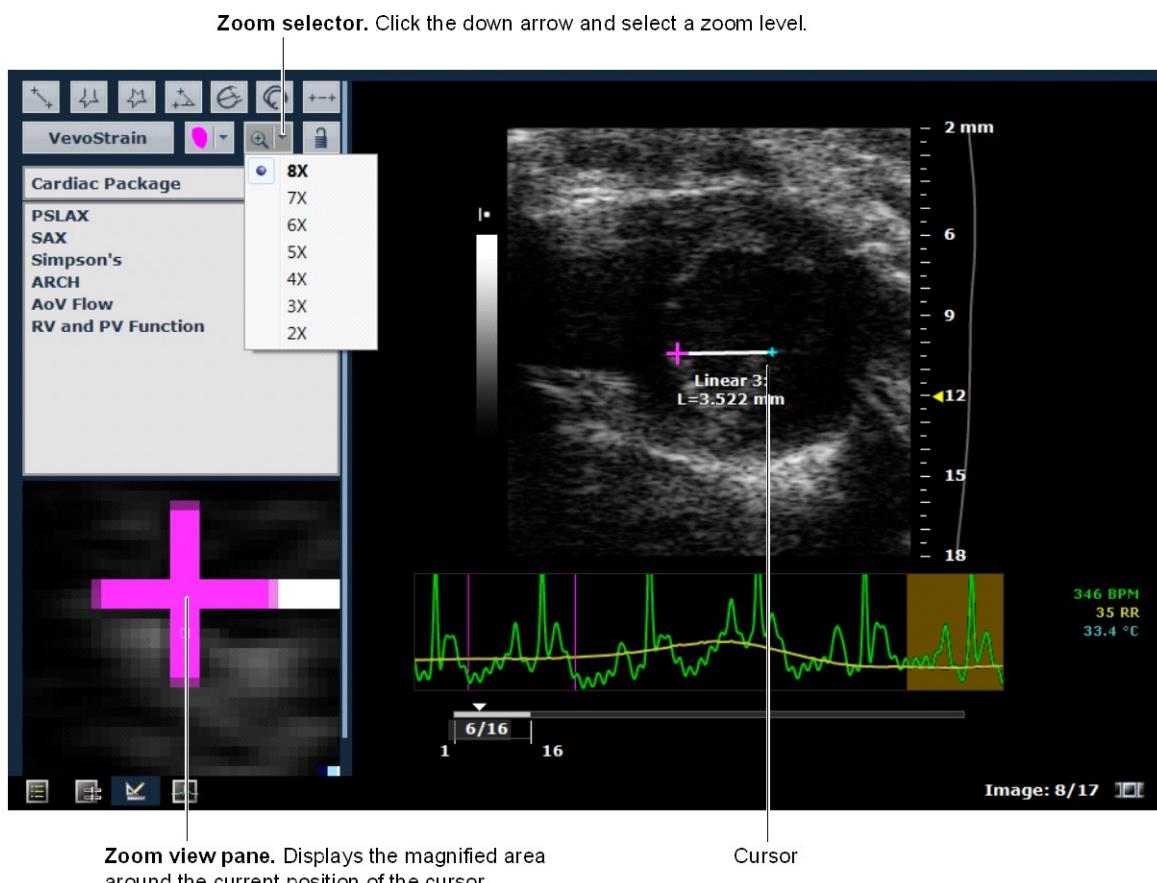
### Related information

- *Copying and pasting linear and nonlinear contrast regions* (page 606)
- *Modifying a contour measurement* (page 304)

## Zooming into a measurement location

Vivo 1100 Vivo 2100 Vivo LAZR

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



### ► To zoom in to a measurement location:

1. Click the down-arrow on the zoom tool and select a zoom level.
2. Click the magnifying glass area on the zoom tool to activate the zoom function. The zoom tool becomes blue and the zoom view pane displays the magnified area around the current position of the cursor.
3. Select the measurement tool you want to use and then use a combination of the zoom view pane and the main image pane to locate and apply the precise points for your measurement.
4. To turn zoom off, click the magnifying glass area on the zoom tool again.

## Related information

- [Zoom \(page 714\)](#)

---

## Locking measurements

 Vevo 1100    Vevo 2100    Vevo LAZR

► **To lock a measurement:**

1. Select the measurement.
2. Click the  measurement lock icon. The system locks all the measurements on the image.

► **To unlock a measurement:**

Select the measurement and then click the lock icon.

---

## Deleting measurements

 Vevo 1100    Vevo 2100    Vevo LAZR

► **To delete a measurement:**

- Right-click a measurement, and select **Delete**.
- Select a measurement in the list of measured values and press **DEL**.

# Working with annotations

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

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

This chapter describes how to work with annotations when you are analyzing an acquired ultrasound image in an image Mode window.

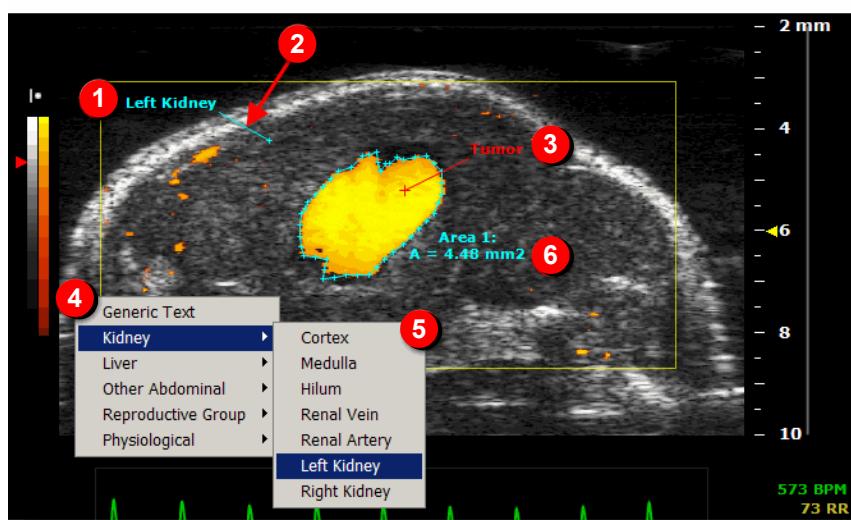
## In this chapter

Annotation workspace .....	309
Predefined annotations.....	311
Adding annotations .....	315
Modifying annotations .....	315
VevoColor area tool .....	317

## Annotation workspace

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



- 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 315).
- 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 315).

## Predefined annotations

 Vevo 1100  Vevo 2100  Vevo LAZR

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 160).

This section lists the available default predefined annotations.

### Abdominal Package annotations

 Vevo 2100  Vevo LAZR

Category	Annotation text
Generic	Annotation text
Kidney	Cortex Medulla Hilum Renal Vein Renal Artery Left Kidney Right Kidney
Liver	Hepatic Artery Hepatic Vein Portal Vein Lobe Right Lobe Left Lobe Liver
Other Abdominal	Adrenal Gland Intestines Bladder
Reproductive Group	Ovary Uterus Uterine Horn Testicle Seminal Vesicle Prostate

Category	Annotation text
Physiological	Inspiration
	Expiration
	Electrical Systole
	Electrical Diastole
	Mechanical Systole
	Mechanical Diastole
	Max dP/dT

## Cardiac Package annotations

 Vevo 1100  Vevo 2100  Vevo LAZR

Category	Annotation text
Generic Text	Annotation text
Cardiology	Left Ventricle
	LV PW
	Right Ventricle
	RV AW
	Left Atrium
	Right Atrium
	Intra-Ventricular Septum
	Infarct
	Respiratory Motion
	Coronary Artery
	Aortic Valve
	Mitral Valve
	Tricuspid Valve
	Pulmonary Artery
	Pulmonary Valve
Physiological	Inspiration
	Expiration
	Electrical Systole
	Electrical Diastole
	Mechanical Systole
	Mechanical Diastole
	Max dP/dT

## Embryology Package annotations

 Vevo 2100  Vevo LAZR

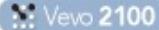
Category	Annotation text
Generic text	Annotation text
Embryology	Placenta Umbilical Cord Embryo Neural Tube Heart Tube Heart Aorta Eye Lens Retina Liver Somite Lungs Lateral Ventricle Third Ventricle Fourth Ventricle
Fetal/Maternal Blood Flow	Umbilical Vein Umbilical Artery Vitelline Artery Vitelline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

 Vevo 2100  Vevo LAZR

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

## Vascular Package annotations

 Vevo 2100  Vevo LAZR

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

---

## Adding annotations

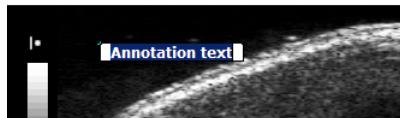
 Vevo 1100    Vevo 2100    Vevo LAZR

You can add custom annotations in addition to predefined 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. (Optional) 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 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.

---

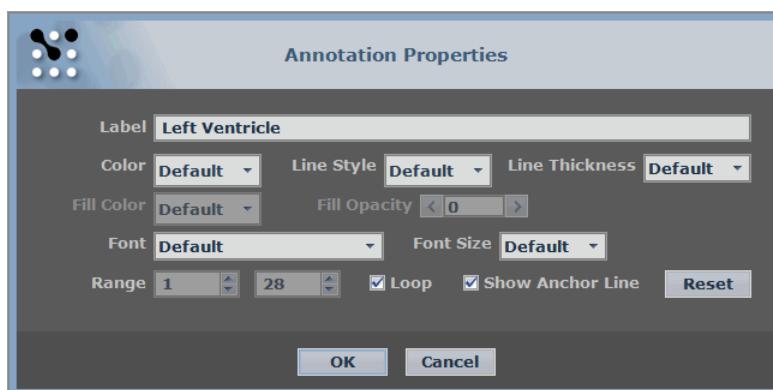
## Modifying annotations

 Vevo 1100    Vevo 2100    Vevo LAZR

► **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:**
- From the **Study Browser**, click the Preferences icon  and then click the **Annotation** tab.
  - In the **Annotation Display** section, select or deselect the **Show Annotations** check box.
- **To modify the properties of an annotation:**
- Right-click the annotation and select **Properties**. The **Annotation Properties** box appears.



- Modify the properties as described in the following table.

Property	Description
Label	Annotation text. Type in new text.
Line Style	Select from a plain line or three arrow-head lines.
Line Thickness	Modifies the thickness of the anchor line. Select from Thin, Medium, Heavy.
Color	In the drop-down box select one of 25 colors.
Font	Select from the available fonts on the system.
Font Size	Select a font size between 8-48 points.
Range	Specifies the range of frames in the cine loop that display the annotation. Only available if you de-select the <b>Loop</b> check box.
Loop	Applies the annotation to the entire cine loop or to a specific frame range in the loop.

Property	Description
Show Anchor Line	Select or de-select the check box to show or hide the anchor line between the annotation text and the initial caliper point.
Reset	Click to return all properties to the default values.

3. Click **OK**.

► **To modify the list of predefined annotations:**

1. From the **Study Browser**, click the Preferences icon  and then click the **Annotation** tab.
2. Add, reorder or delete package categories and category annotations as detailed in *Setting the Annotation tab preferences* (page 160).

## VevoColor area tool



VevoColor is a tool you can use to:

- Add color to any area of interest on an image frame
- Add color to any area on any frame in a cine loop so you can track how the area morphs over the period between the frames on the cine loop

The tool does not provide area measurements.

► **To add a VevoColor area to an image:**

1. Click the VevoColor tool . To change the area color, click the drop-down and select the color you want to apply.
2. Click on your image to place the initial caliper along the boundary of the region you want to define.
3. Click approximately one-third the way around the boundary of the region and then click across to another point on the boundary. You have now created a defined region. Typically you will continue to click to add a few more points to define the boundary of your region more precisely.
4. To complete the region, right-click your final point. The system applies the color area to all frames in the cine loop.
5. (Optional) To move the entire area, place the cursor near the center of the area until the cursor changes to a cross and then drag the area.

- 
- 
- 
- 
- 
6. (Optional) To add a label or modify the area properties, right-click the area, select **Properties** and complete your changes.

► **To morph a VevoColor area over a range of frames:**

1. Move the cine loop to a frame where you can start a range of frames and then add your first VevoColor area.
2. Move the cine loop to an end frame for the range.
3. Move the area or change the boundary points to define the changed area.
4. To view the area morphing, drag the cine loop between the two points.
5. Repeat the area redefinition procedures on any frame in the cine loop. The system will apply the morphing between each of the frames where you have defined the area properties.

# 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

Creating an analysis report.....	319
Reviewing the image that contains a report measurement .....	321
Exporting an analysis report.....	321

---

## Creating an analysis report



An analysis report is the collection of measurements, calculations and graphs 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.

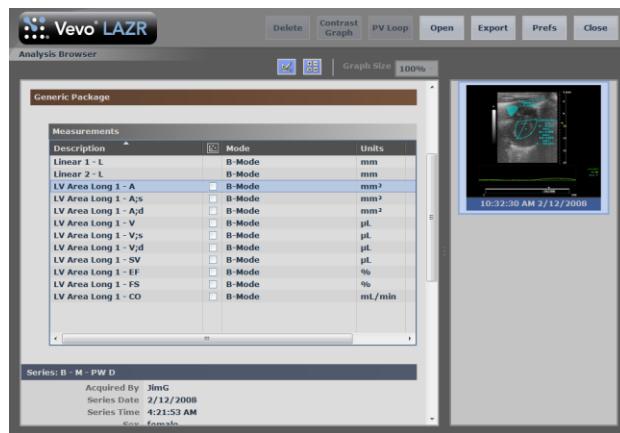
### Analysis report guidelines

- 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.

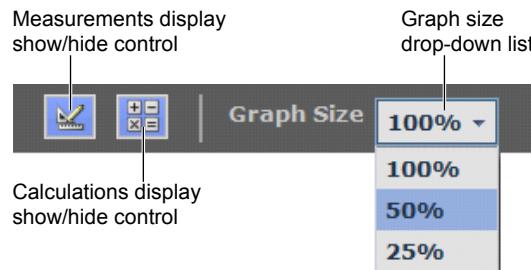
### ► To report your analysis results:

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:
  - To select one item, click it
  - To select a collection of individual items, press and hold **CTRL** and then click to select each item
  - To select a consecutive group of items, click to select the first item, press and hold **SHIFT** and then click to select the last item in the range
3. Click **Report**. The system compiles your selections into a single report and displays the report in the Analysis Browser.



4. (Optional) Use the measurement or calculation display controls to modify your view of the report contents.



- **Measurements/Calculations display controls.** Click either or both controls to show or hide the data. Blue icon = report *shows* the data. Gray icon = report *hides* the data.

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

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

---

## Reviewing the image that contains a report measurement

 Vevo 1100  Vevo 2100  Vevo LAZR

► **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 contain 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 analysis report

 Vevo 1100  Vevo 2100  Vevo LAZR

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 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
  - To select one item, click it
  - To select a collection of individual items, press and hold **CTRL** and then click to select each item
  - To select a consecutive group of items, click to select the first item, press and hold **SHIFT** and then click to select the last item in the range
3. Press **Export**. The **Export Report** window appears.
4. Browse to, and then select, the folder that will contain the export.
5. (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
6. In the **Options** section, rename the report (optional) and select whether or not to include measurements and/or calculations.
7. Click **OK**.

► **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 **Report**. The **Analysis Browser** appears and displays a preview of the report.
3. Press **Export**. The **Export Report** window appears.
4. Browse to, and then select, the folder that will contain the export.
5. (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
6. In the **Options** section, name your report (optional) and select whether or not to include measurements and/or calculations.

7. Click **OK**.
- **To export your analysis report from the Mode window on the ultrasound cart:**
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. Browse to, and then select, the folder that will contain the export.
  5. (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
  6. In the **Options** section, name your report (optional) and select whether or not to include measurements and/or calculations.
  7. Click **OK**. The system exports the analysis report for the series that contains the image.

#### Related information

- *Analysis Browser window workspace* (page 100)
- *Export and Copy To windows workspaces* (page 103)

## Section 10

# 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.

You also:

- Use B-Mode in other imaging modes as the background orientation image over which the active mode data is applied.
- Use B-Mode as a real-time orientation window in other imaging mode windows so you can visually guide the transducer to the right location to acquire the most useful data in your active imaging mode.

### In This Section

B-Mode acquisition .....	325
B-Mode analysis .....	341

## Chapter 50

# B-Mode acquisition

 Vevo 1100    Vevo 2100    Vevo LAZR

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.

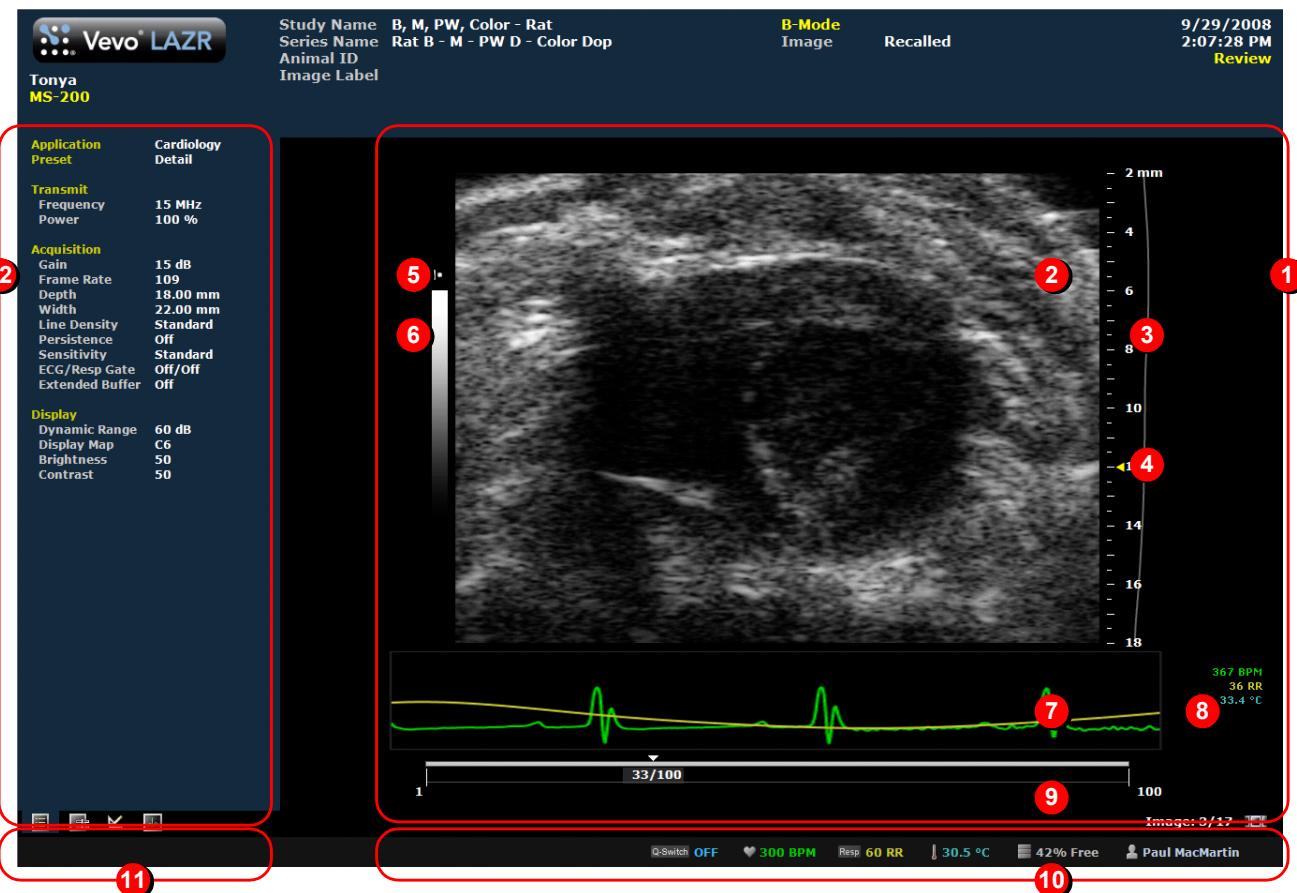
### In this chapter

B-Mode window workspace .....	326
Control panel controls for B-Mode .....	329
B-Mode settings .....	334
Typical B-Mode image acquisition session .....	335
Optimizing your B-Mode for imaging tissue detail .....	337
Adding focal zones .....	338
Visualizing injections with a needle guide overlay .....	338

## B-Mode window workspace

Vivo 1100 Vivo 2100 Vivo LAZR

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.



### ① Image area

This large area:

- Displays image data
- Displays physiological data for the animal (if recorded during image acquisition)
- Provides cine loop range controls for acquired cine loops
- Provides a Browse Images tool for scrolling through an inset gallery of images without having to return to the Study Browser

If you export an image and select Image as your export type, the system includes the image area content along with header information.

## ② Image data panel

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

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.

## ③ Image scale

Indicates in *mm* the distance from the face of the transducer.

## ④ Focal depth indicator

When you acquire data, use the **Focal Zones** control on the control panel to add up to three focal zones (note that only one focal zone is available on the Vevo 1100).

## ⑤ Transducer orientation indicator

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 for your preference, you can click the indicator to flip the image horizontally.

## ⑥ Dynamic range bar

Indicates the dynamic range of the display. When you acquire data, use the **Dynamic Range** control on the control panel to change the range.

## ⑦ Physiological data trace panel

Displays the 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 measurements in this window.

## **8** Live physiological data values

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

## **9** 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. To only display the image frames in that range, drag the left and right vertical markers. For more information, see *Working with cine loops* (page 288).

## **10** Status bar

Displays:

-  3D motor position, when the 3D motor is initialized (where 3D-Mode is supported)
- Monitored physiological values in real time during image acquisition

**PREREQUISITES:** Live physiological data is only available a) when you enable the inputs in the *Physiological* tab of the Preferences window; and b) when the animal is connected to the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station.

For more detailed information on physiological monitoring, see *Vevo Imaging Station description* (page 69), *Physiological preferences tab* (page 141) and *Setting up to acquire physiological data* (page 269).

- Percentage of **free space** to store image data so you can see when you should start to back up your image data to free up space on the system
-  User name, in blue, when **User Management Mode** is enabled (where User Management Mode is supported)
-  Elapsed session time when you hover over the displayed blue user name when User Management Mode is enabled.

## **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.
- Confirmation messages when you store an image.

- The updated parameter and system information when you make adjustments on the control panel.
- Control options in the acquisition mode you are using. To select, either a) cursor to the option and then click; or b) turn the **Screen Keys** dial to display the option, then press the dial.

## **⑫ Image mode management panel**

Displays a unique set of controls and information sections depending on the control key you press, or the image management panel tab you click:

- 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 (where ECG Trigger is supported).
- Press **Image Process** to set the panel to display the controls for brightness, contrast, baseline, priority, display maps, display layouts, loading into 3D and TGC loading and saving.
- Press **Mode Settings** to set the panel to display the Mode settings. This is the default panel when you open a Mode window.

## 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 through a predefined set of overlays and optimization maps that you can apply either while you acquire or review image data. Push up or pull down to cycle through the available maps for the active imaging mode.

To set the base color for the display maps in all acquisition modes that feature display maps:

1. In B-Mode, in the image management panel tabs, click the **Image Processing** tab .
2. In the **Display Setting** section, select the appropriate color.

### **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 Image Process**

When in a mode window, activates the image processing panel, which provides additional post-processing options.

### **⑤ 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.

### **⑥ Back**

- Removes or cancels the last measurement point before you commit your measurement.
- Resets the parameters to the pre-defined values in the current preset.

### **⑦ 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.

**8 Presets**

Active during image acquisition in every Mode other than 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 users added to the system.

All presets are both mode dependent, transducer dependent and application dependent.

**9 Transmit Power**

Adjusts the power of the ultrasound signal transmission.

Turn the dial 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%.

**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.

**11  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.

#### 12 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.

#### 13 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.
- Pull down to decrease the range by 5dB and increase contrast.

#### 14 B-Mode

Activates B-Mode acquisition and begins displaying the acquired B-Mode data in the B-Mode window.

#### 15 2D Gain

Adjusts the visual intensity of the signal when it returns to the face of the transducer. Turn clockwise to add gain and brighten the mode data, turn counterclockwise to reduce gain and darken the mode data.

#### 16 Sensitivity

Adjusts the level of detail at deeper distances from the transducer head. The higher you set the sensitivity level, the lower the system sets the frame rate. Push up to increase sensitivity to *High*. Pull down to decrease sensitivity to *Standard* level.

## B-Mode settings

 Vevo 1100    Vevo 2100    Vevo LAZR

### ► To view the B-Mode settings:

Press **Mode Settings**. The settings panel displays the following parameters:

#### Transmit

Parameter	Description
Frequency	The ultrasound frequency, measured in <i>MHz</i> . Adjust with the <b>Frequency</b> control.
Power	The transmission power level of the ultrasound signal, displayed as a percentage of the maximum power. Adjust with the <b>Transmit Power</b> control.

#### Acquisition

Parameter	Description
Gain	The strength of the ultrasound signal in <i>dB</i> increments when it returns to the face of the transducer. Adjust with the <b>2D Gain</b> control.
Frame Rate	The number of image frames per second that the system is acquiring. Adjust with the <b>Frame Rate</b> dial.
Extended Buffer	 The state (On or Off) of the option to increase the size of the cine buffer or cine loop. Specify this option in the General tab in the Preferences window.
Depth	The distance, measured in <i>mm</i> , from the face of the transducer. Adjust with the <b>Image Depth</b> control.
Width	The width of the acquired image area, measured in <i>mm</i> . Adjust with the <b>Image Width</b> control.
Line Density	 The line density level. One of four settings: Quarter, Third, Half, Full. Adjust with the <b>Line Density</b> control.
Persistence	The state of the Persistence feature: Off, Low, Med, High, Max. Adjust with the <b>Persist</b> control.
Sensitivity	 The level of detail at deeper distances from the transducer head. Adjust with <b>Sensitivity</b> . The higher you set the sensitivity level, the lower the system sets the frame rate. Push up to increase sensitivity to High level. Pull down to decrease sensitivity to Standard level.
ECG/Resp Gate	The state of the ECG trigger and respiration gating, respectively. Values: Off, On. For example, if both are on, the parameter displays On/On. To adjust, press <b>Physio Settings</b> and then select or clear the appropriate check boxes.
<b>NOTE:</b> On Vevo 1100, only the Resp Gate feature is available.	
TGC	The saved TGC control curve that has been manually loaded for the current image acquisition. Adjust in the <b>Image Process</b> panel. Click <b>Load</b> to apply a different TGC control curve.

## Display

Parameter	Description
Dynamic Range	The contrast of your image, measured in dB. Adjust with the <b>Dynamic Range</b> control.
Display Map	The selected predefined display map from the predefined set of maps. Adjust with the <b>Display Map</b> control.
Brightness	The image brightness level. Adjust with the <b>Brightness</b> slider in the image management panel after you press <b>Image Process</b> .
Contrast	The image contrast level. Adjust with the <b>Contrast</b> slider in the image management panel after you press <b>Image Process</b> .

## Typical B-Mode image acquisition session

 Vevo 1100  Vevo 2100  Vevo LAZR

### Before you begin acquiring data

If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 269).
- Prepare your animal on the animal platform. For detailed information refer to the user manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 273).

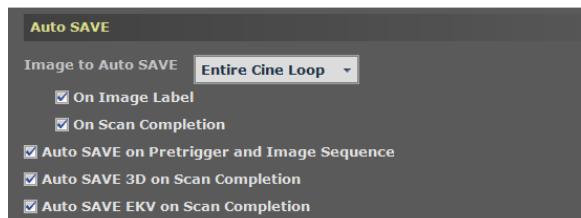
### ► To acquire a B-Mode image:

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 the 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.
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 329) to refine the image acquisition settings if required.
7. Press **Scan/Freeze** 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 a cine loop or image frame and also add a label, press **Image Label**.

**NOTE:** To set or remove auto-save default preference, select your option in the Auto SAVE section (**Preferences** window > **General** tab > **Auto SAVE** section).



- To save the displayed image frame press **Frame Store**.
10. Press **Scan/Freeze** to resume scanning.
  11. Save images as required.
  12. In the function keys row, press **Close**. The system closes the series you are working on and displays the **Study Information** window.
- 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 341)
- *Adding protocol measurements* (page 298)

## Optimizing your B-Mode for imaging tissue detail

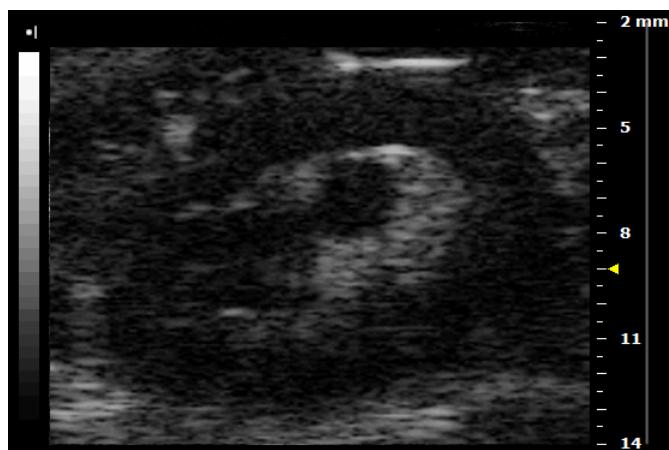
Vevo 1100 Vevo 2100 Vevo LAZR

When your study focuses on identifying specific tissue details in applications such as liver or spleen, you need to maximize the resolution of your image.

You can turn the **Frame Rate** dial to the maximum. But you can still increase the frame rate further by using B-Mode controls to crop your image.



Aortic arch. All



► **To increase the frame rate beyond the highest Frame Rate dial setting:**

- Pull back the **Image Width** rocker switch to crop the width of your image as much as reasonably possible around the target tissue.
- Pull back the **Image Depth** rocker switch to crop the height of your image as much as reasonably possible.

When your study focuses on the dynamics of tissue movement in applications such as cardiology, you need to maximize the imaging frame rate.

---

## 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:

1. Begin acquiring image data in B-Mode.
2. With the injection target below focus or out of the plane, using the *Veo 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** option that is displayed at the bottom left corner of the window.

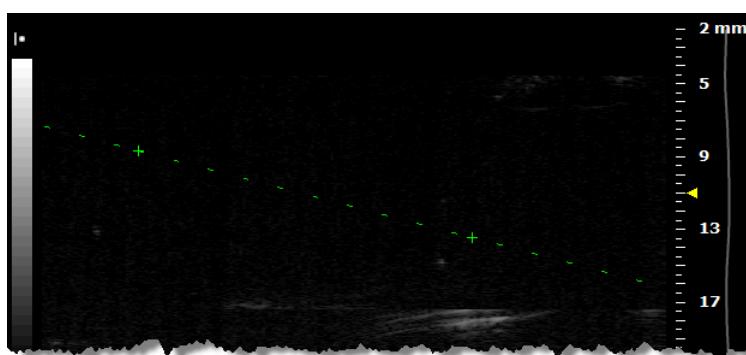


4. Turn **Screen Keys** to activate the **Needle Guide Overlay** feature.
5. Turn **Screen Keys** again to display the caliper cursor.
6. Position the caliper cursor on the tip of the needle (where it appears on the screen), then click to apply the first caliper.
7. Trackball to the location where the 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 *Veo 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 *Veo Imaging Station*.

#### Related information

- *Cine Loop Size preferences* (page 131)
- *Typical B-Mode image acquisition* (page 335)
- *Saving a cine loop* (page 282)

# B-Mode analysis

 Vevo 1100    Vevo 2100    Vevo LAZR

This chapter shows you how to analyze B-Mode images that are saved to a study.

## In this chapter

Adding generic B-Mode measurements.....	341
Adding protocol measurements.....	342
Creating pressure-volume loop measurements in B-Mode.....	344
VevoStrain™: Strain rate step 1: Adding the LV wall trace.....	347
VevoStrain™: Strain rate step 2: Analyzing the data .....	350

## Adding generic B-Mode measurements

 Vevo 1100    Vevo 2100    Vevo LAZR

B-Mode provides seven generic measurement tools. Use these tools when you want to add measurements that are not part of a measurement protocol.

### Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want the default to be to hide them, go to **Prefs > Measurements** tab, clear the **Show Values and Labels** check box and save your edits in a custom measurement package.
- If you want to temporarily override the default, clear or select the **Show Values and Labels** check box at the bottom of the measurement panel.



### ► 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 image management panel. Hover over a tool to see the description label.

### Generic B-Mode measurements

All generic measurements are described in the *Generic measurements* (page 597) appendix. The following generic measurements are available for B-Mode images:

- Time Interval for B-Mode images (page 623)
- Linear distance (page 614)
- Traced distance (page 625)
- 2D area (page 597)
  - Mean and standard deviations (page 598)
- Angle (page 600)
- LV Area long axis (page 615)
  - Modifying points on an LV area trace (page 617)
  - Modifying the LV area trace (page 617)
- LV Area short axis (page 618)
- VevoColor area (page 317)
  - Coloring a measured area (page 627)

## Adding protocol measurements



Protocol measurements are labeled uniquely for a specific measurement protocol.

► **Step 1: 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**.

► **Step 2: Place the 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 measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement.

#### Next step

- *Reporting your analysis results* (page 319)

#### Related information

- *Analyzing image data* (page 286)
- *Protocol measurements* (page 297)

## Lens radius measurement



The lens radius measurement is only available in the Ophthalmology measurement package for B-Mode images. Lens radius is measured in *mm*.

### ► To place a lens radius measurement:

1. Open an existing eye image or begin acquiring an eye ultrasound image and then press **Scan/Freeze**.
2. Press **Measure**.
3. In the drop-down list of measurement packages select **Ophthalmology**.
4. In the list of measurements click **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 an entire measurement, click on the measurement line, then drag and drop.

## Creating pressure-volume loop measurements in B-Mode

Vevo 1100 Vevo 2100 Vevo LAZR

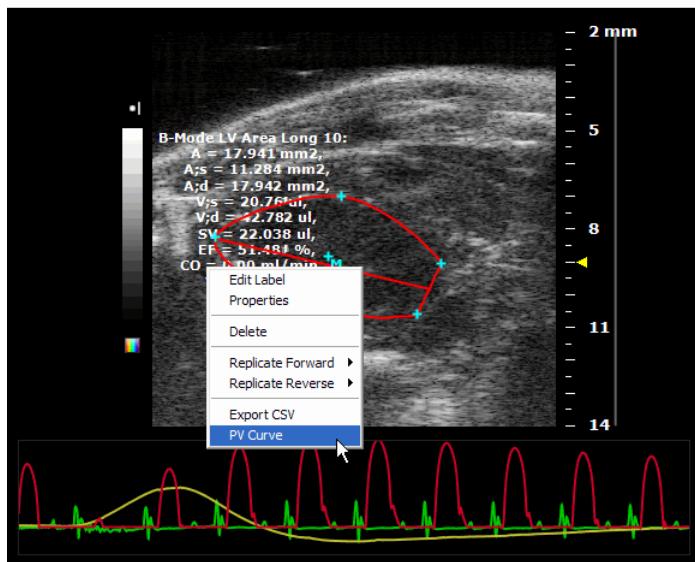
Pressure-volume (PV) loop measurements provide a graphical method of identifying and evaluating LV pressure-volume relationship changes related to dynamic levels of cardiac stress.

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.

Within a study, you can also display PV loops from different cine loops from different series.

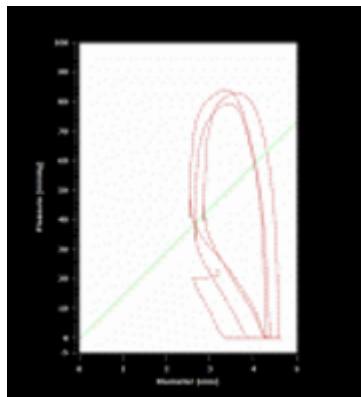
### ► To obtain PV loops from a B-Mode image:

1. Create a B-Mode cine loop of the heart in a long-axis orientation.
2. Complete a B-Mode LV Area measurement (page 615) 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.

- 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

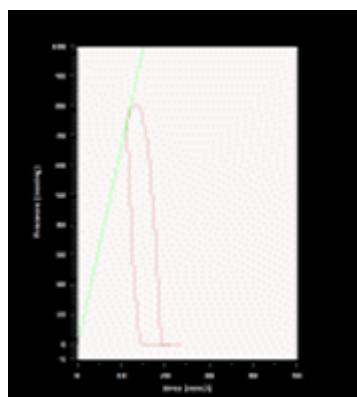
Vevo 1100   Vevo 2100   Vevo LAZR

When you have generated pressure-volume graph data, you can use the tools on the Pressure Volume Relationship window to:

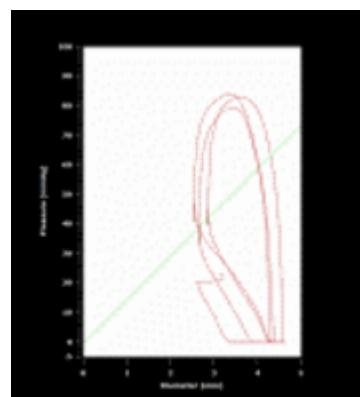
- Display the end systolic PV points
- Display the end diastolic points
- Display a loop that represents a virtual or averaged cardiac cycle
- Toggle the horizontal dimension between Volume and the basic dimension of the loops
- Export the pressure-volume relationship data

### ESPR check box

Check this box to display the end systolic PV points.



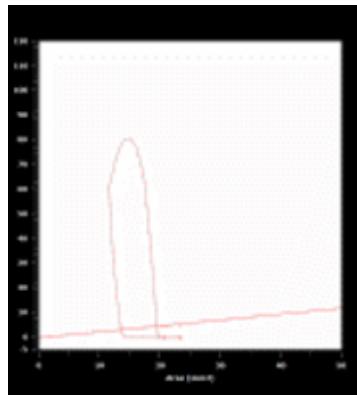
If the graph displays one measurement over one cycle, the system plots a green dot on the curve at the End Systolic point.



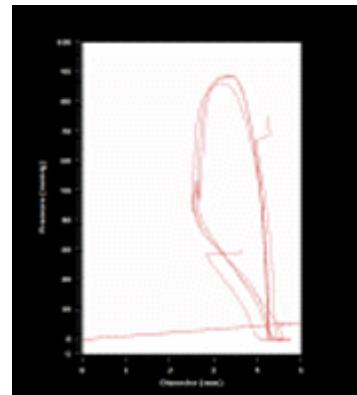
If the graph displays one measurement over multiple cycles, the system plots a best-fit line through the End Systolic points.

### **EDPVR check box**

Check this box to display the end diastolic points.



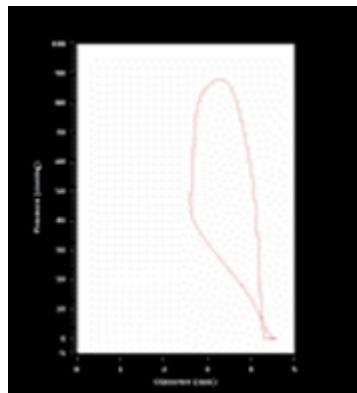
*If the graph displays one measurement over one cycle, the system plots a red dot on the curve at the End Diastolic point.*



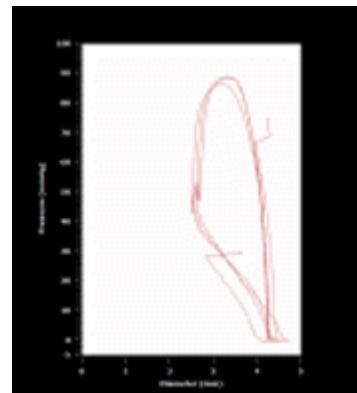
*If the graph displays one measurement over multiple cycles, the system plots a best-fit line through the End Diastolic points.*

### **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 derived from the data from all measurements over all cardiac cycles.*



*When the Average option is cleared, the graph displays the loops derived from each measurement over all the cardiac cycles.*

### **Volume command**

Click this command to toggle the horizontal dimension between Volume and the basic dimension of the loops. For measurements made in M-Mode the dimension is Diameter in millimeters. For measurements made in B-Mode, the dimension is Area in square millimeters.

## Export command

Click this command to export the data 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.

---

## VeoStrain™: Strain rate step 1: Adding the LV wall trace

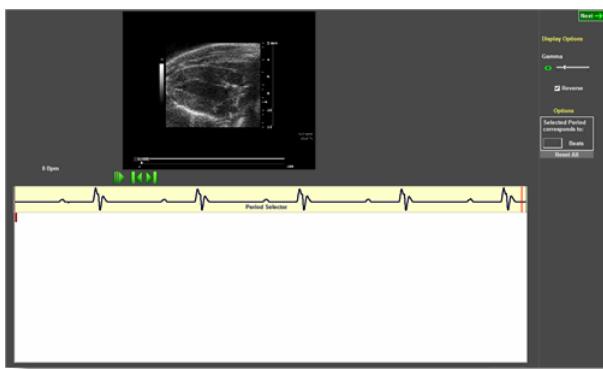


You measure strain rate using the system's optional VeoStrain™ Analysis application. Included within the Veo Imaging System, this tool produces velocity strain and time-to-peak analyses on myocardial wall images.

### ► To create the LV wall trace:

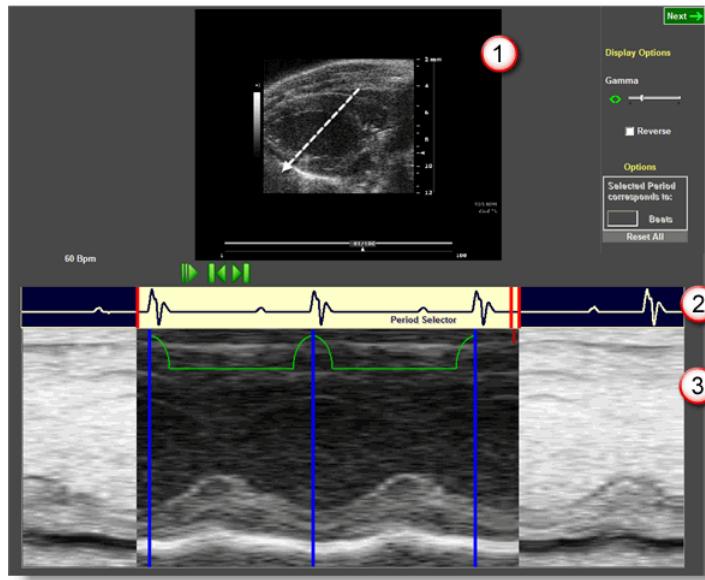
1. From the **Study Browser**, select the B-Mode cine loop you want to analyze and then click **VeoStrain**.

The system processes the cine loop and then displays the cine loop in the VeoStrain Analysis 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.

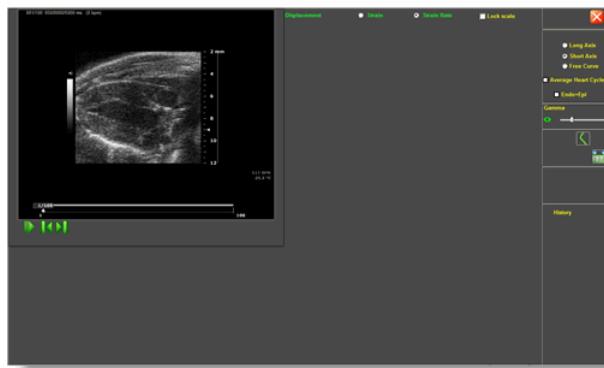


- c. Select the Reverse check box if you want to switch the grayscale contrast values for the background you will work with in the VveoStrain Analysis window.
3. In the EKG panel (area ②):
  - a. On the left side drag the single red slider to the position where you want the data period to begin.
  - 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.
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.

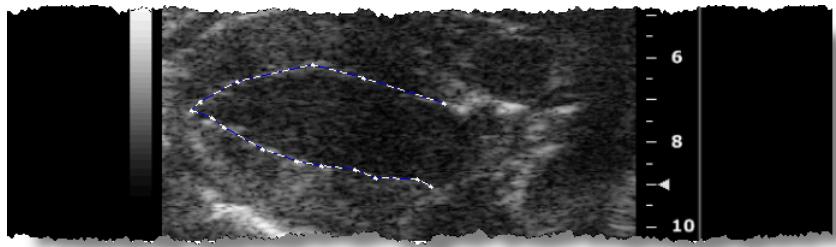
For the best results, create your selection period between one respiration cycle and the next.

  - 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.



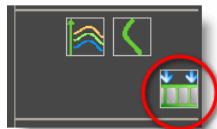
6. At the top of the screen, select the appropriate strain measurement.
7. In the right panel:
  - a. Select the type of trace you will create (Short Axis, Long Axis, Free Curve).
  - b. Select whether you want the system to calculate the average heart cycle.
  - c. Select if you want the system to simultaneously 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.



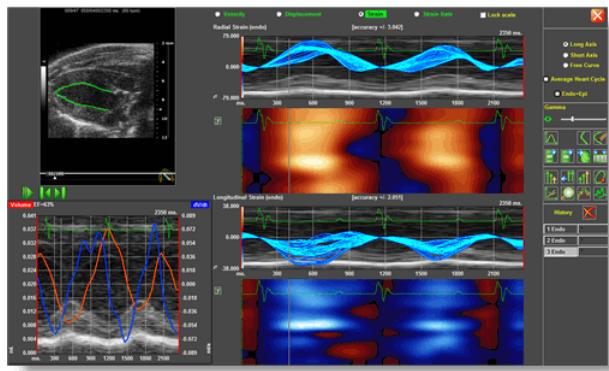
If you want to return to the AM-Mode view to select a new cardiac period, click the Sequence button below, create the new period and then click **Next** again.



9. Click the Start Analysis button.



10. VevoStrain Analysis 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 350)

---

## VevoStrain™: Strain rate step 2: Analyzing the data

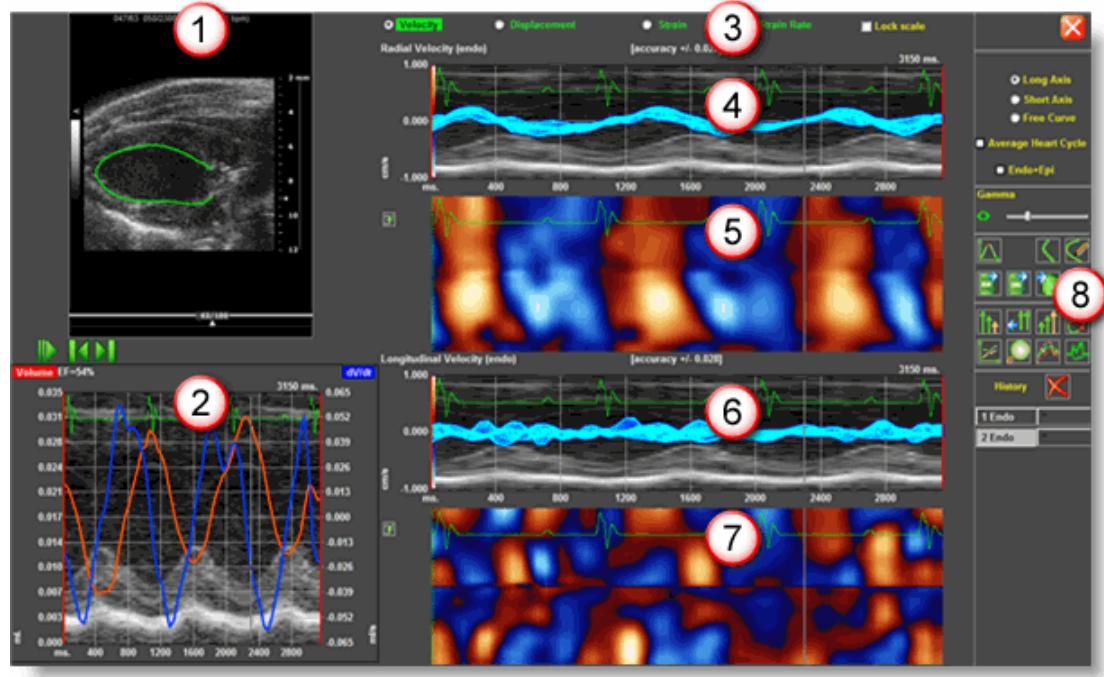


#### Before you begin

- You must complete the procedure in *Strain rate step 1: Adding the LV wall trace* (page 347).

## VeoStrain Analysis window workspace

The following illustration and table describes the information and features in the VeoStrain Analysis window workspace.



- 1** **LV wall trace on B-Mode cine loop.** 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.
- 2** **Derivative distribution graph.** For the long axis, the graph displays the volume and volume derivative. For the short axis, displays the area and area derivative.
- 3** **Graph type options.** Includes Velocity, Displacement, Strain, Strain Rate.
- 4** **Graph.** Velocity distribution along the radial axis.
- 5** **Graph.** Parametric distribution for the radial axis.
- 6** **Graph.** Velocity distribution along the longitudinal axis.
- 7** **Graph.** Parametric distribution along the longitudinal axis.

**⑧ 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 Imaging System, in TIFF and JPEG image formats, AVI formats for cine loops - compressed and uncompressed, and data export to TXT format.
- Row 3: Decrease Vector Size, Reset Vector Size, Increase Vector Size, Toggle contour/vector/orbit line/B-Mode.
- 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 analysis

 Vevo 2100  Vevo LAZR

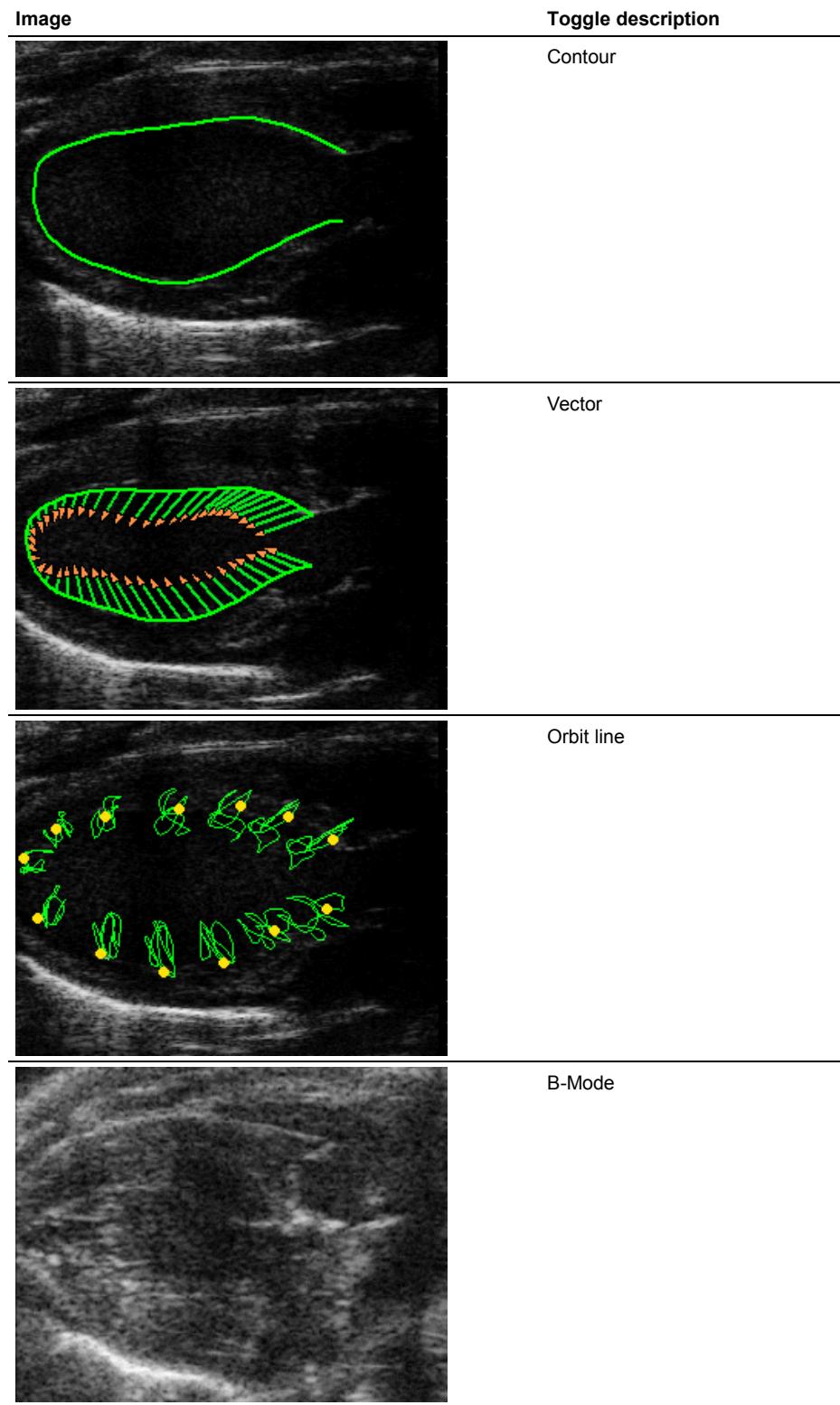
### Before you begin

- You must complete the procedure in *Strain rate step 1: Adding the LV wall trace* (page 347).

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.

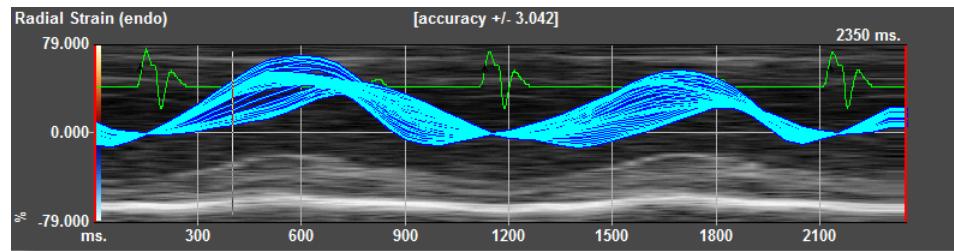
## Displaying individual curves for specific points on the trace in VevoStrain

Vevo 2100 Vevo LAZR

### Before you begin

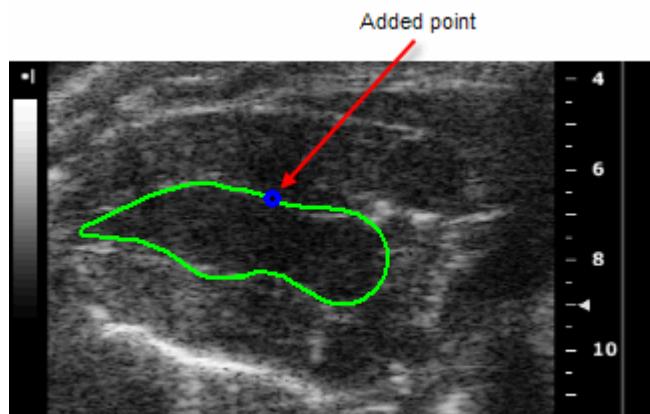
- You must complete the procedure in *Strain rate step 1: Adding the LV wall trace* (page 347).

By default the system displays all the curves for the individual points along the trace.

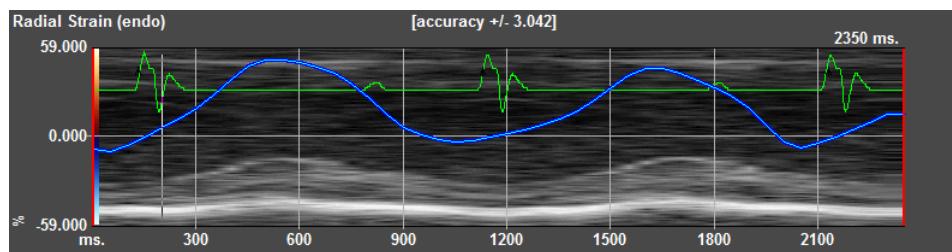


### ► To display the curve for a specific point on the trace:

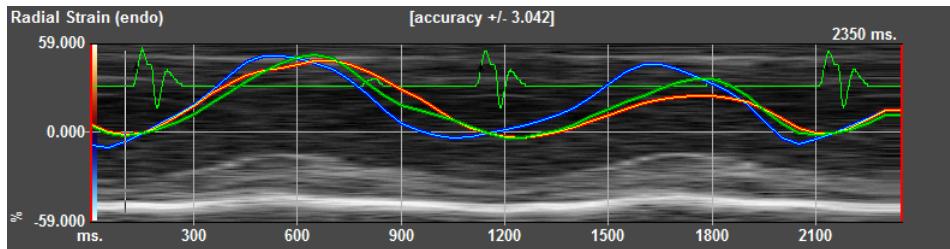
- Click on the contour to create a point.



- 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 analysis

Vevo 2100   Vevo LAZR

### Before you begin

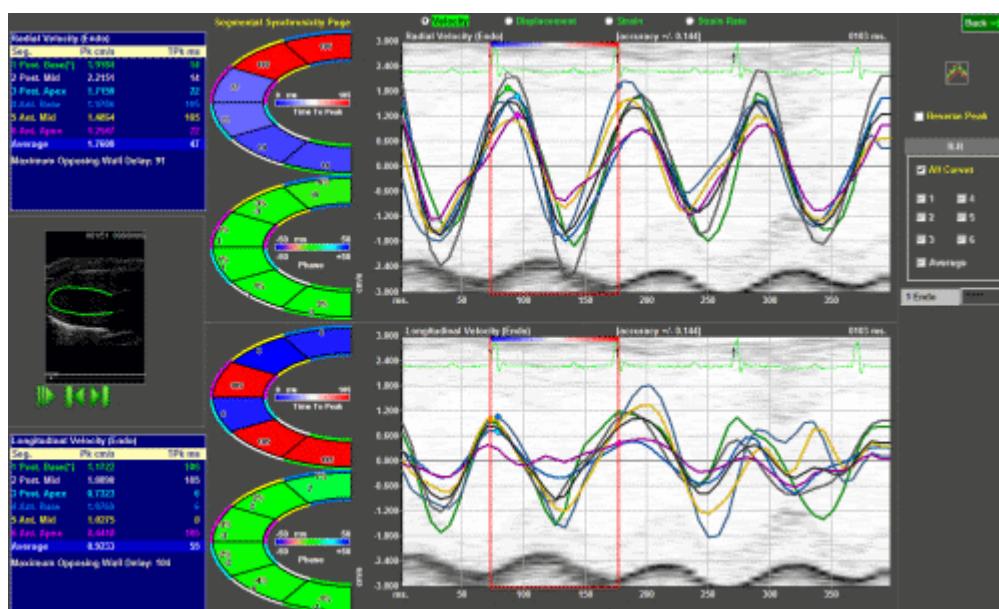
- You must complete the procedure in *Strain rate step 1: Adding the LV wall trace* (page 347).

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.

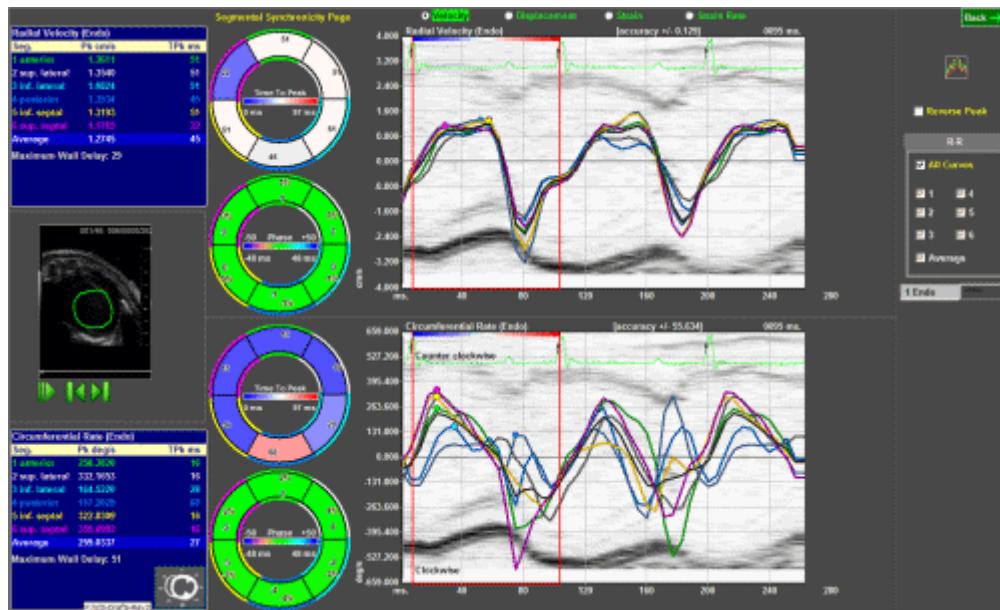
### ► To view the time-to-peak analysis:

Click the Time-to-Peak button

The time-to-peak window for your selected cardiac period appears.



### Time-to-peak window for long axis wall data



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 Analysis

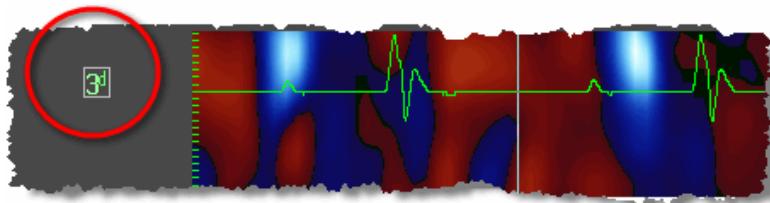
Vevo 2100 Vevo LAZR

### Before you begin

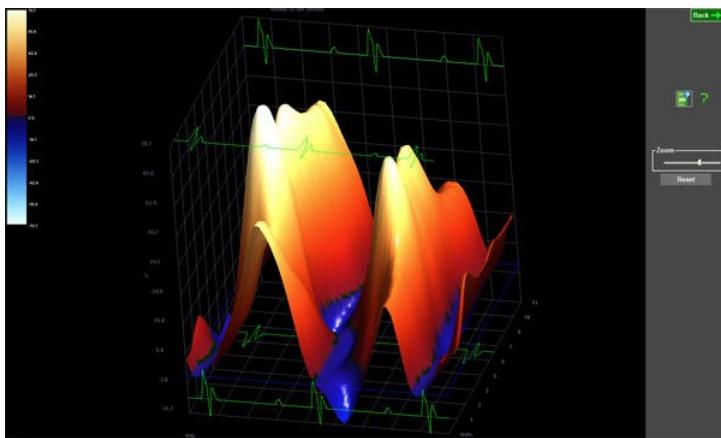
- You must complete the procedure in *Strain rate step 1: Adding the LV wall trace* (page 347).

#### ► To view strain data in 3D:

- From the VevoStrain Analysis window, click the 3d button that is located to the left of the parametric distribution graph.



- The system displays the strain rate data in three dimensions.



- Modify your view of the data.
  - Drag the image to rotate the image on any axis
  - Move the **Zoom** slider as needed
- If you want to save the image, click the Export Picture button located above the Zoom slider.

## Section 11

# PA-Mode imaging and analysis



PA-Mode (photoacoustic mode) is a method for obtaining optical contrast from biological tissues and detecting it with ultrasound. By illuminating tissue with pulsed laser light, a thermoelastic expansion occurs and this expansion creates an ultrasound wave which can be detected with an ultrasound transducer.

### In This Section

PA-Mode acquisition .....	359
PA-Mode analysis .....	395

## Chapter 52

# PA-Mode acquisition



This chapter shows you how to acquire images in PA-Mode and in the PA-Mode sub-modes.



**WARNING:** Only those who have been formally trained by VisualSonics to use this laser system may operate this photoacoustic imaging system.



**WARNING: Laser radiation.** This is a Class 1 laser product as per IEC 60825-1:2007. Avoid eye or skin exposure to direct or scattered radiation.



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



**WARNING:** Only use coupling gels that are specifically approved for use with this system.

## In this chapter

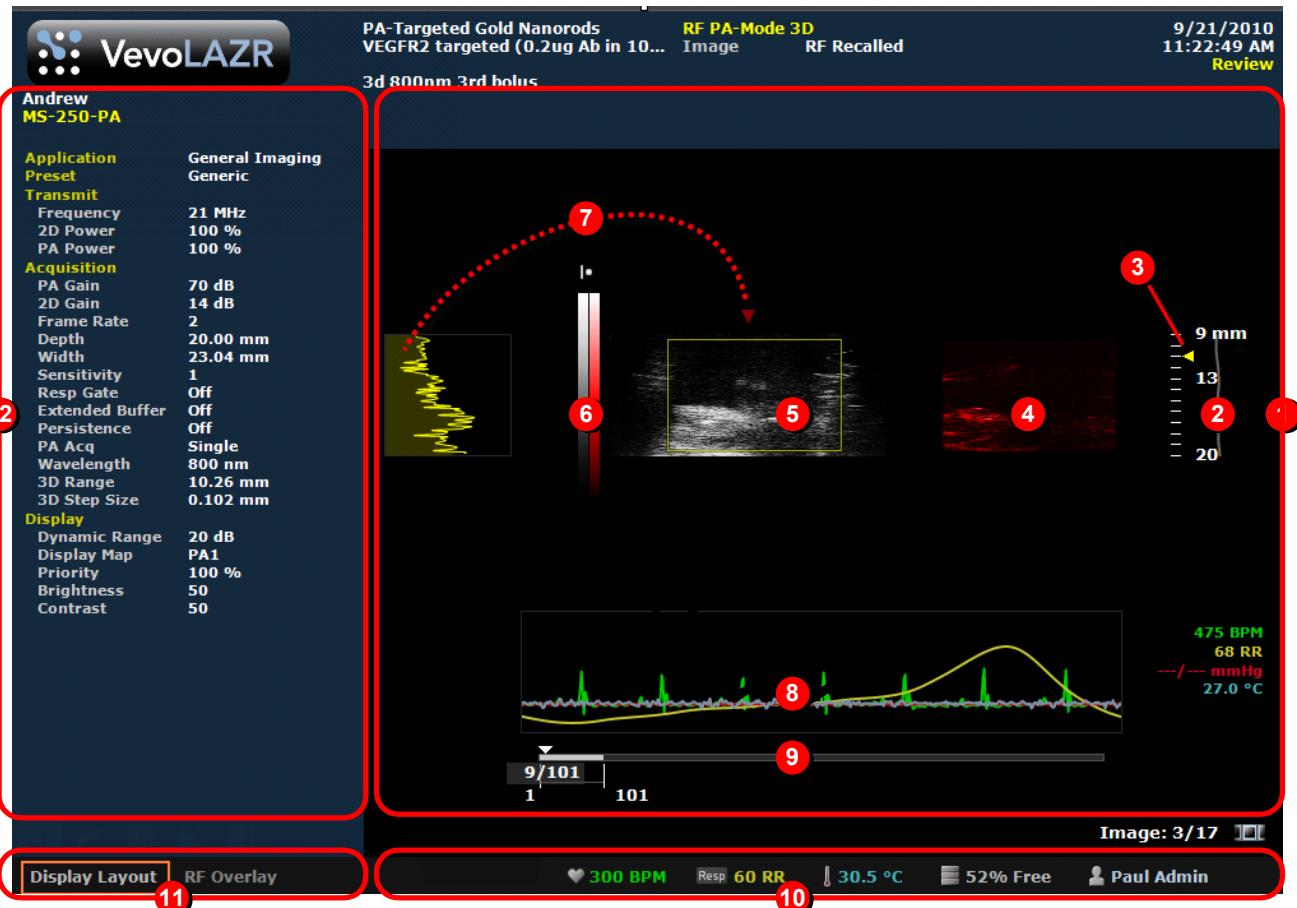
PA-Mode window workspace .....	360
Control panel controls for PA-Mode .....	365
PA-Mode settings.....	367
Selecting acquisition sub-modes in PA-Mode .....	369
PA-Mode sub-modes .....	370
Changing the PA-Mode display layout.....	389
Acquiring PA-Mode images in 3D.....	390
Controlling the laser .....	391

---

## PA-Mode window workspace



The PA-Mode window is the workspace you use whenever you view image data in PA-Mode. The following illustration and table describes the information and features in the PA-Mode window.



### ① Image area

This large area:

- Displays image data
- Displays physiological data for the animal (if recorded during image acquisition)
- Provides cine loop range controls for acquired cine loops
- Provides a Browse Images tool for scrolling through an inset gallery of images without having to return to the Study Browser

If you export an image and select Image as your export type, the system includes the image area content along with header information.

## **② Image scale**

Indicates in *mm* the distance from the face of the transducer.

## **③ Focus depth scale**

Indicates the distance from the transducer face where the system maximizes image resolutions. The triangular arrow indicates the focal length(s) of the transducer. When you acquire image data, use the **Image Depth** control on the control panel to increase or decrease the depth that you can see.

## **④ PA-Mode (photoacoustic) image data**

Displays the image that is generated from ultrasound signals received from the laser light that excites the tissue of interest. This Side by Side view with the PA data beside the B-Mode data is the default view. To view the other display options (Both, B-Mode Only, PA Only) press **Screen Keys** and then turn **Screen Keys** to cycle through the options.

## **⑤ B-Mode image data**

Displays the B-Mode data that the transducer acquires.

## **⑥ Gray scale and photoacoustic scale**

The right column of the scale is the photoacoustic scale. The left column of the scale is the gray scale for the B-Mode background image.

## **⑦ Ultrasound signal intensity histogram**

Appears when you press **RF** while acquiring in PA-Mode. Displays the intensity of the signal along the vertical line extending down from the red cross-section indicator above the B-Mode image.

## **⑧ Physiological data trace panel**

Displays the animal's dynamic heart rate, temperature, respiration rate and blood pressure data. This data is gathered by the Advanced Physiological Monitoring Unit that connects to the Vevo Imaging Station.

## **9** 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. To only display the image frames in that range, drag the left and right vertical markers. For more information, see *Working with cine loops* (page 288).

## **10** Status bar

Displays:

- 3D motor position, when the 3D motor is initialized (where 3D-Mode is supported)
- Monitored physiological values in real time during image acquisition

**PREREQUISITES:** Live physiological data is only available a) when you enable the inputs in the Physiological tab of the Preferences window; and b) when the animal is connected to the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station.

For more detailed information on physiological monitoring, see *Vevo Imaging Station description* (page 69), *Physiological preferences tab* (page 141) and *Setting up to acquire physiological data* (page 269).

- Percentage of **free space** to store image data so you can see when you should start to back up your image data to free up space on the system
- User name, in blue, when **User Management Mode** is enabled (where User Management Mode is supported)
- Elapsed session time when you hover over the displayed blue user name when User Management Mode is enabled.

## **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.
- Confirmation messages when you store an image.
- The updated parameter and system information when you make adjustments on the control panel.
- Control options in the acquisition mode you are using. To select, either a) cursor to the option and then click; or b) turn the **Screen Keys** dial to display the option, then press the dial.

## **Image mode management panel**

Displays a unique set of controls and information sections depending on the control key you press, or the image management panel tab you click:

- 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 (where ECG Trigger is supported).
- Press **Image Process** to set the panel to display the controls for brightness, contrast, baseline, priority, display maps, display layouts, loading into 3D and TGC loading and saving.
- Press **Mode Settings** to set the panel to display the Mode settings. This is the default panel when you open a Mode window. Press **Mode Settings** again to toggle to the panel that displays the laser controls.
- In PA-Mode, when you are reviewing a PA-Mode (NanoStepper) image, click the  Laser Control tab to display the Laser Control and Wavelength controls you can use to control the operation of the laser in the Vevo LAZR cart and the wavelength values.
- When you are reviewing a PA-Mode (NanoStepper) image, click the Multiplexer Control tab  to access a set of tools you can use to assign color and other visual properties to each wavelength image series in your NanoStepper acquisition so you can view layers as individual or combined views of the data.

## Control panel controls for PA-Mode



When you are acquiring PA-Mode image data, these are the controls you use to optimize the image you see on the screen.



### ① PA-Mode

Activates PA-Mode acquisition and begins displaying the acquired data.

### ② RF

Activates RF Mode data acquisition.

### ③ 2D Gain

**In PA-Mode:** Adjusts the intensity of the photoacoustic image data.

### ④ 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.

#### 5 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.

#### 6 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.

#### 7 Display Map

Cycles through a predefined set of overlays and optimization maps that you can apply either while you acquire or review image data. Push up or pull down to cycle through the available maps for the active imaging mode.

#### 8 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.

#### 9 Image Process

When in a mode window, activates the image processing panel, which provides additional post-processing options.

### **10 Back**

- Removes or cancels the last measurement point before you commit your measurement.
- Resets the parameters to the pre-defined values in the current preset.

### **11 Presets**

Active during image acquisition in every Mode other than 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 users added to the system.

All presets are both mode dependent, transducer dependent and application dependent.

### **12 Screen Keys**

Turn the dial to cycle through options for the current imaging mode and then press the dial to select. In **PA-Mode**, cycles through the PA Acquisition sub-mode selections: **Single, NanoStepper, Oxy-Hemo, Spectro**.

### **13 Sensitivity**

Adjusts the amount of photoacoustic image data collected through the transducer. Push up or down to select *High* or *Low*. The default setting is *High*. To acquire PA-Mode image data at 20Hz, you must select *Low*.

---

## **PA-Mode settings**



### **► To view the PA-Mode settings:**

Press **Mode Settings**. The settings panel displays the following parameters:

#### **Transmit**

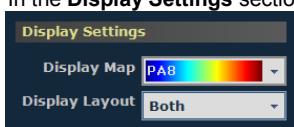
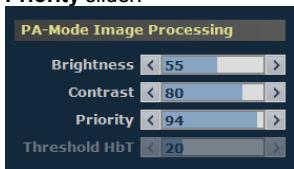
<b>Parameter</b>	<b>Description</b>
Frequency	The ultrasound frequency, measured in MHz. Adjust with the <b>Frequency</b> control.
2D Power	Read-only value that is adjusted when you acquire data in B-Mode. The transmission power level of the ultrasound signal, displayed as a percentage of the maximum power. Adjust with the <b>Transmit Power</b> control.
PA Power	PA Power is not adjustable. The power level is always 100%.

## Acquisition

Parameter	Description
PA Gain	Dynamic value that is adjusted when you acquire data in PA-Mode. The strength of the photoacoustic signal in <i>dB</i> increments when it returns to the face of the transducer. Adjust with the <b>2D Gain</b> control.
2D Gain	Read-only value that is adjusted when you acquire data in B-Mode. The strength of the ultrasound signal in <i>dB</i> increments when it returns to the face of the transducer. <b>NOTE:</b> If you are in a session that is primarily focused on acquiring PA-Mode images and you want to adjust the 2D Gain value, remember that you must press <b>B-Mode</b> first, then adjust the <b>2D Gain</b> control until you are satisfied with the B-Mode image. Then you can start PA-Mode again to continue acquiring PA-Mode images.
Frame Rate	The number of image frames per second that the system is acquiring. Adjust with the <b>Frame Rate</b> dial. Available in PA-Mode Single Sub-Mode. Adjust with the <b>Image Width</b> control or change the size of your PA image acquisition box.
Depth	The distance, measured in mm, from the face of the transducer. Adjust with the <b>Image Depth</b> control.
Width	The width of the acquired image area, measured in <i>mm</i> . Adjust with the <b>Image Width</b> control.
Sensitivity	The image quality setting: High or Low. Defaults to High. Select Low if you need to acquire PA-Mode data at 20Hz. Adjust with the <b>Sensitivity</b> control.
Resp Gate	The state of respiration gating: Off, On. To adjust, press <b>Physio Settings</b> and then select or clear the Respiration Gate check box.
Extended Buffer	The state (On or Off) of the option to increase the size of the cine buffer or cine loop. Specify this option in the General tab in the Preferences window.
Persistence	The state of the Persistence feature: Off, Low, Med, High, Max. Adjust with the <b>Persist</b> control.
PA Acquisition	The active PA-Mode acquisition sub-mode: Single, NanoStepper, Oxy-Hemo, Spectro. Adjust with the <b>Screen Keys</b> control.
Wavelength	The photoacoustic laser output wavelength, measured in <i>nm</i> . To adjust, press <b>Mode Settings</b> twice and then drag or step the slider controls in the Wavelength range bar. If you are in NanoStepper sub-mode, this section lists all the selected wavelengths and their <i>nm</i> values. An asterisk (*) beside the wavelength indicates that the system is acquiring photoacoustic data at that wavelength.
Correct Energy	The state ( <b>On</b> or <b>Off</b> ) of the Correct Energy option. To access the check box for this option during acquisition, click the Laser Control tool  below the image management panel. Select the check box to enable the feature; clear it to disable.

## Display

Parameter	Description
Display Map	The selected predefined display map from the predefined set of maps. Adjust with the <b>Display Map</b> control.

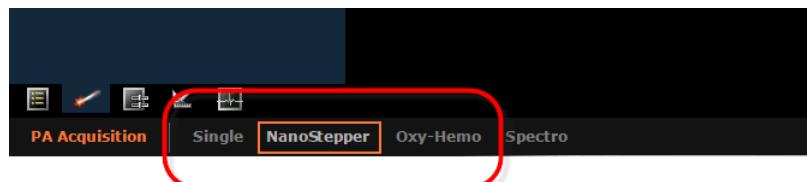
Parameter	Description
Priority	<p>Displays the amount of transparency of the PA-Mode data that is displayed when PA-Mode data overlaps with B-Mode data. <b>0</b>=fully transparent; <b>100</b>=fully opaque. To adjust:</p> <ol style="list-style-type: none"> <li>1. Click the Image Processing panel tab .</li> <li>2. In the <b>Display Settings</b> section ensure that <b>Display Layout</b> is set to <b>Both</b>.</li> </ol>  <ol style="list-style-type: none"> <li>3. In the <b>PA-Mode Image Processing</b> section, drag the bar or click the arrows in the <b>Priority</b> slider.</li> </ol> 
Threshold	Applies only to PA-Mode (Oxy-Hemo) when the OxyZated display type is selected. Sets the point at which the image data appears. Adjust with the <b>Threshold</b> slider in the image management panel after you press <b>Image Process</b> .
Brightness	The image brightness level. Adjust with the <b>Brightness</b> slider in the image management panel after you press <b>Image Process</b> .
Contrast	The image contrast level. Adjust with the <b>Contrast</b> slider in the image management panel after you press <b>Image Process</b> .

## Selecting acquisition sub-modes in PA-Mode



### ► To select an acquisition sub-mode in PA-Mode:

1. Begin acquiring PA-Mode data and then at the bottom-left of the screen select **PA Acquisition**. The list of PA-Mode sub-modes appear.
2. To select the sub-mode you want to use, either a) cursor to the option and then click; or b) turn the **Screen Keys** dial to display the option, then press the dial.



## PA-Mode sub-modes



PA-Mode includes four image acquisition sub-modes:

- **Single** - Use for acquiring images at one wavelength
- **NanoStepper** - Use for acquiring images at multiple (up to five) wavelengths
- **Oxy-Hemo** - Use for acquiring images at two wavelengths that represent two blood oxygenation levels
- **Spectro** - Use for acquiring a flexible range of images at defined steps between a range of wavelengths

This section walks you through the typical acquisition sessions for each of these sub-modes.

### PA-Mode (Single)



PA-Mode (Single) is a single-wavelength PA-Mode image acquisition sub-mode that acquires photoacoustic data at one wavelength.



**WARNING:** Before you use the Vevo LAZR system be sure that you understand and observe the laser-related safety warnings presented in this manual.

#### Before you begin acquiring data

If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 269).
- Prepare your animal on the animal platform. For detailed information refer to the user manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 273).

#### Preparing the animal

- Connect the 3D motor to the system and secure the transducer as detailed in the *Vevo Imaging Station Operator Manual*.
- Prepare the animal according to your protocol.
- Position the transducer and locate your region of interest. The focus depth of the laser is set to the optimal focus depth for the transducer.

- To ensure that your region of interest falls within this range, prepare to apply a significant amount of gel standoff.

### Ensuring the laser safety interlocks are closed

Check the interlocks:

- Ensure that the interlock light is not on.
- On the inside of the Vevo LAZRTight make sure you connect the fiber interlock cable to the **Fiber Interlock** box.
- On the outside of the Vevo LAZRTight ensure that the left and right access port covers are pulled down to their seated position.
- On the outside of the Vevo LAZRTight, on the front cover, ensure that the two sliding doors are pulled completely closed.
- On the outside of the Vevo LAZRTight, on the right side, ensure that the blue **Laser** status light is on.
- On the laser cart ensure that the laser fiber bundle optic cable is securely positioned behind the red locking ring. Also ensure that the audio jack cable is connected to the **FIBER INTERLOCK** connector.



**WARNING:** Only use coupling gels that are specifically approved for use with this system.



**WARNING:** Do not use protective sheaths when operating an LZ series transducer.

### ► To acquire PA image data at one wavelength:

#### Step 1: Optimize your image in B-Mode

- Press **B-Mode**. The **B-Mode** imaging window appears.

2. 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.



3. Press **Presets** to cycle through the available presets and then select an appropriate set of optimized image acquisition settings.
4. Adjust the **Image Width** control to remove image content outside the region of interest.
5. Close the Vevo LAZRTight front panel doors.

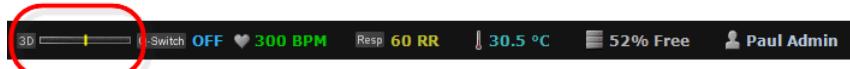
### Step 2: Acquire PA-Mode data in Single sub-mode

1. Press **PA-Mode**. The laser initializes and then begins firing in the **Single** sub-mode at the 700nm default wavelength.
2. The **PA-Mode** imaging window appears and the system begins storing cine loop data in the acquisition buffer.
3. If you need to refine the image further, on the control panel adjust the control panel controls to refine your image acquisition settings.
4. To adjust the wavelength press **Mode Settings**, then drag or step the **Single Wavelength Setup** slider controls.
5. Press **Scan/Freeze** to begin acquiring image data at the wavelength you specified.
6. To change the overlay press **Display Map** and cycle through the maps.

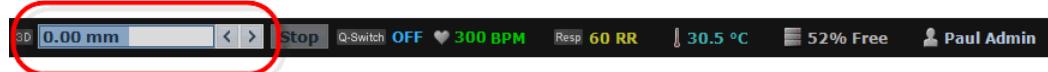
### Step 3: (Optional): Remotely position the transducer

**CAUTION:** To acquire a consistent signal, ensure that the coupling gel is equally covering the area you are imaging.

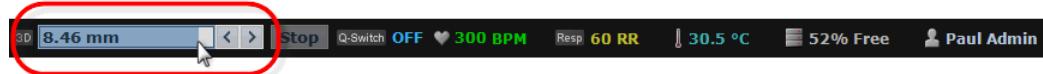
1. Press **Cursor**.
2. In the status bar, hover the cursor over the 3D motor position control (the yellow bar indicates the current position of the 3D motor).



The 3D motor position control changes from a status indicator to a controllable position bar.



3. Drag the blue bar to reposition the transducer. For fine position control (+ or - 0.02mm) click the left or right controls.

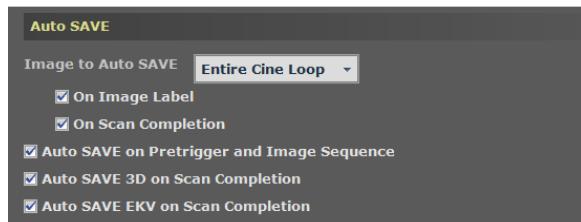


When you are done, the indicator bar displays the new position.



#### Step 4: Save your work

1. Press **Scan/Freeze** to stop the data acquisition so you can review the data in the acquisition buffer.
2. Roll the trackball side to side to scroll through the cine loop.
3. 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 a cine loop or image frame and also add a label, press **Image Label**.  
**NOTE:** To set or remove auto-save default preference, select your option in the Auto SAVE section (**Preferences** window > **General** tab > **Auto SAVE** section).



- To save the displayed image frame press **Frame Store**.
4. Press **Scan/Freeze** to resume scanning.
  5. Save images as required.
  6. In the function keys row, press **Close**. The system closes the series you are working on and displays the **Study Information** window.

Complete the required fields to define your study and click **OK**. The **Study Browser** appears.

You have successfully acquired single wavelength photoacoustic image data.

### Related topics

- *Vevo LAZR safety* (page 58)
- *Logging on for a typical session* (page 126)
- *Blood Pressure section* (page 273)
- *Acquiring image data* (page 257)
- *Vevo Imaging Station* (page 69)
- *Working with the 3D motor stage* (page 261)
- *3D-Mode imaging and analysis* (page 454)

### Next step

- *Adding generic PA-Mode measurements* (page 395)

## PA-Mode (NanoStepper)



NanoStepper is a multi-wavelength PA-Mode image acquisition sub-mode that acquires photoacoustic images at up to five custom wavelengths. First, you specify up to five wavelength values at which to acquire data. Then when you start acquiring data through the transducer the system repeatedly steps through the series of specified wavelengths and acquires an image frame at each wavelength. The result is a cine loop that contains data for all five wavelengths.



**WARNING:** Before you use the Vevo LAZR system be sure that you understand and observe the laser-related safety warnings presented in this manual.

### Before you begin acquiring data

If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 269).
- Prepare your animal on the animal platform. For detailed information refer to the user manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 273).

## Preparing the animal

- Connect the 3D motor to the system and secure the transducer as detailed in the *Veo Imaging Station Operator Manual*.
- Prepare the animal according to your protocol.
- Position the transducer and locate your region of interest. The focus depth of the laser is set to the optimal focus depth for the transducer.
- To ensure that your region of interest falls within this range, prepare to apply a significant amount of gel standoff.

## Ensuring the laser safety interlocks are closed

Check the interlocks:

- Ensure that the interlock light is not on.
- On the inside of the Veo LAZRTight make sure you connect the fiber interlock cable to the **Fiber Interlock** box.
- On the outside of the Veo LAZRTight ensure that the left and right access port covers are pulled down to their seated position.
- On the outside of the Veo LAZRTight, on the front cover, ensure that the two sliding doors are pulled completely closed.
- On the outside of the Veo LAZRTight, on the right side, ensure that the blue **Laser** status light is on.
- On the laser cart ensure that the laser fiber bundle optic cable is securely positioned behind the red locking ring. Also ensure that the audio jack cable is connected to the **FIBER INTERLOCK** connector.



**WARNING:** Only use coupling gels that are specifically approved for use with this system.



**WARNING:** Do not use protective sheaths when operating an LZ series transducer.

► **To acquire PA image data at multiple wavelengths:**

**Step 1: Optimize your image in B-Mode**

1. Press **B-Mode**. The **B-Mode** imaging window appears.
2. 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.



3. Press **Presets** to cycle through the available presets and then select an appropriate set of optimized image acquisition settings.
4. Adjust the **Image Width** control to remove image content outside the region of interest.
5. Close the Vevo LAZRTight front panel doors.

**Step 2: Specify the wavelengths and acquire PA-Mode data in NanoStepper sub-mode**

1. Press **PA-Mode**. The laser initializes and then begins firing in the **Single** sub-mode at the 700nm default wavelength.
2. The **PA-Mode** imaging window appears and the system begins storing cine loop data in the acquisition buffer.
3. If you need to refine the image further, on the control panel adjust the control panel controls to refine your image acquisition settings.
4. Turn the **Screen Keys** dial to select the **NanoStepper** sub-mode and then press the dial to activate the sub-mode.
5. To configure the sub-mode to acquire data for up to five wavelengths:
  - a. Press **Mode Settings**.
  - b. In the **NanoStepper Setup** section click to enable the number of wavelengths you want to acquire.

- c. Drag or step the **Wavelength** slider controls to specify the wavelength values.

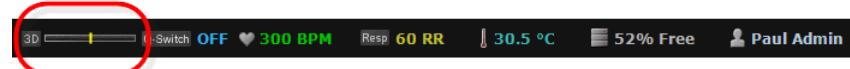


6. Press **Scan/Freeze** to begin acquiring image data at the stepped wavelengths.
7. To change the overlay press **Display Map** and cycle through the maps.

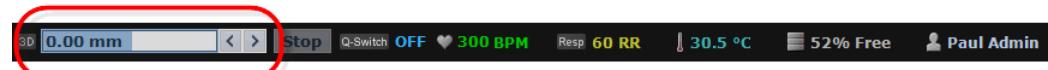
### Step 3 (Optional): Remotely position the transducer

**CAUTION:** To acquire a consistent signal, ensure that the coupling gel is equally covering the area you are imaging.

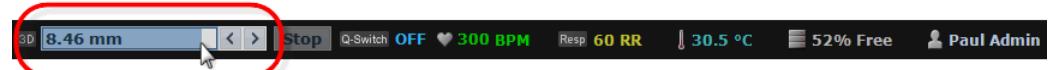
1. Press **Cursor**.
2. In the status bar, hover the cursor over the 3D motor position control (the yellow bar indicates the current position of the 3D motor).



The 3D motor position control changes from a status indicator to a controllable position bar.



3. Drag the blue bar to reposition the transducer. For fine position control (+ or - 0.02mm) click the left or right controls.



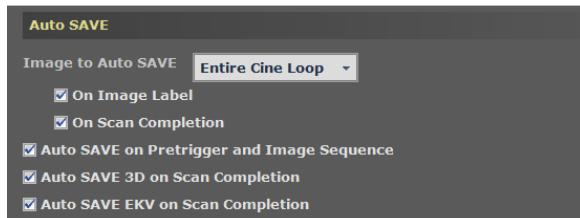
When you are done, the indicator bar displays the new position.



#### Step 4: Save your work

**NOTE:** The multiplexer panel appears automatically when you stop acquiring data.

1. Press **Scan/Freeze** to stop the data acquisition so you can review the data in the acquisition buffer.
2. Roll the trackball side to side to scroll through the cine loop.
3. 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 a cine loop or image frame and also add a label, press **Image Label**.  
**NOTE:** To set or remove auto-save default preference, select your option in the Auto SAVE section (**Preferences** window > **General** tab > **Auto SAVE** section).



- To save the displayed image frame press **Frame Store**.
4. Press **Scan/Freeze** to resume scanning.
5. Save images as required.
6. In the function keys row, press **Close**. The system closes the series you are working on and displays the **Study Information** window.

Complete the required fields to define your study and click **OK**. The **Study Browser** appears.

You have successfully acquired multi-wavelength photoacoustic image data.

#### Related topics

- *Veo LAZR safety* (page 58)
- *Logging on for a typical session* (page 126)
- *Blood Pressure section* (page 273)

- *Acquiring image data* (page 257)
- *Veveo Imaging Station* (page 69)
- *Working with the 3D motor stage* (page 261)
- *3D-Mode imaging and analysis* (page 454)

#### Next step

- *Adding generic PA-Mode measurements* (page 395)

## PA-Mode 3D (NanoStepper)



### ► To acquire a NanoStepper 3D-Mode image:

1. Set up for a 3D-Mode image acquisition session (page 465).
2. Follow the typical steps for a typical NanoStepper sub-mode acquisition session (page 374) and save the images as a cine loop.
3. Press **3D**.
4. In the **3D Acquisition Setup** dialog box, configure your step distance and size and click **Scan**. To compile the 3D image data the system follows the image acquisition process selected in the **PA-Mode** preferences tab (page 139). If you select **Sequential Wavelengths**, the process is comparatively faster and produces high quality image output. If you select **Alternating Wavelengths**, the process is comparatively slower and produces the highest quality image output. When the 3D acquisition has completed, the **Multiplexer Control** panel appears.
5. Press **Cine Store**.
6. Click **Multiplex** to access the tools and then make whatever multiplex layer or image setup or calculation changes you want to make as detailed in *Multiplexer control (NanoStepper color and layer views)* (page 398). The system cannot load the image data into 3D if you do not click this button.
7. At the bottom of the panel, in the **3D Settings** section, click **Load Into 3D**. The system merges all the frames from all the selected NanoStepper image wavelengths and then displays them as one 3D image in the **PA-Mode 3D** workspace.
8. Analyze the NanoStepper PA-Mode 3D image using the 3D analysis tools as described in *3D Mode images* (page 470).

## Related information

- *PA-Mode 3D Acquisition Method (Oxy-Hemo and NanoStepper) preferences* (page 139)
- *3D-Mode visualization tools* (page 470)
- *Typical NanoStepper sub-mode acquisition session* (page 374)
- *Typical 3D-Mode image acquisition session* (page 457)
- *Typical Color Doppler Mode image acquisition session* (page 498)

## PA-Mode (Oxy-Hemo)



Oxy-Hemo sub-mode acquires PA-Mode image data at two wavelengths. In the Mode Settings preferences tab (**Prefs > Mode Settings** tab) you can select one of two default wavelength values (734 nm or 750 nm) for Wavelength 1. Wavelength 2 is always 850 nm. The blue overlay displays deoxygenated blood. The red overlay displays oxygenated blood.

**NOTE:** The Oxy-Hemo sub-mode acquires PA-Mode image data at two wavelengths. The second wavelength is always 850 nm. However, in the Mode Settings preference tab you can select one of two default wavelength values for the first wavelength. See *PA-Mode Oxy-Hemo Settings preferences* (page 140) for more information.



**WARNING:** Before you use the Vevo LAZR system be sure that you understand and observe the laser-related safety warnings presented in this manual.

## Before you begin acquiring data

If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 269).
- Prepare your animal on the animal platform. For detailed information refer to the user manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 273).

## Preparing the animal

- Connect the 3D motor to the system and secure the transducer as detailed in the *Vevo Imaging Station Operator Manual*.
- Prepare the animal according to your protocol.

- Position the transducer and locate your region of interest. The focus depth of the laser is set to the optimal focus depth for the transducer.
- To ensure that your region of interest falls within this range, prepare to apply a significant amount of gel standoff.

### Ensuring the laser safety interlocks are closed

Check the interlocks:

- Ensure that the interlock light is not on.
- On the inside of the Vevo LAZRTight make sure you connect the fiber interlock cable to the **Fiber Interlock** box.
- On the outside of the Vevo LAZRTight ensure that the left and right access port covers are pulled down to their seated position.
- On the outside of the Vevo LAZRTight, on the front cover, ensure that the two sliding doors are pulled completely closed.
- On the outside of the Vevo LAZRTight, on the right side, ensure that the blue **Laser** status light is on.
- On the laser cart ensure that the laser fiber bundle optic cable is securely positioned behind the red locking ring. Also ensure that the audio jack cable is connected to the **FIBER INTERLOCK** connector.



**WARNING:** Only use coupling gels that are specifically approved for use with this system.



**WARNING:** Do not use protective sheaths when operating an LZ series transducer.

### ► To acquire photoacoustic images at two wavelengths:

#### Step 1: Optimize your image in B-Mode

1. Press **B-Mode**. The **B-Mode** imaging window appears.

2. 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.



3. Press **Presets** to cycle through the available presets and then select an appropriate set of optimized image acquisition settings.
4. Adjust the **Image Width** control to remove image content outside the region of interest.
5. Close the Vevo LAZRTight front panel doors.

## Step 2: Acquire PA-Mode data in Oxy-Hemo sub-mode

1. Press **PA-Mode**. The laser initializes and then begins firing in the **Single** sub-mode at the 700nm default wavelength.

The **PA-Mode** imaging window appears and the system begins storing cine loop data in the acquisition buffer.

If you need to refine the image further, on the control panel adjust the control panel controls to refine your image acquisition settings. If you are using the OxyZated display type, **Threshold** is typically the one adjustment that will most improve the quality of your image.

### To adjust the Threshold:

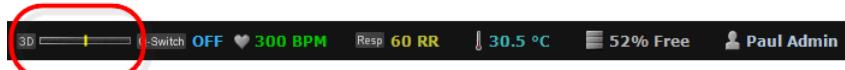
- a. Press **Image Process**.
  - b. In the **Threshold** slider control drag or click in the range bar or click the – or + controls and fine tune the parameter by increments of 1%. Decrease **Threshold** until you begin to see artifacting outside the skin. This means that you have reached the limit of accurate, usable imaging data.
2. Increase the parameter a small amount to remove the artifacts until you are confident that you are viewing the maximum amount of signal only from the tissue.
  3. Press **Screen Keys**, turn the dial to switch the PA-Mode display view from **Acquisition** to **Oxy-Hemo** and then press the dial again to activate the sub-mode.
  4. Press **Scan/Freeze** to begin acquiring image data. The laser system initializes and then begins firing at the 750 nm and 850 nm wavelengths and begins storing cine loop data for both wavelengths in the acquisition buffer.

- To change the overlay press **Display Map** and cycle through the maps.

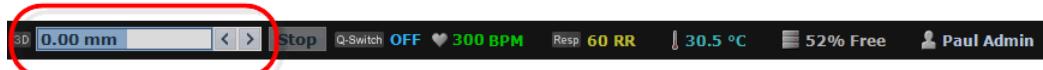
### Step 3 (Optional): Remotely position the transducer

**CAUTION:** To acquire a consistent signal, ensure that the coupling gel is equally covering the area you are imaging.

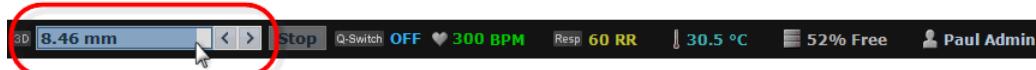
- Press **Cursor**.
- In the status bar, hover the cursor over the 3D motor position control (the yellow bar indicates the current position of the 3D motor).



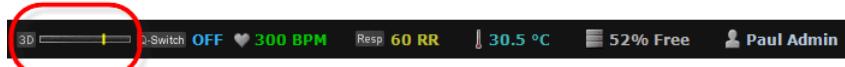
The 3D motor position control changes from a status indicator to a controllable position bar.



- Drag the blue bar to reposition the transducer. For fine position control (+ or - 0.02mm) click the left or right controls.



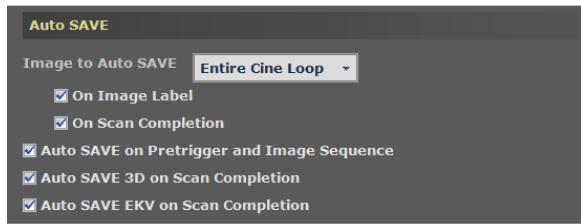
When you are done, the indicator bar displays the new position.



### Step 4: Save your work

- Press **Scan/Freeze** to stop the data acquisition so you can review the data in the acquisition buffer.
- Roll the trackball side to side to scroll through the cine loop.
- 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 a cine loop or image frame and also add a label, press **Image Label**.  
**NOTE:** To set or remove auto-save default preference, select your option in the Auto SAVE section (**Preferences** window > **General** tab > **Auto SAVE** section).



- To save the displayed image frame press **Frame Store**.
4. Press **Scan/Freeze** to resume scanning.
  5. Save images as required.
  6. In the function keys row, press **Close**. The system closes the series you are working on and displays the **Study Information** window.  
Complete the required fields to define your study and click **OK**. The **Study Browser** appears.

You have successfully acquired Oxy-Hemo dual-wavelength photoacoustic image data.

## Related topics

- *Setting the PA-Mode tab preferences* (page 139)
- *PA-Mode Oxy-Hemo Settings preferences* (page 140)
- *Vevo LAZR safety* (page 58)
- *Measuring blood oxygenation* (page 396)
- *Logging on for a typical session* (page 126)
- *Blood Pressure section* (page 273)
- *Acquiring image data* (page 257)
- *Vevo Imaging Station* (page 69)
- *Working with the 3D motor stage* (page 261)
- *3D-Mode imaging and analysis* (page 454)

## Next step

- *Adding generic PA-Mode measurements* (page 395)

## PA-Mode (Spectro)



Spectro is a multiple-wavelength PA-mode image acquisition sub-mode that acquires a flexible range of two-dimensional images at defined steps between a range of wavelengths.



**WARNING:** Before you use the Vevo LAZR system be sure that you understand and observe the laser-related safety warnings presented in this manual.

### Before you begin acquiring data

If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 269).
- Prepare your animal on the animal platform. For detailed information refer to the user manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 273).

### Preparing the animal

- Prepare the animal according to your protocol.
- Position the transducer and locate your region of interest. The focus depth of the laser is set to the optimal focus depth for the transducer.
- To ensure that your region of interest falls within this range, prepare to apply a significant amount of gel standoff.

### Ensuring the laser safety interlocks are closed

Check the interlocks:

- Ensure that the interlock light is not on.
- On the inside of the Vevo LAZRTight make sure you connect the fiber interlock cable to the **Fiber Interlock** box.
- On the outside of the Vevo LAZRTight ensure that the left and right access port covers are pulled down to their seated position.
- On the outside of the Vevo LAZRTight, on the front cover, ensure that the two sliding doors are pulled completely closed.
- On the outside of the Vevo LAZRTight, on the right side, ensure that the blue **Laser** status light is on.

- On the laser cart ensure that the laser fiber bundle optic cable is securely positioned behind the red locking ring. Also ensure that the audio jack cable is connected to the **FIBER INTERLOCK** connector.



**WARNING:** Only use coupling gels that are specifically approved for use with this system.



**WARNING:** Do not use protective sheaths when operating an LZ series transducer.

## ► To acquire PA image data in Spectro sub-mode:

### Step 1: Optimize your image in B-Mode

- Press **B-Mode**. The **B-Mode** imaging window appears.
- 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.



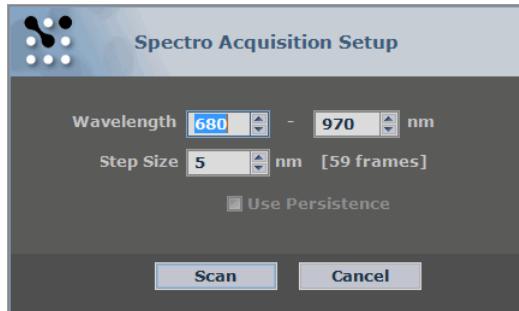
- Press **Presets** to cycle through the available presets and then select an appropriate set of optimized image acquisition settings.
- Adjust the **Image Width** control to remove image content outside the region of interest.
- Close the Vevo LAZRTight front panel doors.

### Step 2: Acquire Spectro sub-mode image frames

- Press **PA-Mode**. The laser initializes and then begins firing in the **Single** sub-mode at the 700nm default wavelength.

The **PA-Mode** imaging window appears and the system begins storing cine loop data in the acquisition buffer.

2. If you need to refine the image further, on the control panel adjust the control panel controls to refine your image acquisition settings.
3. Press **Screen Keys**, turn the dial to **PA Acquisition** and then select **Spectro**. The **Spectro Acquisition Setup** dialog box appears.
4. Configure the wavelength range and step size:

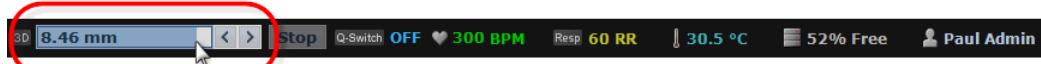


- a. In the two **Wavelength** fields define the start and stop wavelengths.
- b. In the **Step Size** field define the number of nanometers between image frame acquisitions. The system dynamically calculates and displays the number of image frames that will be acquired based on your settings.
- c. If you want to include a persistence level that you have set using the **Persist** key, select **Use Persistence**, if available.
- d. Click **Scan**. The system acquires the frames.
5. Press **Cine Store** to save your acquisition.
6. To change the overlay press **Display Map** and cycle through the maps.

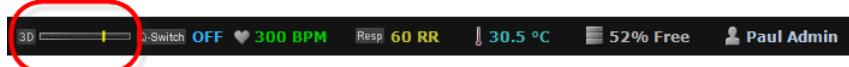
### Step 3 (Optional): Remotely position the transducer

**CAUTION:** To acquire a consistent signal, ensure that the coupling gel is equally covering the area you are imaging.

1. Press **Cursor**.
2. Drag the blue bar to reposition the transducer. For fine position control (+ or - 0.02mm) click the left or right controls.

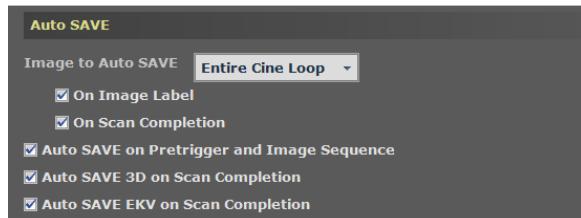


When you are done, the indicator bar displays the new position.



#### Step 4: Save your work

1. Press **Scan/Freeze** to stop the data acquisition so you can review the data in the acquisition buffer.
2. Roll the trackball side to side to scroll through the cine loop.
3. 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 a cine loop or image frame and also add a label, press **Image Label**.  
**NOTE:** To set or remove auto-save default preference, select your option in the Auto SAVE section (**Preferences** window > **General** tab > **Auto SAVE** section).



- To save the displayed image frame press **Frame Store**.
4. Press **Scan/Freeze** to resume scanning.
5. Save images as required.
6. In the function keys row, press **Close**. The system closes the series you are working on and displays the **Study Information** window.

Complete the required fields to define your study and click **OK**. The **Study Browser** appears.

You have successfully acquired Spectro sub-mode image data.

#### Related topics

- *Veo LAZR safety* (page 58)
- *Logging on for a typical session* (page 126)
- *Blood Pressure section* (page 273)
- *Acquiring image data* (page 257)

- *Vevo Imaging Station* (page 69)

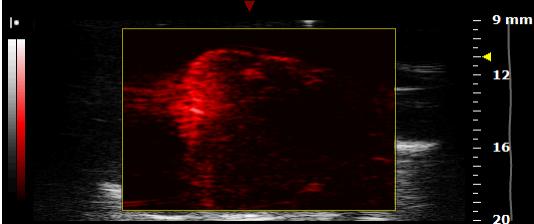
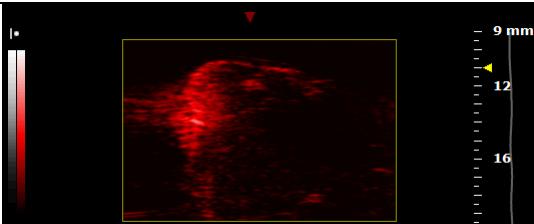
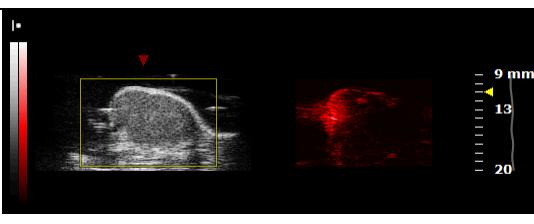
### Next step

- *Adding generic PA-Mode measurements* (page 395)

## Changing the PA-Mode display layout



You can view the PA-Mode image data in one of four ways:

Name	Layout	Description
Both		Overlays the PA-Mode image over the B-Mode image.
B-Mode Only		Displays only the B-Mode image.
PA Only		Displays only the PA-Mode image.
Side by Side		Displays the B-Mode image on the left and the PA-Mode image on the right.

### ► To change the PA-Mode image view:

1. Press **Screen Keys** to display the **Display Layout** options.
2. Turn **Screen Keys** to select the view you want.

3. Press **Screen Keys** to activate the change to the new view.

## Acquiring PA-Mode images in 3D



Acquiring 3D-Mode images in PA-Mode is similar to 3D-Mode acquisition in all imaging modes.

► **To complete a 3D-Mode image acquisition session for a PA-Mode sub-mode:**

1. Begin acquiring PA-Mode data and then at the bottom-left of the screen select **PA Acquisition**. The list of PA-Mode sub-modes appear.
2. To select the sub-mode you want to use, either a) cursor to the option and then click; or b) turn the **Screen Keys** dial to display the option, then press the dial.



3. Follow the *Typical 3D-Mode image acquisition session* procedure (page 457).

**NOTE:** When you reposition the transducer, the new position becomes the new start/home/origin position when you run a 3D-Mode image scan. The scan runs within the distance range set from the 3D setting dialog box.

**NOTE:** Spectro sub-mode does not support 3D-Mode image acquisition.

### How 3D-Mode scan frames are calculated for PA-Mode scans

The displayed number of acquired frames is a calculated value based on an equation that multiplies the number of planes by the number of wavelengths.

### Speed and image considerations

3D-Mode images are created by acquiring a series of image slices (called *image frames*) and then stacking them together. The time it takes to complete the scan is based on how long it takes to complete each image slice (frame). Here is how it works for the PA-mode sub-modes:

- In **Single** sub-mode, the laser remains at one wavelength during the scan and therefore requires no pauses for the laser to switch wavelengths. Therefore, the scan will take approximately the same amount of time to complete as a 3D-Mode scan in any of the other supported modes such as B-Mode or Power Doppler Mode.
- In **NanoStepper** sub-mode and **Oxy-Hemo** sub-mode, to compile the 3D image data the system follows the image acquisition process selected in the **PA-Mode** preferences tab (page 139). If you select **Sequential Wavelengths**, the process is comparatively faster and produces high quality image output. If you select **Alternating Wavelengths**, the process is comparatively slower and produces the highest quality image output.

### Related information

- *Typical PA-Mode sub-mode acquisition sessions* (page 370)
- *Typical 3D-Mode image acquisition session* (page 457)
- *3D-Mode window workspace* (page 461)
- *Control panel controls for 3D-Mode* (page 464)
- *Setting up for a 3D-Mode image acquisition* (page 465)
- *Recording a 3D-Mode analysis session* (page 469)
- *Analyzing 3D Mode images* (page 470)

## Controlling the laser



Vevo LAZR provides controls that you can use to turn the flashlamp on and off as well as to:

- optimize the laser energy
- change the wavelength while in Single or NanoStepper sub-mode

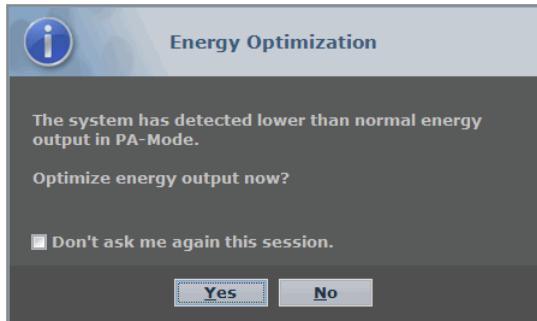
## Optimizing the laser energy



Vevo LAZR automatically alerts you when the laser energy output level needs to be optimized in order to produce an optimal photoacoustic image. You can also optimize the laser at any time.

## Approach 1: Optimize the laser energy output at the system prompt

The system constantly monitors the laser energy output. When the energy drops below the optimal level the system displays the following box to prompt you to run the optimization process:



When you click **Yes** the system runs the optimization process and displays the optimization progress bar. This can take a couple of minutes to complete.

## Approach 2: Optimize anytime

### ► To optimize the laser energy output at any time:

1. If you are acquiring data press **Scan/Freeze** to freeze your acquisition.
2. Press **Cursor**, click the Laser Control image management panel tab and then click **Optimize**. The system runs the optimization process. This can take a couple of minutes to complete.

## Changing the laser wavelength



You can change the laser wavelength when you are acquiring images in any of the PA-Mode sub-modes except for Oxy-Hemo which operates at two fixed wavelengths (Wavelength 1: 734 nm or 750nm; and Wavelength 2: 850nm).

### ► To change the laser wavelength:

1. Press **Scan/Freeze** and then press **Mode Settings** and cycle through to display the **Laser Controls** panel.
2. Press **Cursor**, click the Laser Control image management panel tab and then in the **Wavelength** range bar drag or step the slider controls.
3. Press **Scan/Freeze** to begin acquiring image data again.

## Related information

- *Typical Oxy-Hemo sub-mode acquisition session* (page 380)
- *PA-Mode Oxy-Hemo Settings preferences* (page 140)

## Remotely positioning the transducer in Vevo LAZRTight



The LZ series transducers mount to the 3D motor on the Vevo Imaging System inside Vevo LAZRTight. You cannot manually access the interior while the transducer is operating because the front sliding doors must be shut in order for the laser to operate.

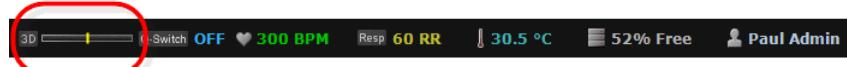
Vevo Imaging System software, however, can remotely control the position of the transducer by remotely controlling the position of the 3D motor.



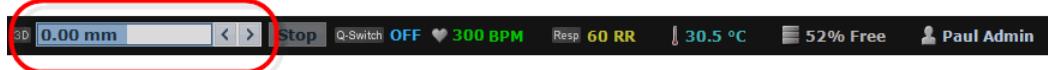
- **To remotely position the transducer while you are acquiring PA-Mode data:**

**CAUTION:** To acquire a consistent signal, ensure that the coupling gel is equally covering the area you are imaging.

1. Press **Cursor**.
2. In the status bar, hover the cursor over the 3D motor position control (the yellow bar indicates the current position of the 3D motor).



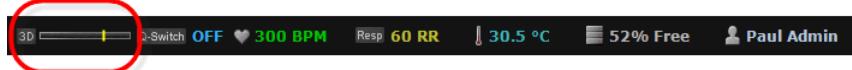
The 3D motor position control changes from a status indicator to a controllable position bar.



3. Drag the blue bar to reposition the transducer. For fine position control (+ or - 0.02mm) click the left or right controls.



When you are done, the indicator bar displays the new position.



### Related information

- [Connecting the 3D motor stage to Vevo \(page 261\)](#)
- [Imaging System](#)
- [Connecting a MicroScan transducer to the 3D motor \(page 263\)](#)
- [Connecting an LZ transducer to the 3D motor \(page 264\)](#)

# PA-Mode analysis



This chapter shows you how to analyze PA-Mode images that are saved to a study.

## In this chapter

Adding generic PA-Mode measurements.....	395
Measuring blood oxygenation.....	396
Multiplexer control (NanoStepper color and layer views) .....	398
Generating and analyzing NanoStepper 3D images .....	400
Measuring region changes in a Photoacoustic loop.....	401

---

## Adding generic PA-Mode measurements



PA-Mode provides six generic measurement tools. Use these tools when you want to add measurements that are not part of a measurement protocol.

**NOTE:** PA-Mode does not support protocol measurements.

### Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want the default to be to hide them, go to **Prefs > Measurements** tab, clear the **Show Values and Labels** check box and save your edits in a custom measurement package.
- If you want to temporarily override the default, clear or select the **Show Values and Labels** check box at the bottom of the measurement panel.



► **To access the generic measurement tools for PA-Mode:**

- If you are acquiring PA-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 image management panel. Hover over a tool to see the description label.

### Generic PA-Mode measurements

All generic measurements are described in the *Generic measurements* (page 597) appendix. The following generic measurements are available for PA-Mode images:

- Time Interval for B-Mode images (page 623)
- Linear distance (page 614)
- Traced distance (page 625)
- 2D area (page 597)
  - Mean and standard deviations (page 598)
- Angle (page 600)
- PA region measurement (page 620)
- VevoColor area (page 317)
  - Coloring a measured area (page 627)

---

## Measuring blood oxygenation



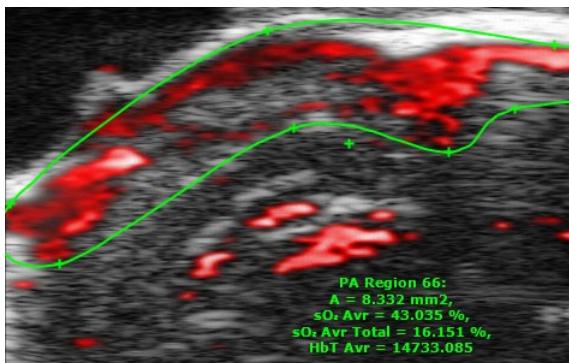
When you are analyzing an Oxy-Hemo sub-mode image, you can select specific target regions and precisely measure the percentage level of blood oxygenation in that region.

Vevo LAZR provides two measuring tools to measure your Oxy-Hemo images:

- **OxyZated™ tool** calculates and quantifies oxygen saturation. This tool is particularly useful for studying the hypoxic state of tumor microenvironment to predict disease burden, studying fetal/maternal physiology, and studying stroke/ischemia.
- **HemoMeaZure™ tool** measures and quantifies hemoglobin content and quantification. This tool is particularly useful for studying anemia.

► **To complete an oxygenation measurement:**

1. Open the Oxy-Hemo image and then press **Image Process**.
2. In the **Display Settings** section, select the appropriate **Display Map** and **Display Layout**.
3. Press **Measure** and click the photoacoustics region measurement button .
4. Click on your image to place the initial caliper along the boundary of the region you want to define.
5. Click approximately one-third the way around the boundary of the region and then click across to another point on the boundary. You have now created a defined region.
6. Typically, you will continue to click to add a few more points to define the boundary of your region more precisely.
7. To complete the region, right-click your final point. The completed Oxy-Hemo measurement appears.



► **To export a PA region measurement:**

1. Right-click the measurement and click **Export Region Values**.
2. In the **Export PA Region** page, browse to the location where you want to export the data and select the folder.
3. In the **Options** section, type the name of the region.
4. Click **OK**. The system exports the region measurement values.

**NOTE:** The PA measurements are cine loop measurements. The values displayed in the report or the exported report correspond to the frame as saved in the thumbnail image.

#### Related topics

- *Modifying points on a contour measurement* (page 303)

- *Modifying a contour measurement* (page 304)
- *Photoacoustics region measurement* (page 620)
- *Typical Oxy-Hemo sub-mode acquisition session* (page 380)

---

## Multiplexer control (NanoStepper color and layer views)

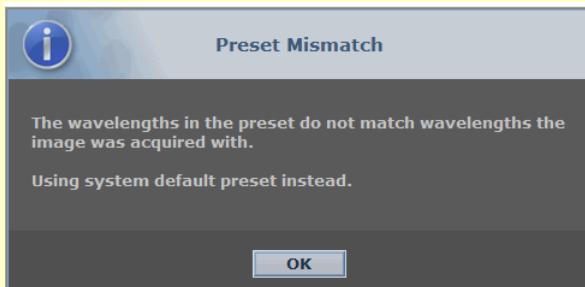


Multiplexer control is a set of tools you can use to assign color and other visual properties to each wavelength image series in your NanoStepper acquisition. You can then view these layers as individual or combined views of the data.

### Use multiplexer control tools to:

- Add between 1-5 image data layers that you can view individually or simultaneously in any combination
- Apply unique or common color overlays to each layer so you can more easily identify individual or combined wavelength image data
- Add or subtract wavelength values to a layer so you can produce unique visual displays
- Save a complete set of configurations as a named preset

**NOTE:** If you load a preset with wavelengths that do not match the wavelengths in the current image, the following message appears:



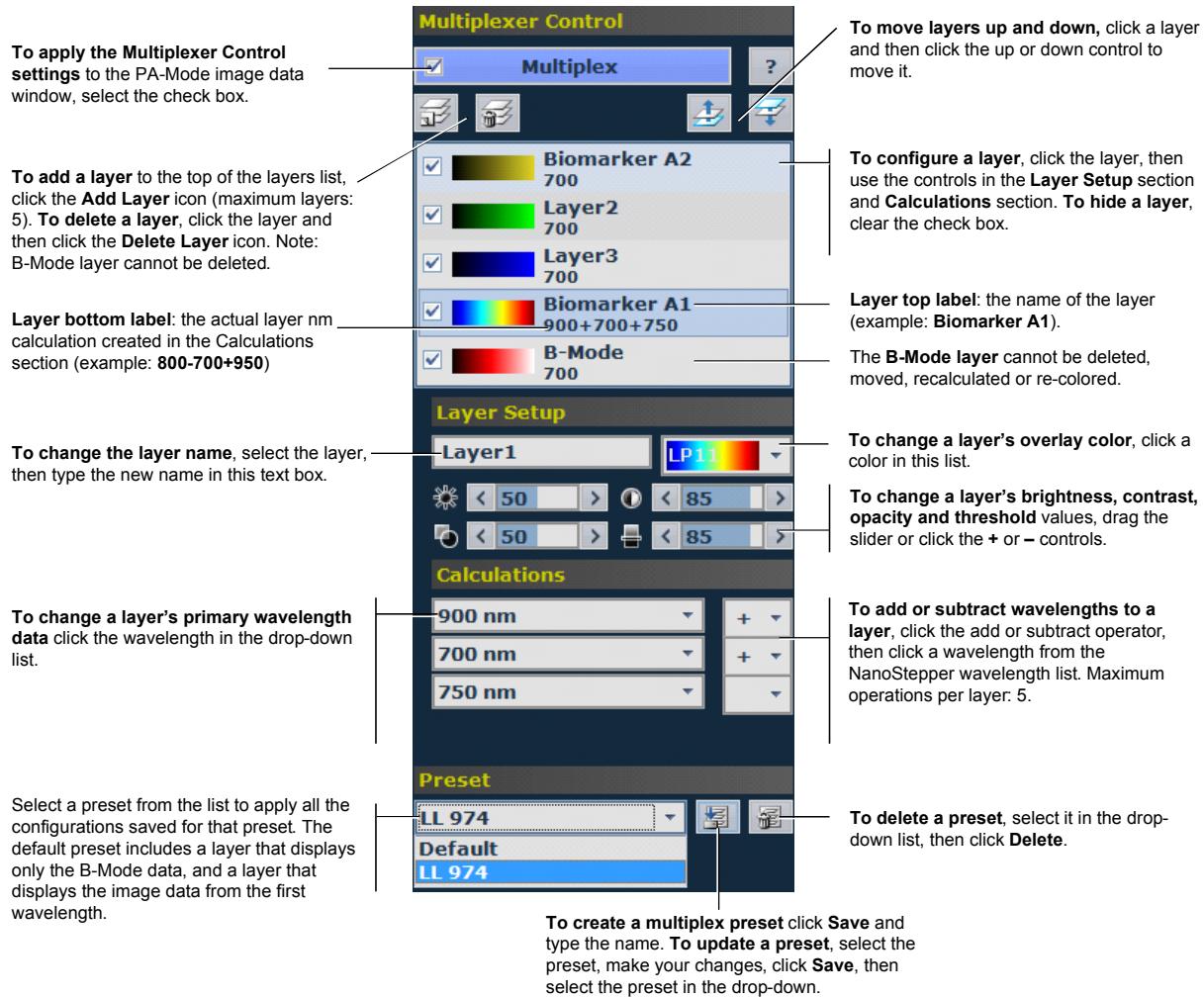
To apply a valid preset, click **OK**, create a new preset with the appropriate wavelengths for the image you want to work with, then apply that preset.

### ► To apply multiplexer controls to a PA-Mode (NanoStepper) image:

1. From the **Study Browser**, open your PA-Mode image and then in the image management panel click the **Multiplexer Control** tool .

- Click **Multiplex**. The image area refreshes and, on the right side, displays the default NanoStepper layer data in red for wavelength 1 in the NanoStepper series.
- Configure layers of NanoStepper-acquired image data using the tools in the **Multiplexer Control** panel to see the layers in the mode window.

The following diagram describes how to use the Multiplexer Control tools in the panel:



## Generating and analyzing NanoStepper 3D images



To compile the 3D image data the system follows the image acquisition process selected in the **PA-Mode** preferences tab (page 139). If you select **Sequential Wavelengths**, the process is comparatively faster and produces high quality image output. If you select **Alternating Wavelengths**, the process is comparatively slower and produces the highest quality image output.

### ► To generate and analyze NanoStepper 3D images:

1. Specify the 3D image acquisition process as described in *Setting the PA-Mode tab preferences* (page 139).
2. Press **3D**.
3. In the **3D Acquisition Setup** box, set up your 3D-Mode image slices parameters as described in the following table.

3D parameter	Description
Scan Distance	Sets the distance (in millimeters) that the 3D motor stage will travel during the entire 3D image acquisition. Scan distance ranges between 0.8 mm and 38 mm.
Step Size	Sets the distance that the 3D motor stage travels between each B-Mode slice. Step sizes ranges between 0.03 mm and 0.5 mm. <ul style="list-style-type: none"><li>▪ Smaller step size produces more image slices which generates a more detailed 3D image, typically useful for detailed evaluations of structures</li><li>▪ Higher step size produces fewer image slices which generates a less detailed 3D image, but typically suitable for quick evaluations of structure volumes</li><li>▪ The default value of the step size is based on the resolution of the transducer array</li></ul>
Scan Frames	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.

4. Press **Scan/Freeze**.

The system acquires the specified number of frames across the specified scan distance and displays the progress at the bottom of the image area.

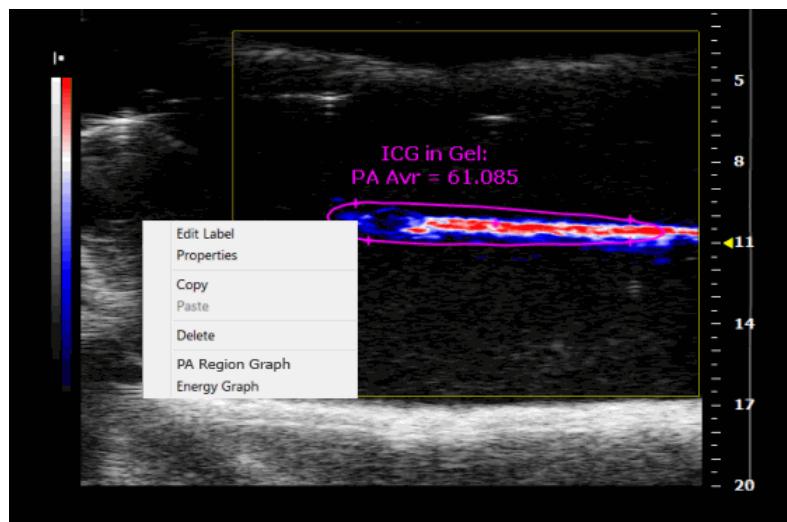
## Measuring region changes in a Photoacoustic loop



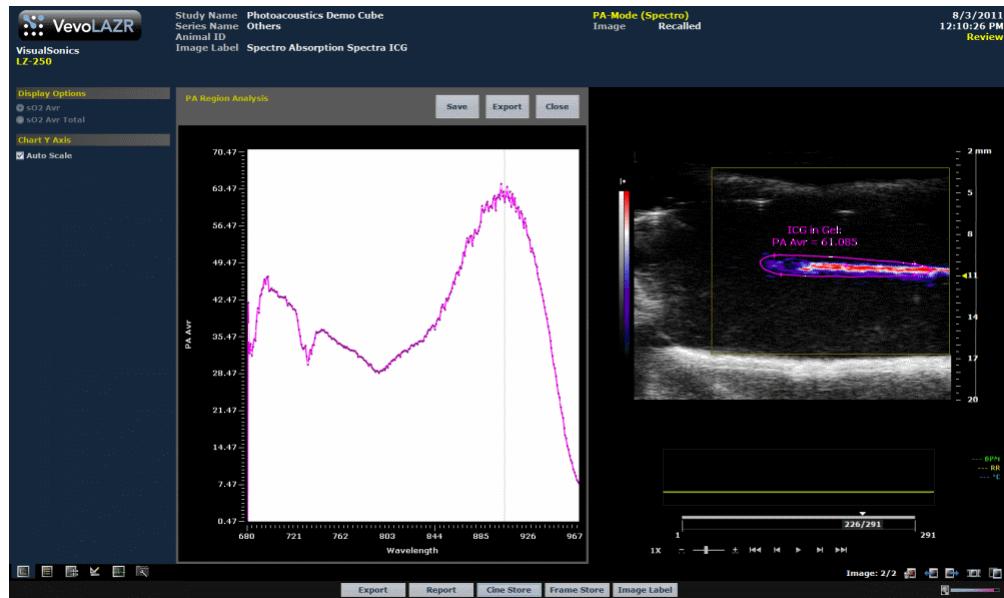
You can use the PA region graph feature of the photoacoustics region measurement tools to measure and graph the changes in PA-Mode data across wavelengths or frames in a defined region. First, you define the region of interest. Then you generate a graph that measures the energy changes that appear in that region over your PA-Mode loop.

### ► To measure region changes in a Spectro loop:

1. Open the Spectro image, click the PA Region measurement tool and place your measurement, as described in *PA region measurement* (page 620).
2. On the PA-Mode image, right-click the contour or the image label and select **PA Region Graph**.



The system calculates the contrast intensity within the boundaries of the region curve and displays the data in the **PA Region Analysis** window.



► **To save a TIFF image of the chart to a report:**

Click **Save**.

► **To export the PA region analysis:**

1. Click **Export**. The **Export Region** window appears.
2. In the folder browser, browse to the location where you want to export the data and select the folder.
3. In the **Export Type** section, select the appropriate type.
4. 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 the report.
5. Click **OK**. The system exports the analysis report.

## Section 12

# M-Mode imaging and analysis



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

M-Mode works fundamentally differently than B-Mode. Where B-Mode is a frame-based image that uses multiple scanning beams to create its image, M-Mode is a time-based image that uses just one beam.

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.

### In This Section

M-Mode acquisition.....	404
M-Mode analysis.....	416

## Chapter 54

# M-Mode acquisition

 Vevo 1100    Vevo 2100    Vevo LAZR

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.

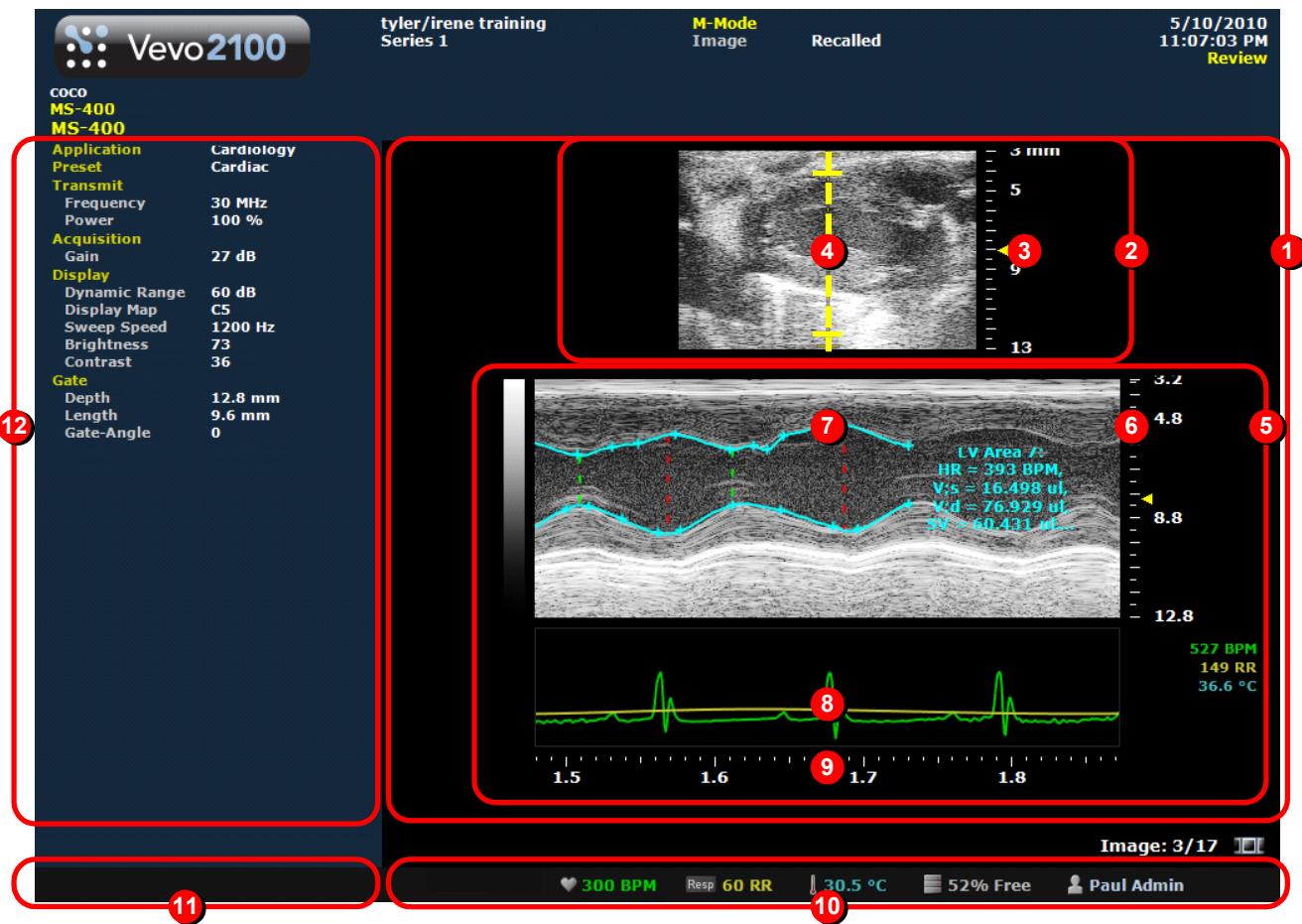
### In this chapter

M-Mode window workspace.....	405
Control panel controls for M-Mode and AM-Mode .....	409
M-Mode settings.....	412
Typical M-Mode image acquisition session.....	413
Setting the M-Mode region of interest.....	415

## M-Mode window workspace

Vevo 1100   Vevo 2100   Vevo LAZR

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.



### ① M-Mode Image area

This large area:

- Displays image data
- Displays physiological data for the animal (if recorded during image acquisition)
- Provides cine loop range controls for acquired cine loops
- Provides a Browse Images tool for scrolling through an inset gallery of images without having to return to the Study Browser

If you export an image and select Image as your export type, the system includes the image area content 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.

## **④ Sample gate overlay**

The sample gate overlay is the vertical line between the brackets in the small B-Mode scout window that relates to the content in the M-Mode region of interest window. The image data that the transducer acquires along this line is presented in the region of interest window.

## **⑤ 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.

## **⑥ Image scale**

Indicates in *mm* the distance from the face of the transducer.

## **⑦ 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.

## **⑧ Physiological data trace panel**

Displays the animal's dynamic heart rate, temperature, respiration rate and blood pressure data. This data is gathered by the Advanced Physiological Monitoring Unit that connects to the Vevo Imaging Station.

## **⑨ 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.

## **⑩ Status bar**

Displays:

-  3D motor position, when the 3D motor is initialized (where 3D-Mode is supported)
- Monitored physiological values in real time during image acquisition

**PREREQUISITES:** Live physiological data is only available a) when you enable the inputs in the Physiological tab of the Preferences window; and b) when the animal is connected to the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station.

For more detailed information on physiological monitoring, see *Vevo Imaging Station description* (page 69), *Physiological preferences tab* (page 141) and *Setting up to acquire physiological data* (page 269).

- Percentage of **free space** to store image data so you can see when you should start to back up your image data to free up space on the system
-  User name, in blue, when **User Management Mode** is enabled (where User Management Mode is supported)
-  Elapsed session time when you hover over the displayed blue user name when User Management Mode is enabled.

## **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.
- Confirmation messages when you store an image.
- The updated parameter and system information when you make adjustments on the control panel.
- Control options in the acquisition mode you are using. To select, either a) cursor to the option and then click; or b) turn the **Screen Keys** dial to display the option, then press the dial.

## **⑫ Image mode management panel**

Displays a unique set of controls and information sections depending on the control key you press, or the image management panel tab you click:

- 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 (where ECG Trigger is supported).
- Press **Image Process** to set the panel to display the controls for brightness, contrast, baseline, priority, display maps, display layouts, loading into 3D and TGC loading and saving.
- Press **Mode Settings** to set the panel to display the Mode settings. This is the default panel when you open a Mode window.

## Control panel controls for M-Mode and AM-Mode



When you are acquiring M-Mode image data, these are the controls you use to optimize the image data you see in the lower window of the image area.



### ① 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.

### ② Transmit Power

Adjusts the power of the ultrasound signal transmission.

Turn the dial 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 Back

- Removes or cancels the last measurement point before you commit your measurement.
- Resets the parameters to the pre-defined values in the current preset.

### ⑤ Invert

Flips the image. **In M-Mode and AM-Mode:** In the dual window view, press to flip the B-Mode scout image left/right.

### ⑥ Display Map

Cycles through a predefined set of overlays and optimization maps that you can apply either while you acquire or review image data. Push up or pull down to cycle through the available maps for the active imaging mode.

### ⑦ 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.
- Pull down to decrease the range by 5dB and increase contrast.

**In M-Mode:** applies to the images in both the M-Mode window as well as the B-Mode scout window.

### ⑧ 2D Gain

Adjusts the visual intensity of the signal when it returns to the face of the transducer. Turn clockwise to add gain and brighten the mode data, turn counterclockwise to reduce gain and darken the mode data.

**In M-Mode:** Applies to the images in both the M-Mode window as well as the B-Mode scout window.

**9** **Update**

### 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**.

 **10 PW Angle/AM-Mode**

Steers the sample volume to an angle other than the vertical position.

#### In M-Mode: Adjusts the gate angle.

- If you adjust this angle during acquisition, the system starts scanning again
- If you set an angle other than 0°, the system acquires data in AM-Mode

**In AM-Mode:** Adjusts the angle of image data acquisition (in 5-degree increments on the ultrasound cart control panel; in 1-degree increments on Vevo LAB) through the ultrasound grayscale information along the sample volume plane. Turn right to increase the angle; turn left to decrease the angle.

**11** **SV/Gate**

Push up to increase. Pull back to decrease.

**In M-Mode and AM-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.

**12** **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 and AM-Mode:** Set the sweep speed parameter in a range from 200 Hz to 4000 Hz (AM-Mode range can be slightly different) 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 settings



► **To view the M-Mode settings:**

Press **Mode Settings**. The settings panel displays the following parameters:

### Transmit

Parameter	Description
Frequency	The ultrasound frequency, measured in <i>MHz</i> . Adjust with the <b>Frequency</b> control.
Power	The transmission power level of the ultrasound signal, displayed as a percentage of the maximum power. Adjust with the <b>Transmit Power</b> control.

### Acquisition

Parameter	Description
Gain	The strength of the ultrasound signal in <i>dB</i> increments when it returns to the face of the transducer. Adjust with the <b>2D Gain</b> control.
TGC	The saved TGC control curve that has been manually loaded for the current image acquisition. Adjust in the <b>Image Process</b> panel. Click <b>Load</b> to apply a different TGC control curve.

### Display

Parameter	Description
Dynamic Range	The contrast of your image, measured in <i>dB</i> . Adjust with the <b>Dynamic Range</b> control.

Parameter	Description
Display Map	The selected predefined display map from the predefined set of maps. Adjust with the <b>Display Map</b> control.
Sweep Speed	The cine loop playback speed, measured in Hz in a range from 200 to 4000 Hz. Adjust with the <b>Sweep Speed</b> control.
Brightness	The image brightness level. Adjust with the <b>Brightness</b> slider in the image management panel after you press <b>Image Process</b> .
Contrast	The image contrast level. Adjust with the <b>Contrast</b> slider in the image management panel after you press <b>Image Process</b> .

## Gate

Parameter	Description
Depth	The distance, measured in mm, from the face of the transducer. Adjust with the <b>Image Depth</b> control.
Length	The length, measured in mm, of the gate. Adjust with the <b>SV/Gate</b> control.
Gate-Angle	 Number of degrees away from 0° (the current position of the transducer) that the cross-section data through the B-Mode image is being acquired. Adjust with the <b>PW Angle/AM-Mode</b> control.

## Typical M-Mode image acquisition session



### Before you begin acquiring data

If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 269).
- Prepare your animal on the animal platform. For detailed information refer to the user manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 273).

### ► To acquire an M-Mode image:

1. Start imaging in B-Mode and position the transducer to situate the 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.
3. Press **M-Mode**.

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 409) to refine your image acquisition settings if required.
8. Press **Scan/Freeze** 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** to resume scanning.
12. Save images as required.
13. In the function keys row, 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 416)
- *Adding protocol measurements* (page 298)

## 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 image management panel press **Mode Settings**.

The mode settings panel displays the following **Gate** parameters.

Parameter	Description
Depth	The distance in mm from the face of the transducer to the center of the gate.
Length	The length in mm of the gate.

4. Adjust the **PW Angle/AM-Mode** to *steer* the cross-section data digitally through the B-Mode image away from the current position of the transducer.

**NOTE:** The moment the angle changes from 0 degrees to any other value, the system is acquiring data in AM-Mode.

The mode settings panel displays the **Gate-Angle** value.

# M-Mode analysis

 Vevo 1100  Vevo 2100  Vevo LAZR

This chapter shows you how to analyze M-Mode images.

## In this chapter

Adding generic M-Mode measurements .....	416
Adding protocol measurements.....	417
Creating pressure-volume loop measurements in M-Mode.....	419

---

## Adding generic M-Mode measurements

 Vevo 1100  Vevo 2100  Vevo LAZR

M-Mode provides five generic measurement tools. Use these tools when you want to add measurements that are not part of a measurement protocol.

### Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want the default to be to hide them, go to **Prefs** > **Measurements** tab, clear the **Show Values and Labels** check box and save your edits in a custom measurement package.
- If you want to temporarily override the default, clear or select the **Show Values and Labels** check box at the bottom of the measurement panel.



### ► 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 image management panel. Hover over a tool to see the description label.

### Generic M-Mode measurements

All generic measurements are described in the *Generic measurements* (page 597) appendix. The following generic measurements are available for M-Mode images:

- Depth interval (page 612)
- Velocity (page 626)
- Heart rate (page 613)
- M-Mode LV wall trace (page 619)
  - Modifying the trace
  - Refining the trace
- Time Interval for M-Mode images (page 624)

## Adding protocol measurements



Protocol measurements are labeled uniquely for a specific measurement protocol.

► **Step 1: 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**.

► **Step 2: Place the 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 measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement.

## Next step

- *Reporting your analysis results* (page 319)

## Related information

- *Analyzing image data* (page 286)
- *Protocol measurements* (page 297)

## Adding M-Mode measurement chains

 Vevo 1100    Vevo 2100    Vevo LAZR

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.

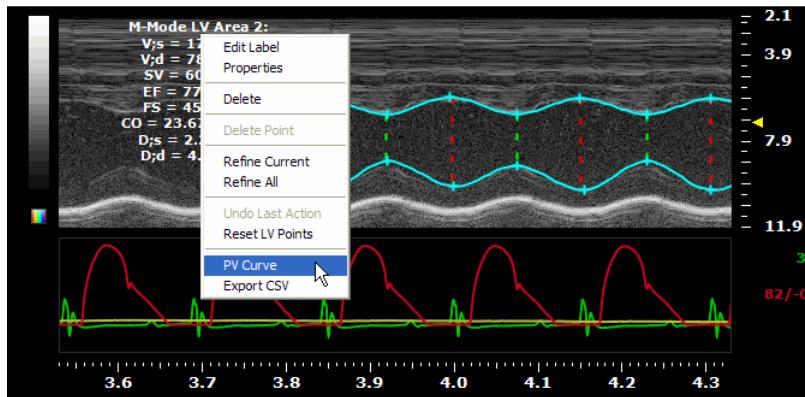
Within a study, you can also display PV loops from different cine loops from different series.

This section describes how to obtain PV loops from M-Mode images.

► **To obtain PV loops from an M-Mode image:**

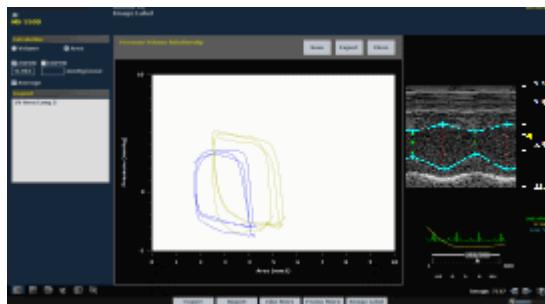
1. Create an M-Mode cine loop of the heart in a long-axis orientation.
2. Complete an M-Mode LV Area wall trace measurement (page 619) that includes at least two cardiac cycles.

- 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.

- 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

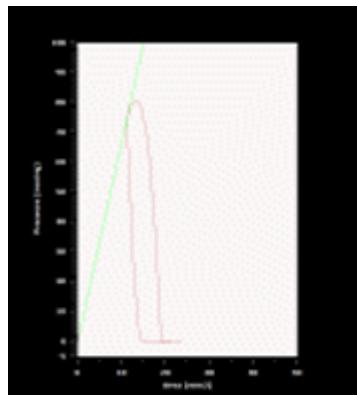
Vevo 1100   Vevo 2100   Vevo LAZR

When you have generated pressure-volume graph data, you can use the tools on the Pressure Volume Relationship window to:

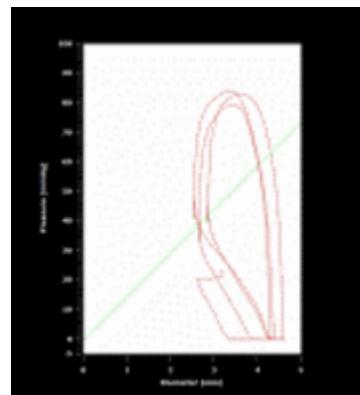
- Display the end systolic PV points
- Display the end diastolic points
- Display a loop that represents a virtual or averaged cardiac cycle
- Toggle the horizontal dimension between Volume and the basic dimension of the loops
- Export the pressure-volume relationship data

### ESPVR check box

Check this box to display the end systolic PV points.



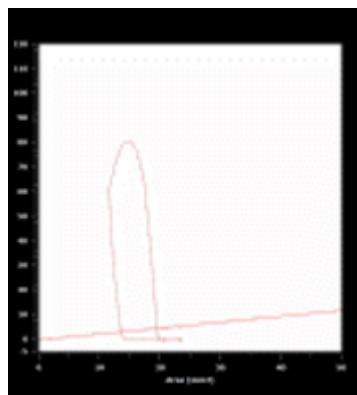
If the graph displays one measurement over one cycle, the system plots a green dot on the curve at the End Systolic point.



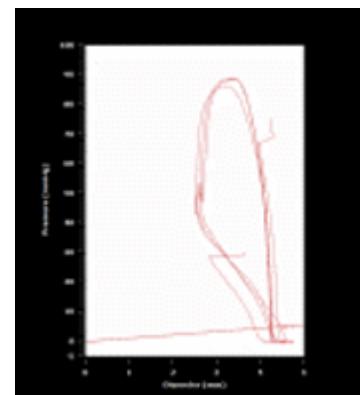
If the graph displays one measurement over multiple cycles, the system plots a best-fit line through the End Systolic points.

#### EDPVR check box

Check this box to display the end diastolic points.



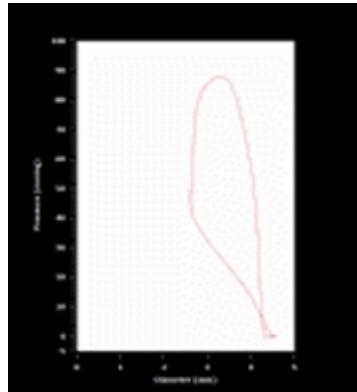
If the graph displays one measurement over one cycle, the system plots a red dot on the curve at the End Diastolic point.



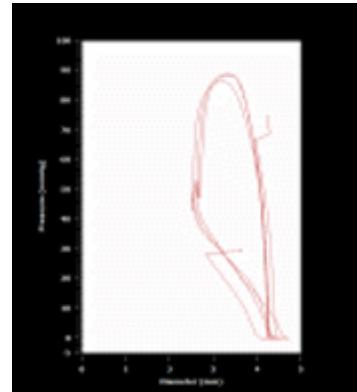
If the graph displays one measurement over multiple cycles, the system plots a best-fit line through the End Diastolic points.

#### 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 derived from the data from all measurements over all cardiac cycles.



When the Average option is cleared, the graph displays the loops derived from each measurement over all the cardiac cycles.

### Volume command

Click this command to toggle the horizontal dimension between Volume and the basic dimension of the loops. For measurements made in M-Mode the dimension is Diameter in millimeters. For measurements made in B-Mode, the dimension is Area in square millimeters.

### Export command

Click this command to export the data 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.

## Section 13

# Anatomical M-Mode imaging and analysis



Anatomical M-Mode, or *AM-Mode*, is a modification to standard M-mode typically used in echocardiography; anatomical M-mode is a tool you can use to steer the sample volume to any angle, rather than positioning the sample volume in a strict vertical position.

### In This Section

Anatomical M-Mode acquisition.....	424
Anatomical M-Mode analysis.....	429

# Anatomical M-Mode acquisition

 Vevo 2100  Vevo LAZR

This chapter shows you how to acquire Anatomical M-Mode (AM-Mode) images.



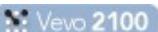
**WARNING:** High levels of ultrasound energy can damage tissue. Do not touch the transducer when acoustic power could be generated.

## In this chapter

Typical Anatomical M-Mode image acquisition session .....	424
Reconstructing AM-Mode images from B-Mode or EKV Mode .....	426

---

## Typical Anatomical M-Mode image acquisition session

 Vevo 2100  Vevo LAZR

Anatomical M-Mode (AM-Mode) gives users a tool to obtain anatomically correct LV measurements along any line through a B-Mode image.

Unlike M-Mode data, which is acquired directly along a single acquisition line, AM-Mode data is constructed. The system generates an AM-Mode spectrum from the acquired B-Mode cine loop based on the ultrasound grayscale information along the sample volume plane. However, all controls that are available in M-Mode are also available in AM-Mode.

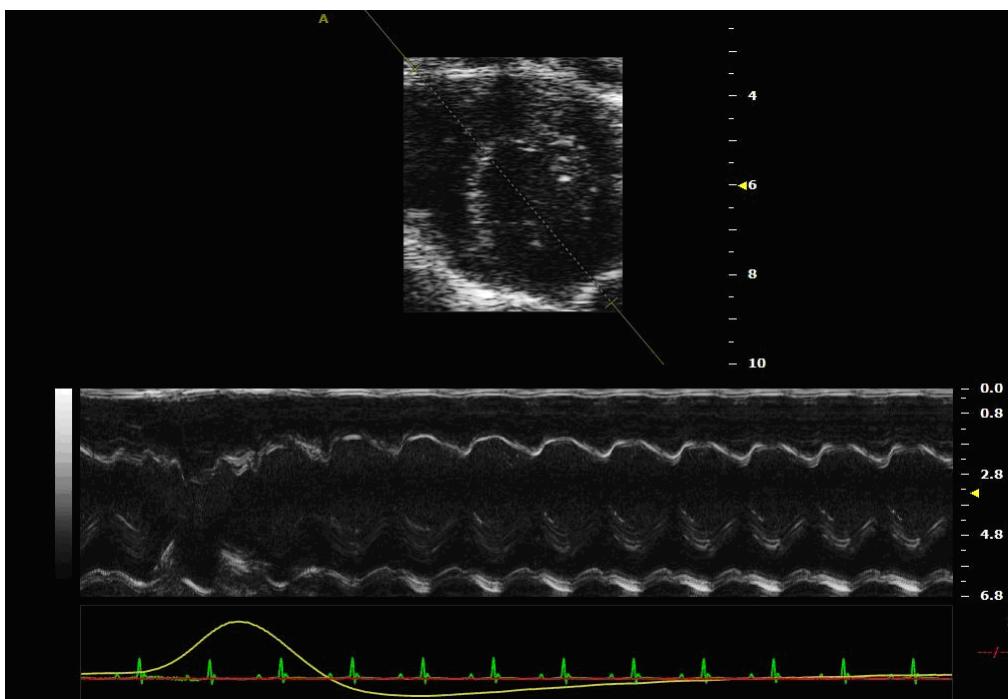
### Before you begin acquiring data

If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 269).
- Prepare your animal on the animal platform. For detailed information refer to the user manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 273).

► **To acquire an AM-Mode image:**

1. Start imaging in B-Mode and position the transducer to situate the 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.
  3. Press **M-Mode**. 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. Turn the **PW Angle/AM-Mode** knob to adjust the orientation of the sample volume. As you change the orientation of the sample volume, the letter **A** is displayed in the scout window. This indicates that the active mode and the screen label are now being displayed as **AM-Mode**.



6. (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.

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 M-Mode controls (page 409) to refine your image acquisition settings if required.
9. Press **Scan/Freeze** 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 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**
12. Press **Scan/Freeze** to resume scanning.
13. Save images as required.
14. In the function keys row, 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.

#### Related information

- *Control panel controls for M-Mode* (page 409)
- *M-Mode acquisition settings* (page 412)
- *Setting the M-Mode region of interest* (page 415)

#### Next step

- *Adding generic M-Mode measurements* (page 416)
- *Adding protocol measurements* (page 298)

## Reconstructing AM-Mode images from B-Mode or EKV Mode



AM-Mode cine loops can be reconstructed from B-Mode or EKV-Mode cine loops.

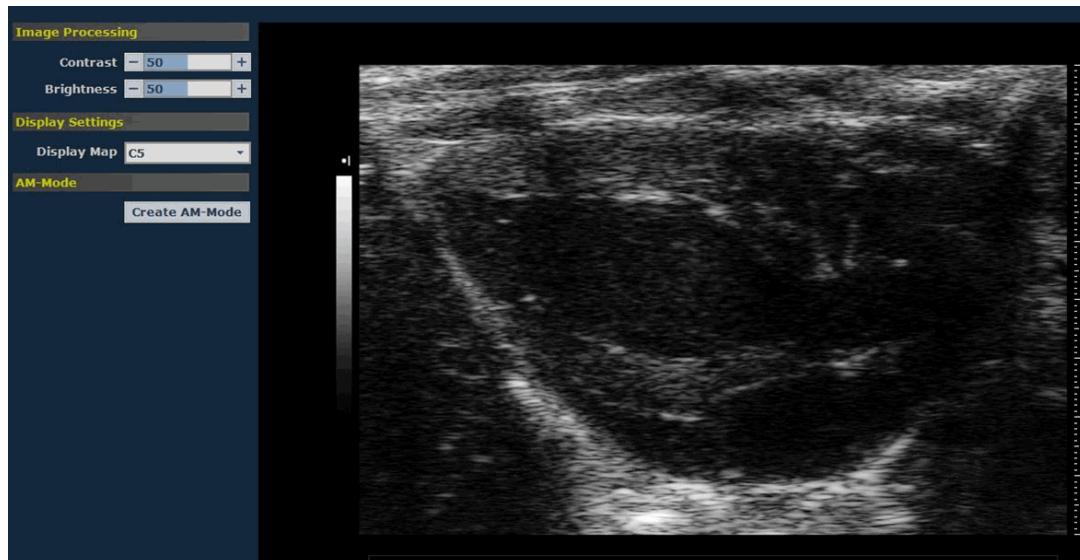
### ► To reconstruct an AM-Mode image from B-Mode or EKV Mode:

1. From the **Study Manager** open a B-Mode cine loop or an EKV Mode cine loop to be reconstructed.

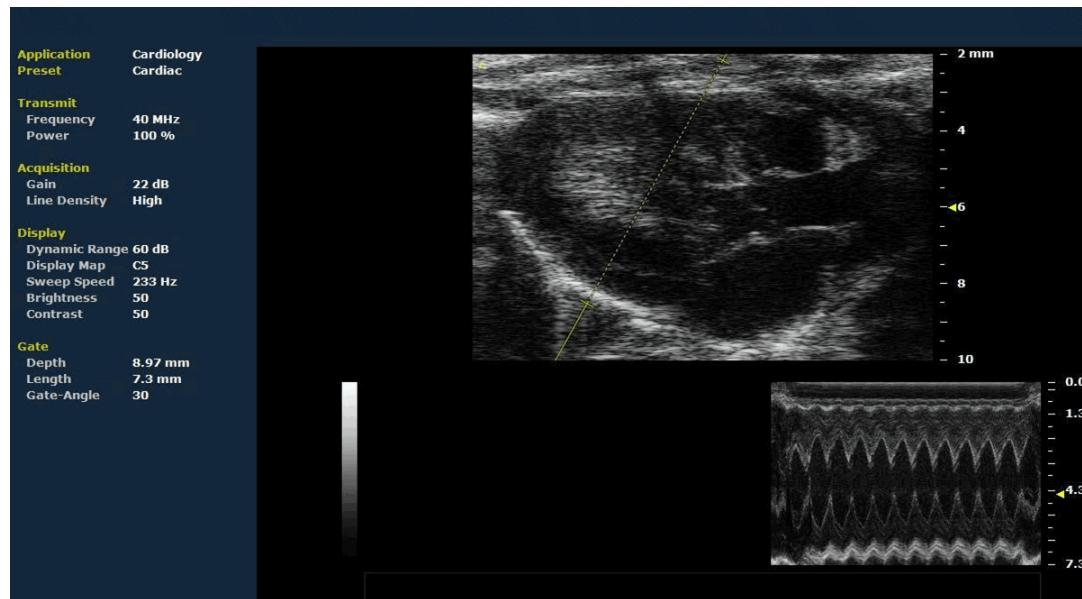
2. On the image management panel tabs:
  - a. Click the Image Processing tab 
  - b. In the **AM-Mode** section, click **Create AM-Mode**. The screen switches to the AM-Mode image area with the status of the image labeled as **Regenerated**.
3. In the AM-Mode image area you can change the orientation, depth and position of the sample volume at their discretion in order to reconstruct the desired motion profile. These changes are reflected on the AM-Mode image scale.
4. 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**

**NOTE:** To ensure good image quality for AM-Mode reconstruction in review, ensure that you acquire the B-Mode cine loop image data at a frame rate of at least 500.

**NOTE:** AM-Mode reconstruction is not available in the following acquisition scenarios:  
 - For B-Mode cine loops acquired using ECG or Respiration gating.  
 - For B-Mode cine loops acquired with less than 50 frames  
 - For B-Mode cine loops acquired with a Frame Rate of less than 20 Fps.  
 - For B-Mode cine loop acquired with Zoom ON.  
 - From B-Mode 3D or RF B-Mode 3D cine loops.



*B-Mode image in the Image Processing panel. Click Create AM-Mode to reconstruct the Anatomical M-Mode from this B-Mode cine loop.*



*AM-Mode reconstructed image from a 300 frames B-Mode cine loop. The positions, orientation and depth of the AM-Mode sample volume can be changed as required for the desired motion profile.*

# Anatomical M-Mode analysis

 Vevo 2100  Vevo LAZR

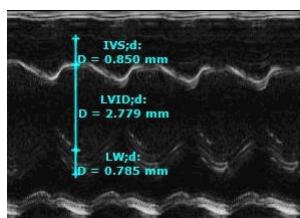
Anatomical M-Mode (AM-Mode) images have all the tools, measurements, display and export functionality that are already available in M-Mode. See *Analyzing M-Mode images* (page 416).

Measurements specific for this mode are available for the Short Axis view as this is the imaging view that would benefit the most from this software tool.

When reviewing an AM-Mode cine loop for the short axis view the protocols available in the Cardiac Package Measurements tools are:

- LV Mass protocol- which has the LV trace measurements - identical with M-Mode functionality
- Anatomical M-Mode protocol, with the following list of measurements:
  - IVS (for systole and diastole)
  - LVID (for systole and diastole)
  - Lateral Wall (for systole and diastole)

All measurements listed in the protocol are depth measurements and chained such that by selecting one of them the user is pointed with the following measurement in order to avoid errors in tracing the sequence. Tracing the chained measurements is similar to the SAX protocol from M-Mode, described in *Adding protocol measurements* (page 298).



AM-Mode chained measurements traced at the diastole: IVS; $d$ , LVID; $d$ , LW; $d$

**NOTE:** If you change the AM-Mode angle in a recreated image, the system deletes all the measurements. If you make a new measurement, the system resaves the image.

## Section 14

# 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.

### In This Section

PW Doppler Mode acquisition .....	431
PW Tissue Doppler Mode acquisition .....	447
PW Doppler Mode and PW Tissue Doppler Mode analysis .....	449

## Chapter 58

# PW Doppler Mode acquisition

 Vevo 1100    Vevo 2100    Vevo LAZR

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

PW Doppler Mode window workspace.....	432
Control panel controls for PW Doppler Mode .....	436
PW Doppler Mode settings.....	441
Typical PW Doppler Mode image acquisition session .....	443
Setting the PW Doppler Mode sample volume.....	444
Setting the PW Doppler Mode sample volume in a distance blockout zone .....	445
Exporting PW Doppler Mode cine loop audio.....	445

## PW Doppler Mode window workspace

Vivo 1100 Vivo 2100 Vivo LAZR

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.



### ① Image area

This large area:

- Displays image data
- Displays physiological data for the animal (if recorded during image acquisition)
- Provides cine loop range controls for acquired cine loops
- Provides a Browse Images tool for scrolling through an inset gallery of images without having to return to the Study Browser

If you export an image and select Image as your export type, the system includes the image area content 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

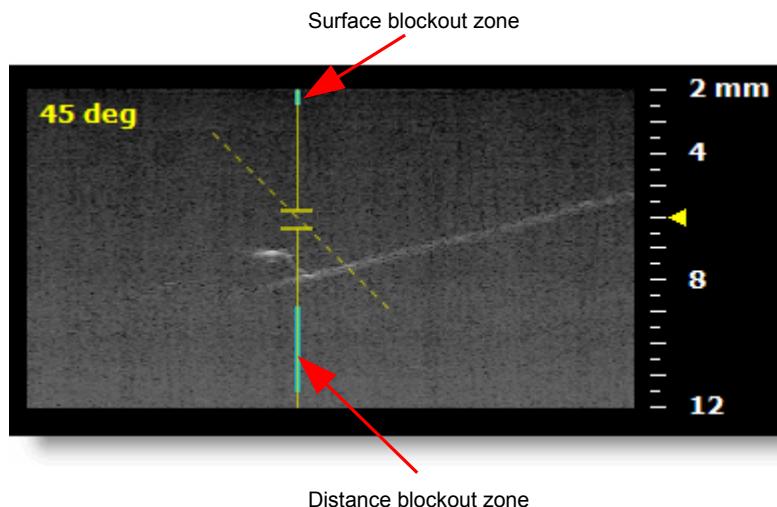
Indicates in *mm* the distance from the face of the transducer.

## ④ 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.

## ⑤ 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.

## ⑥ 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 Mode Settings tab of the Preferences window.

## ⑦ PW Doppler Mode data

Displays the spectral display of the velocity data.

## ⑧ Scale indicator

Indicates the velocity of blood flow. You can set it to Velocity or Frequency in the General tab of the Preferences window.

## ⑨ 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.

## ⑩ 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).

## ⑪ Physiological data trace panel

Displays the animal's dynamic heart rate, temperature, respiration rate and blood pressure data. This data is gathered by the Advanced Physiological Monitoring Unit that connects to the Vevo Imaging Station.

## ⑫ 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.

## ⑬ Status bar

Displays:

-  3D motor position, when the 3D motor is initialized (where 3D-Mode is supported)
- Monitored physiological values in real time during image acquisition

**PREREQUISITES:** Live physiological data is only available a) when you enable the inputs in the Physiological tab of the Preferences window; and b) when the animal is connected to the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station.

For more detailed information on physiological monitoring, see *Vevo Imaging Station description* (page 69), *Physiological preferences tab* (page 141) and *Setting up to acquire physiological data* (page 269).

- Percentage of **free space** to store image data so you can see when you should start to back up your image data to free up space on the system
-  User name, in blue, when **User Management Mode** is enabled (where User Management Mode is supported)
-  Elapsed session time when you hover over the displayed blue user name when User Management Mode is enabled.

## ⑭ 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.
- Confirmation messages when you store an image.
- The updated parameter and system information when you make adjustments on the control panel.
- Control options in the acquisition mode you are using. To select, either a) cursor to the option and then click; or b) turn the **Screen Keys** dial to display the option, then press the dial.

## ⑮ Image mode management panel

Displays a unique set of controls and information sections depending on the control key you press, or the image management panel tab you click:

- 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 (where ECG Trigger is supported).
  - Press **Image Process** to set the panel to display the controls for brightness, contrast, baseline, priority, display maps, display layouts, loading into 3D and TGC loading and saving.
  - Press **Mode Settings** to set the panel to display the Mode settings. This is the default panel when you open a Mode window.

## Control panel controls for PW Doppler Mode

 Vevo 1100  Vevo 2100  Vevo LAZR

When you are acquiring PW Doppler Mode image data, these are the controls you use to optimize the image you see on the screen.



## 1 Transmit Power

Adjusts the power of the ultrasound signal transmission.

Turn the dial 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%.

## 2 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.

## 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 Back

- Removes or cancels the last measurement point before you commit your measurement.
- Resets the parameters to the pre-defined values in the current preset.

## 5 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.

## 6 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.
- Pull down to decrease the range by 5dB and increase contrast.

**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.

**7** **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.

Unless the system is in simultaneous (duplex) mode, the B-Mode image remains constant with only a change displayed within the PW Doppler spectrum.

**8** **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.

**9** **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 element 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 reflected in the top-left corner of the B-Mode scout image. This is the angle between the ultrasound beam and the PW angle.

**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.

**10** **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:** PW Doppler Mode and PW Tissue Doppler Mode image acquisition sessions.

#### ⑪ 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.

#### ⑫ 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.

#### ⑬ SV/Gate

Push up to increase. Pull back to decrease.

**In PW Doppler Mode and PW Tissue Doppler Mode:** This control adjusts the distance in *mm* of the vertical line between the two yellow calipers of the *sample volume*. The primary gate is noticeably larger and thicker, with a larger and longer PW Angle indicator.

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.

#### 14 PW Angle/AM-Mode

Adjusts the angle correction (5-degree increments on the ultrasound cart control panel; 1-degree increments on Vevo LAB) between the vertical line of the ultrasound pulse from the face of the transducer and the direction of vascular flow in the sample volume in a PW Doppler Mode image acquisition session. The dashed yellow line indicates the direction of flow.

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° and 80°, regardless of which side of the vertical line you align the dashed line.

For angles between 60° and 80°, 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.

**In PW Doppler Mode:** Adjusts the PW Doppler angle between 0° and 80°.

#### 15 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 PW 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 Mode Settings preferences tab ([Prefs > Mode Settings tab](#)), 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.

**⑯**  **Tissue**

Activates PW Tissue Doppler Mode image acquisition after you begin acquiring in B-Mode. Press to begin displaying the yellow PW Tissue Doppler Mode sample volume, press **Update** to display the live PW Tissue Doppler Mode spectral data in the lower window and the live B-Mode data in the scout window, then press **Simul**.

**⑰**  **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 settings



► **To view the PW Doppler Mode settings:**

Press **Mode Settings**. The settings panel displays the following parameters:

### Transmit

Parameter	Description
Frequency	The ultrasound frequency, measured in MHz. Adjust with the <b>Frequency</b> control.
Power	The transmission power level of the ultrasound signal, displayed as a percentage of the maximum power. Adjust with the <b>Transmit Power</b> control.
PRF	The pulse repetition frequency (PRF) of the transmitted PW Doppler signal, measured in kilohertz. This parameter defines the maximum observable PW Doppler frequency shift and flow velocity. Adjust with the <b>Velocity</b> control.

### Acquisition

Parameter	Description
Doppler Gain	The PW Doppler frequency, measured in dB. Adjust with the <b>Doppler Gain</b> control.
Beam Angle	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 <b>Beam Angle</b> control.

Wall Filter	The level of low velocity signals, measured in Hz, filtered out of the spectral display. Adjust with the <b>Wall Filter</b> control.
<b>NOTE:</b> Wall Filter control does not apply to PW Tissue Doppler Mode.	
Simultaneous	The state (On or Off) of the <i>simultaneous</i> display of live acquisition data in both the B-Mode scout window and the PW Doppler Mode image window. Adjust with the <b>Simul</b> control.
TGC	The saved TGC control curve that has been manually loaded for the current image acquisition. Adjust in the <b>Image Process</b> panel. Click <b>Load</b> to apply a different TGC control curve.

## Display

Parameter	Description
Dynamic Range	The contrast of your image, measured in <i>dB</i> . Adjust with the <b>Dynamic Range</b> control.
Display Map	The selected predefined display map from the predefined set of maps. Adjust with the <b>Display Map</b> control.
Brightness	The image brightness level. Adjust with the <b>Brightness</b> slider in the image management panel after you press <b>Image Process</b> .
Contrast	The image contrast level. Adjust with the <b>Contrast</b> slider in the image management panel after you press <b>Image Process</b> .

## Doppler SV

Parameter	Description
Depth	The distance, measured in mm, from the face of the transducer. Adjust with the <b>Image Depth</b> control.
Size	The length, measured in mm, of the sample volume. Adjust with the <b>SV/Gate</b> control.
Angle	<p>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.</p> <p>This angle always displays a positive value between 0° and 80°, regardless of which side of the vertical line it is positioned on.</p> <p>Adjust with the <b>PW Angle/AM-Mode</b> control.</p>

## Typical PW Doppler Mode image acquisition session



### Before you begin acquiring data

If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 269).
- Prepare your animal on the animal platform. For detailed information refer to the user manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 273).

### ► 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 444).
3. Adjust the **Image Width** control to remove image content outside the region of interest.
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 436) to refine your image acquisition settings if required.
9. Press **Scan/Freeze** 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.
  - To save a cine loop press **Cine Store**.
  - To name the image you just stored, press **Image Label**.
12. Press **Scan/Freeze** to resume scanning.

13. Save images as required.
14. In the function keys row, press **Close**. The system closes the series you are working on and displays the **Study Information** window.  
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 449)
- *Adding protocol measurements* (page 298)

---

## 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).

► **To set a PW Doppler SV:**

1. Begin acquiring data in a frame-based mode (for example, B-Mode) and position the 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 441) are not displayed in the image management 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 **PW Angle/AM-Mode** 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 a 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 **PW Angle/AM-Mode** 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 240) 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 240) and in the **File Type** box select **Windows Audio Wave File**.

**Related information**

- *Exporting images to DICOM from the Study Browser* (page 247)

# PW Tissue Doppler Mode acquisition

 Vevo 2100  Vevo LAZR

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.....	447
Analyzing PW Tissue Doppler Mode images .....	448

---

## Typical PW Tissue Doppler Mode image acquisition session

 Vevo 2100  Vevo LAZR

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 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 443).

- Press **Tissue** instead of **PW** when you begin the acquisition.
- Set a sample volume as defined in *Setting the PW Doppler sample volume* (page 444).

---

## 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 449).

# PW Doppler Mode and PW Tissue Doppler Mode analysis

 Vevo 1100  Vevo 2100  Vevo LAZR

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

PW Doppler Mode analysis .....	449
PW Tissue Doppler Mode analysis.....	453

---

## PW Doppler Mode analysis

 Vevo 1100  Vevo 2100  Vevo LAZR

This section describes how to analyze PW Doppler Mode analysis images that are saved to a study.

## Adding generic PW Doppler Mode measurements

 Vevo 1100  Vevo 2100  Vevo LAZR

PW Doppler Mode provides six generic measurement tools. Use these tools when you want to add measurements that are not part of a measurement protocol.

### Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want the default to be to hide them, go to **Prefs > Measurements** tab, clear the **Show Values and Labels** check box and save your edits in a custom measurement package.
- If you want to temporarily override the default, clear or select the **Show Values and Labels** check box at the bottom of the measurement panel.



- **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 image management panel. Hover over a tool to see the description label.

### Generic PW Doppler Mode measurements

All generic measurements are described in the *Generic measurements* (page 597) appendix. The following generic measurements are available for PW Doppler Mode images:

- Acceleration (page 600)
- Velocity (page 626)
- VTI measurement without real-time frequency trace enabled (page 629)
- VTI measurement with automatic frequency trace (page 628)
- Coloring areas in a VTI trace (page 302)
- Heart rate (page 613)
- Single point (page 622)
- Time Interval (page 625)

## Applying automatic traces to the frequency waveform

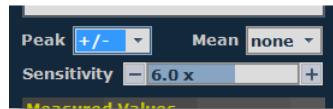


You can set the system to apply a range of peak and mean frequency traces to your PW Doppler spectral data.

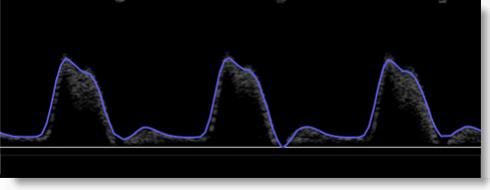
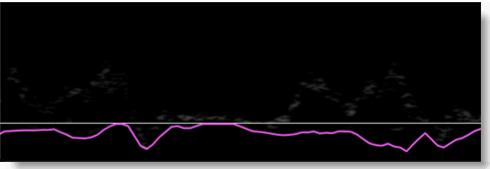
You can apply these traces in real-time to the data in your cine loop acquisition buffer or to an acquired cine loop.

- **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, drag the Sensitivity slider left or right.

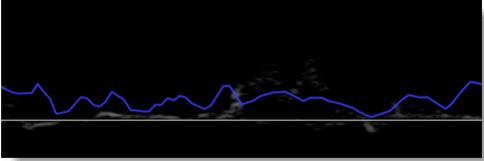
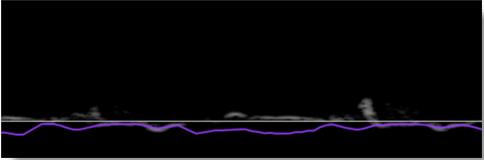
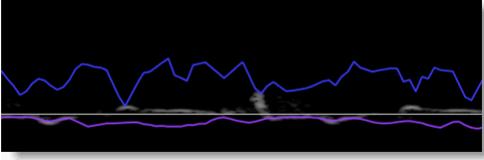


## Peak

Option	Description
none	The system does not apply a trace.
+	Applies a blue trace to all positive peak frequency signal traces (flow moving toward the transducer face) along the entire cine loop. 
-	Applies a pink trace to all negative peak frequency signal traces along the entire cine loop. 
+ / -	Applies both the positive as well as the negative peak frequency traces. 
auto	Applies a green trace to the largest velocity values, positive and negative, along the entire cine loop. 

## Mean

Option	Description
none	The system does not apply a trace.

Option	Description
+	Applies a blue trace to all positive mean frequency signal traces along the entire cine loop. 
-	Applies a purple trace to all negative mean frequency signal traces along the entire cine loop. 
+ / -	Applies both the positive as well as the negative mean frequency traces. 

### Related information

- *VTI measurement with automatic frequency trace* (page 628)

## Adding protocol measurements



Protocol measurements are labeled uniquely for a specific measurement protocol.

- ▶ **Step 1: 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**.
  
- ▶ **Step 2: Place the 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 measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement.

#### Next step

- *Reporting your analysis results* (page 319)

#### Related information

- *Analyzing image data* (page 286)
- *Protocol measurements* (page 297)

---

## PW Tissue Doppler Mode analysis



Vevo 2100



This section describes how to analyze PW Tissue Doppler Mode analysis images that are saved to a study. PW Tissue Doppler mode images provide all the measurement and analysis tools that are provided in PW Doppler mode analysis.

#### Related information

- *Adding generic PW Doppler Mode measurements* (page 449)
- *Applying automatic traces to the frequency waveform* (page 450)
- *Adding protocol measurements* (page 298)

## Section 15

# 3D-Mode imaging and analysis



3D-Mode provides a three-dimensional view of an area of interest from frame-based imaging modes, excluding PA-Mode (Spectro) and EKV Mode. The system acquires the 3D data by a) creating a rapid series of B-Mode slices, and then b) combining these slices into a whole image. You can then view the structures you are interested in by using the analysis and measurement tools.

### In This Section

How 3D-Mode works .....	455
3D-Mode acquisition.....	457
3D-Mode analysis.....	470

## Chapter 61

# 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.

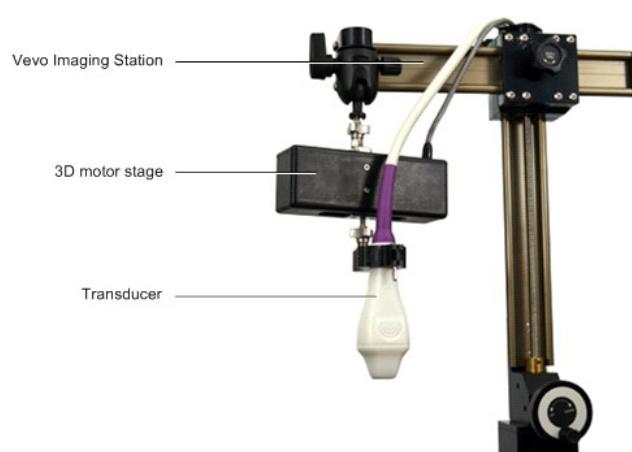
3D imaging is an available tool while you are acquiring data in any imaging mode.

### 3D-Mode hardware setup

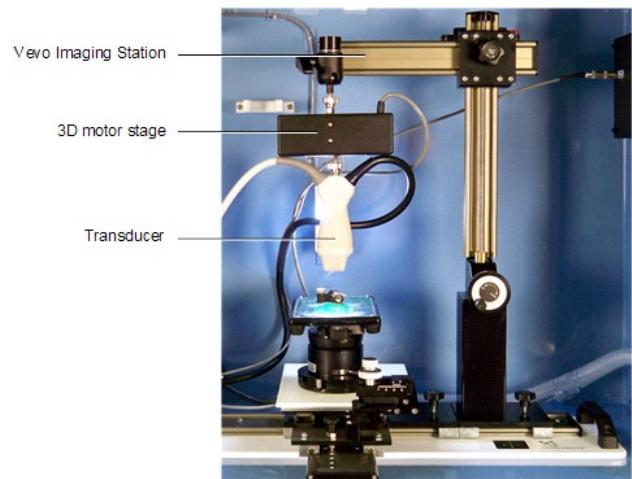
The transducer is mounted on a Vevo Imaging Station equipped with a 3D motor stage.

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 hardware setup Vevo 2100



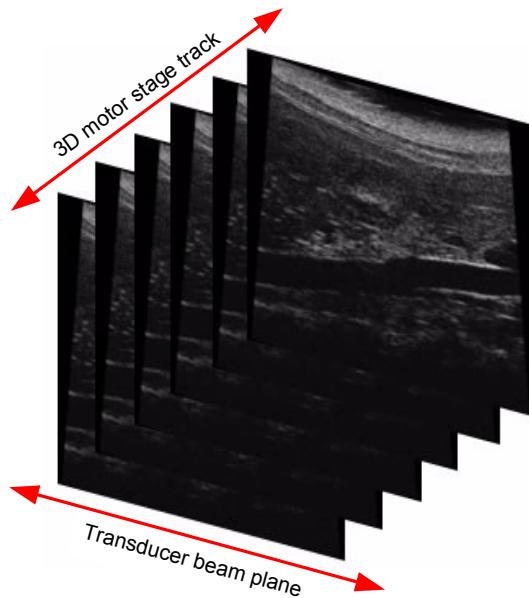
3D-Mode hardware setup Vevo LAZR



### 3D-Mode image acquisition

Based on user-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 image.

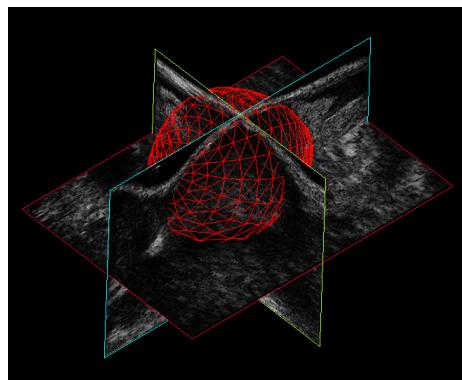


The system compiles each two-dimensional image slice with the other acquired slices and renders them into a three-dimensional whole.

### 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



## Chapter 62

# 3D-Mode acquisition

 Vevo 2100  Vevo LAZR

This chapter shows you how to acquire 3D-Mode images.



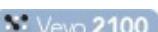
**WARNING:** High levels of ultrasound energy can damage tissue. Do not touch the transducer when acoustic power could be generated.

### In this chapter

Typical 3D-Mode image acquisition session .....	457
3D-Mode window workspace .....	461
Control panel controls for 3D-Mode.....	464
Setting up for a 3D-Mode image acquisition .....	465
Recording a 3D-Mode analysis session .....	469

---

## Typical 3D-Mode image acquisition session

 Vevo 2100  Vevo LAZR

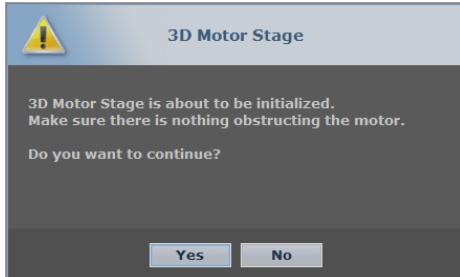
### Before you begin

Prepare your animal on the animal platform. For detailed information refer to the *Vevo Imaging Station Operator Manual*.

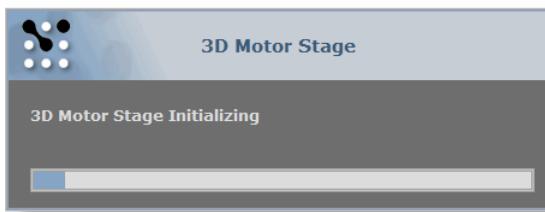
#### ► To acquire a 3D-Mode image:

1. From any imaging mode, or from the Study Browser, press **3D** to activate the 3D-Mode acquisition process.

If the 3D motor has not been initialized previously, the system freezes the image acquisition and displays the **3D Motor Stage** initialization option box.



2. Click **Yes**. First, the system initializes the motor stage.



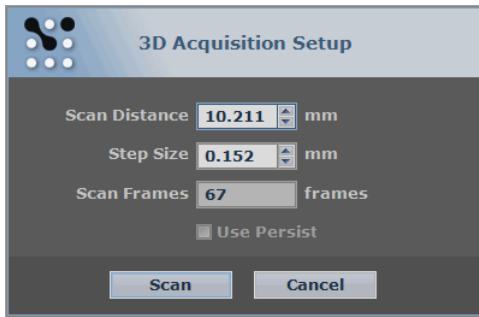
Next, the system confirms the initialization and prompts you to start the 3D slices acquisition.



3. Click **OK**. The system returns to the base image acquisition Mode.
4. Press the mode key to activate the base imaging Mode for the type of 3D-Mode image you want to acquire.
5. Use the platform controls on the Vevo Imaging Station to locate the object of interest and center it as closely as possible relative to the transducer.

**CAUTION:** Ensure that the lateral movement of the 3D motor stage cannot injure the subject and damage the transducer.

6. Press **3D**. The **3D Acquisition Setup** dialog box appears.

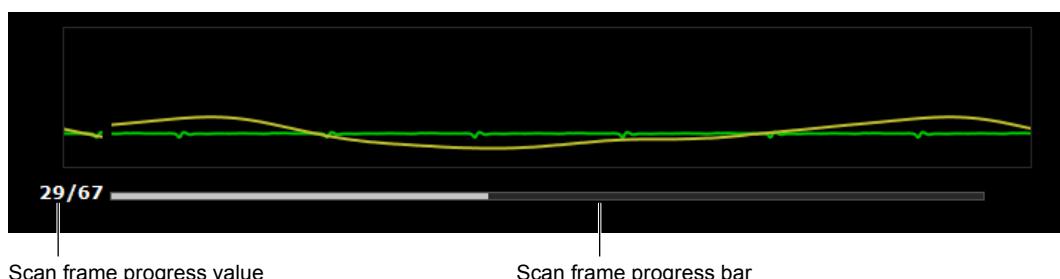


7. In the **3D Acquisition Setup** box, set up your 3D-Mode image slices parameters as described in the following table.

3D parameter	Description
Scan Distance	Sets the distance (in millimeters) that the 3D motor stage will travel during the entire 3D image acquisition. Scan distance ranges between 0.8 mm and 38 mm.
Step Size	<p>Sets the distance that the 3D motor stage travels between each B-Mode slice. Step sizes ranges between 0.03 mm and 0.5 mm.</p> <ul style="list-style-type: none"> <li>▪ Smaller step size produces more image slices which generates a more detailed 3D image, typically useful for detailed evaluations of structures</li> <li>▪ Higher step size produces fewer image slices which generates a less detailed 3D image, but typically suitable for quick evaluations of structure volumes</li> <li>▪ The default value of the step size is based on the resolution of the transducer array</li> </ul>
Scan Frames	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.

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.



When the 3D motor stage finishes acquiring the 3D slices, the system positions the transducer at the center of its range. The 3D data remains as a cine loop and does not load automatically into the 3D-Mode 4-pane view.

**TIP:** If you would like to review your pre-3D image data later, press **Cine Store** to save the image before you load the image into 3D. If you load the data into 3D without saving it first, you cannot retrieve that original image data. To automate this task, in the **General** tab of the **Preferences** screen, select the check box **Auto SAVE 3D on Scan Completion**.

9. When you have reviewed the image, in the image management panel click the **Image Processing** tab 
10. In the **Contrast Settings** section, click **Load Into 3D**. The system loads the image into the 3D-Mode 4-pane view.



11. Press **Cine Store** or **Frame Store** to save the 3D image data.
12. In the function keys row, press **Close**. The system closes the series you are working on and displays the **Study Information** window.  
Complete the required fields to define your study and click **OK**. The **Study Browser** appears.

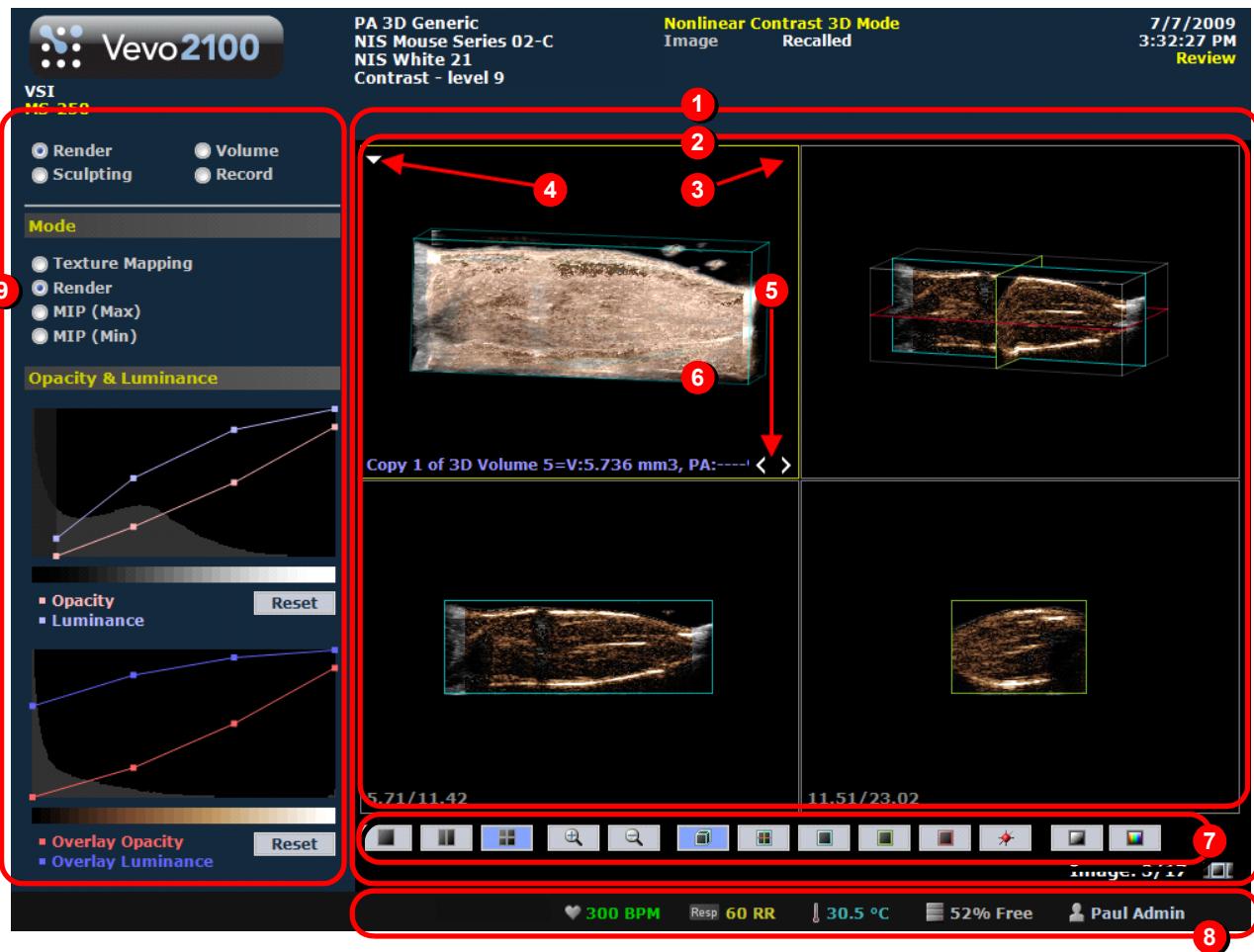
## Related information

- *Typical Color 3D-Mode image acquisition session* (page 499)
- *Typical Power 3D-Mode image acquisition session* (page 517)
- *Typical Linear Contrast 3D-Mode image acquisition session* (page 534)

## 3D-Mode window workspace

Vevo 2100 Vevo LAZR

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.



### ① Image data area

Includes the view panes area and the visualization options toolbar.

### ② View panes area

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.

### **③ Active pane yellow border**

When you select a view pane, the system applies a yellow border to that pane.

### **④ Active pane menu drop-down icon**

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:

Command	Description
Wire-frame	Turns the image outline on/off
Orientation	Turns the orientation marker points on/off
Render Mode	Displays a list of rendering modes you can apply: Texture Mapping, Render, MIP (Max), MIP (Min)
Restore	Resets the original view of the 3D image including size, orientation, brightness and zoom values

### **⑤ Active pane previous/next slice tool**

Click < to view previous slices in your 3D image. Click > to view the next slices. You can use the following keyboard combinations to move forward or back one slice at a time, five at a time, or ten at a time, as detailed in the following table:

Command	Step size
>	1 slice
Shift + >	5 slices
Ctrl + >	10 slices

### **⑥ Unique image view**

Each pane displays a unique view of the 3D image. When you click a different view icon in the image analysis toolbar to change the view, the system visualizes the same slice from a different perspective.

### **⑦ Visualization options toolbar**

Click the appropriate analysis tool to change either the number of panes or the analysis view. For complete information on each tool see *3D-Mode image analysis tools* (page 470).

### **⑧ Status bar**

Displays:

- 3D motor position, when the 3D motor is initialized (where 3D-Mode is supported)

- Monitored physiological values in real time during image acquisition

**PREREQUISITES:** Live physiological data is only available a) when you enable the inputs in the Physiological tab of the Preferences window; and b) when the animal is connected to the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station.

For more detailed information on physiological monitoring, see *Vevo Imaging Station description* (page 69), *Physiological preferences tab* (page 141) and *Setting up to acquire physiological data* (page 269).

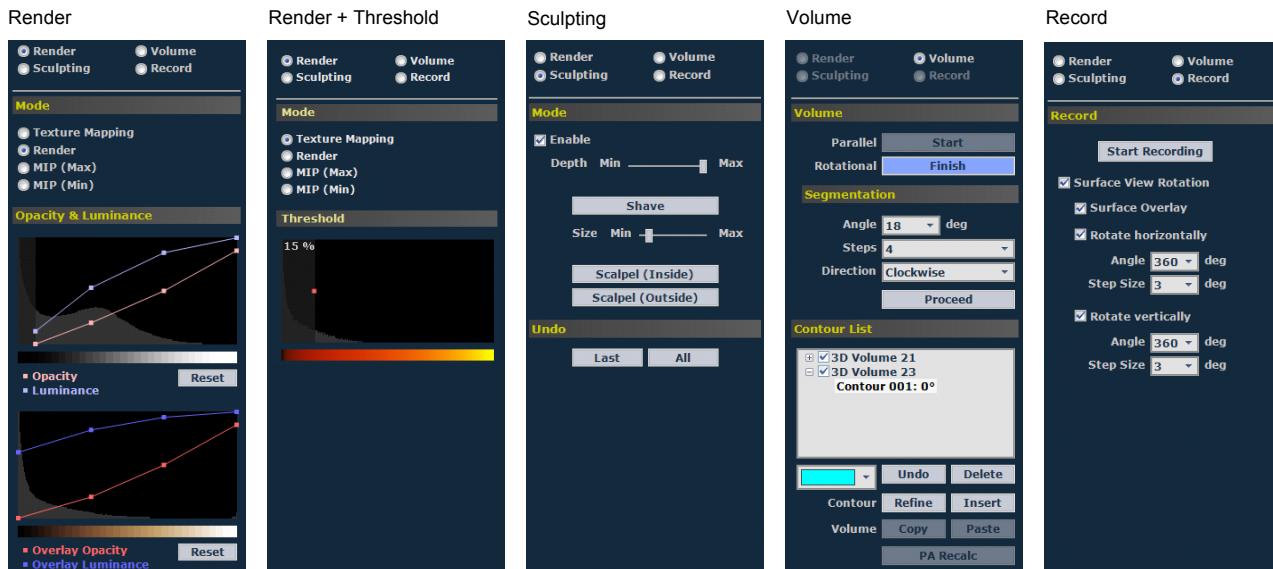
- Percentage of **free space** to store image data so you can see when you should start to back up your image data to free up space on the system
- User name, in blue, when **User Management Mode** is enabled (where User Management Mode is supported)
- Elapsed session time when you hover over the displayed blue user name when User Management Mode is enabled.

## 9 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 a 3D-Mode scan.

### ► To optimize a 3D-Mode image:

- **If you are acquiring a 3D-Mode image:**
  - a. Start imaging in B-Mode and use the *Control panel controls for B-Mode* (page 329) to optimize the image.
  - b. Press **3D** to set the parameters for the automated image acquisition.
- **If you are acquiring a PA-Mode 3D-Mode image:**
  - a. For Single, Oxy-Hemo and NanoStepper sub-modes, start PA-Mode.
  - b. Use the *Control panel controls for PA-Mode* (page 365) to optimize the image.
  - c. Press **3D** to set the parameters for the automated image acquisition.
- **NOTE:** 3D-Mode images cannot be acquired in Spectro sub-mode.
- **If you are acquiring a Color 3D-Mode image:**
  - a. Start imaging in Color Doppler Mode.
  - b. Use the *Control panel controls for Color Doppler Mode* (page 493) to optimize the image.
  - c. Press **3D** to set the parameters for the automated image acquisition.
- **If you are acquiring a Power 3D-Mode image:**
  - a. Start imaging in Power Doppler Mode.
  - b. Use the *Control panel controls for Power Doppler Mode* (page 510) to optimize the image.
  - c. Press **3D** to set the parameters for the automated image acquisition.

- If you are acquiring a Contrast 3D-Mode image:
  - a. Start imaging in Linear Contrast Mode or Nonlinear Contrast Mode.
  - b. Use the *Control panel controls for Linear and Nonlinear Contrast Mode* (page 527) to optimize the image.
  - c. Press **3D** to set the parameters for the automated image acquisition.

#### Related information

- *Typical NanoStepper sub-mode 3D acquisition session* (page 379)
- *Typical Power 3D-Mode image acquisition session* (page 517)
- *Typical Linear Contrast 3D-Mode image acquisition session* (page 534)
- *Typical Color 3D-Mode image acquisition session* (page 499)

## Setting up for a 3D-Mode image acquisition



This section describes how to set up the 3D motor stage and the transducer for a 3D-Mode image acquisition session.

### Connecting the 3D motor stage to Vevo Imaging System

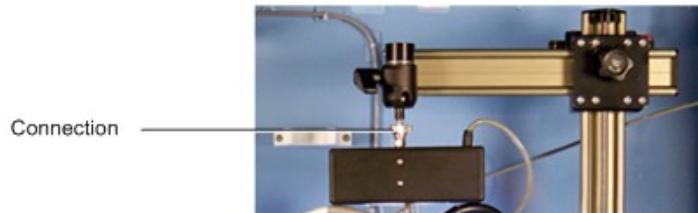


The 3D motor stage features a Quick Release post on the top to connect to the Vevo Imaging Station, and a Quick Release mount on the bottom to affix the transducer.



► **To connect the 3D motor stage to the Vevo Imaging System:**

1. Connect the quick release post to the ball joint on the arm of the Vevo 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 Imaging System.

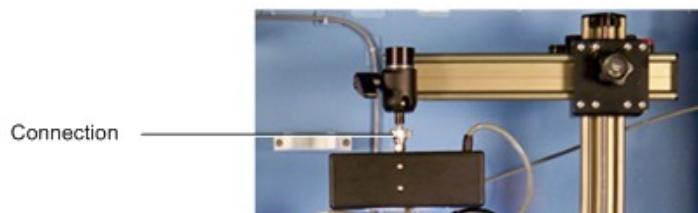


## Connecting the 3D motor stage to Vevo LAZR



► **To connect the 3D motor stage to the Vevo LAZR:**

1. Connect the top of the 3D motor to the connector extending below the arm of the Vevo Imaging Station.



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

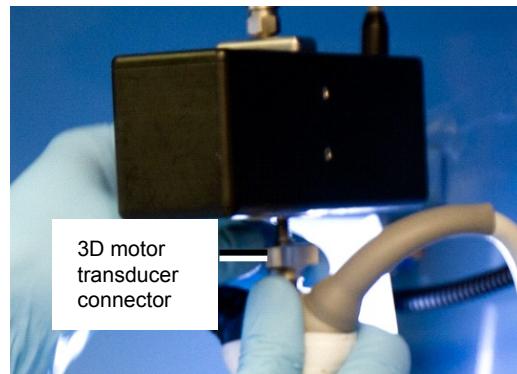


## Connecting an LZ transducer to the 3D motor



### ► To connect an LZ transducer to the 3D motor:

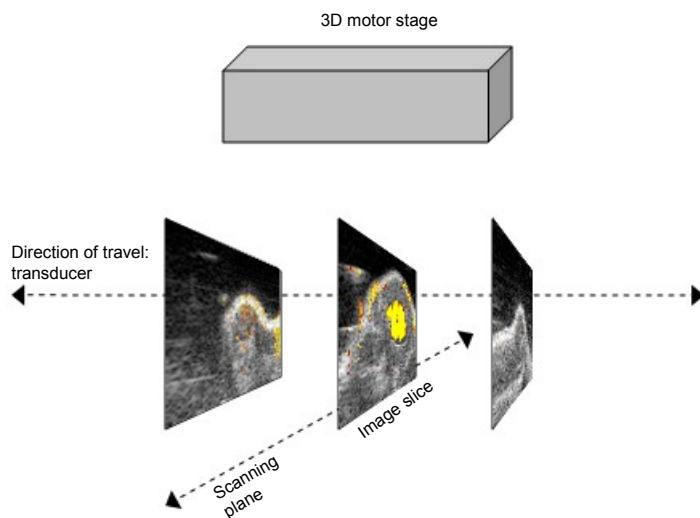
Insert and tighten the 3D motor transducer connector to the opening at the top of the transducer housing.



## 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.

## Remotely positioning the transducer

Vevo 2100 Vevo LAZR

With Vevo Imaging System software, you can use your cursor to remotely control the position of the transducer by remotely controlling the position of the 3D motor.

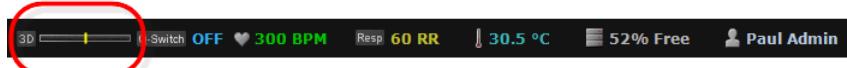
### Prerequisite

You must connect the transducer to the 3D motor and connect the 3D motor to the Vevo Imaging Station.

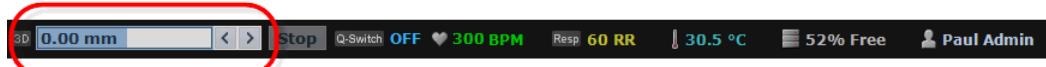
#### ► To remotely position the transducer:

**CAUTION:** To acquire a consistent signal, ensure that the coupling gel is equally covering the area you are imaging.

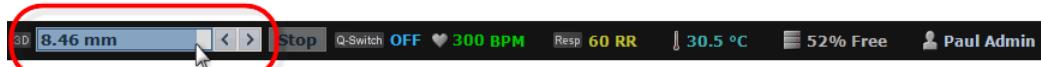
1. Press **Cursor**.
2. In the status bar, hover the cursor over the 3D motor position control (the yellow bar indicates the current position of the 3D motor).



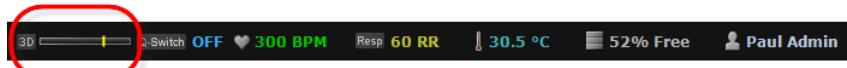
The 3D motor position control changes from a status indicator to a controllable position bar.



3. Drag the blue bar to reposition the transducer. For fine position control (+ or - 0.02mm) click the left or right controls.



When you are done, the indicator bar displays the new position.



## Related information

- *Connecting the 3D motor stage to Vevo (page 261) Imaging System*
- *Connecting a MicroScan transducer to the 3D motor (page 263)*
- *Connecting an LZ transducer to the 3D motor (page 264)*

---

## 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, display the 3D-Mode tools set in the image management panel:
  - If you are on the Vevo Imaging System, press **Mode Settings**.
  - If you are on Vevo LAB, click **3D Settings**.
2. Click **Record**.
3. If you want to record volume surface data:
  - a. Select the **Surface View Rotation** check box.
  - b. Configure the surface overlay and rotation parameters.
4. Click **Start Recording**.
5. In the **3D Recording** window, browse to your save location, name the file and click **OK**.

The system saves the recording to the location you specified.

# 3D-Mode analysis



This chapter shows you how to analyze 3D-Mode images that are saved to a study.

## In this chapter

3D-Mode visualization tools.....	470
Manipulating 3D-Mode image data.....	472
Creating 3D volume measurements .....	478
Thresholding color-mapped 3D images.....	484
Adding generic 3D-Mode measurements .....	485

## 3D-Mode visualization tools



When you are in the cube view, the 3D-Mode image analysis toolbar provides a series of analysis tools you can use to change either the number of view panes in the area or the type of analysis view you want to work with.

### Visualization tools available for all 3D images



The image analysis toolbar includes the following tools:

Tool	Description	Example
	Click to display one 3D image view across the entire image area.  Single Pane	
	Click to display two 3D image views across the image area.  Dual Pane	



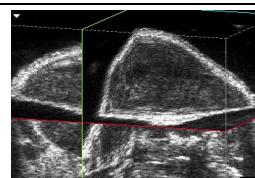
Quad Pane

Click to display four image views across the image area.



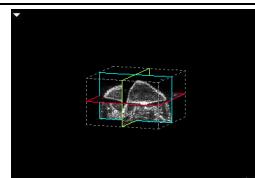
Zoom In

Click to magnify the view up to 20 levels of zoom.



Zoom Out

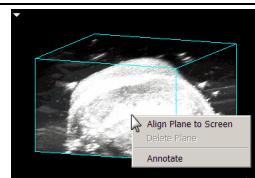
Click to minimize the view up to 20 levels of zoom.



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:

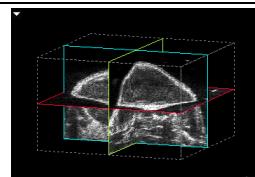
Command	Description
Align Plane to Screen	Rotates the cube to display a head-on view of the active plane
Delete Plane	Removes a manually created plane
Annotate	Provides a text box in which to type an annotation



Cross View

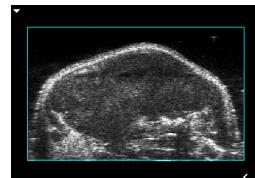
Click to display three single, slidable image slice views presented on the x, y, and z planes. Each plane presents its own color outline:

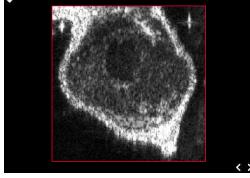
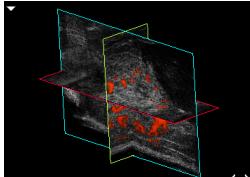
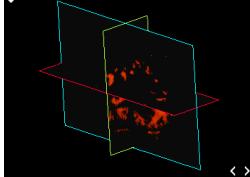
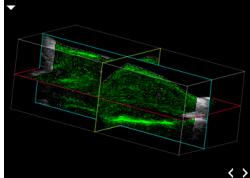
- Blue = x-y plane on the z axis
- Green = y-z plane on the x axis
- Red = x-z plane on the y axis



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.



	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.	
	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.	
	Click to display a compilation view that uses the Cross view to map user-generated volumes to the acquired data.	
	Click to cycle through the overlay states:	
	<ul style="list-style-type: none"> <li>▪ PA-Mode: Both, B-Mode Only, PA-Mode Only</li> <li>▪ Contrast(s): Both, B-Mode Only, Contrast Only</li> <li>▪ Power and Color: Both, B-Mode Only, Color Only</li> <li>▪ B-Mode: No display layout available.</li> </ul>	
	Click to cycle through the set of display maps available for images in all B-Mode based imaging modes:	
	<ul style="list-style-type: none"> <li>▪ B-Mode: C1-C6</li> <li>▪ Nonlinear Contrast Mode: MB1-MB3</li> <li>▪ Linear Mode: MB1, MB2</li> <li>▪ Power Doppler Mode: C1, C2</li> <li>▪ Color Doppler Mode: C1-C5</li> <li>▪ PA-Mode sub-mode Oxy-Hemo and PA-Mode sub-mode Single: PA1-PA9</li> </ul>	

## Manipulating 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

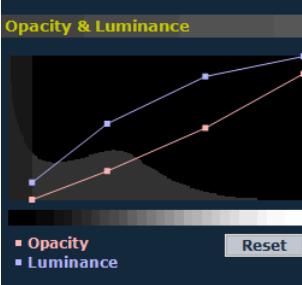


Use the Render tool in 3D-Mode to display the full 3D image. You can only use this tool when you are viewing a 3D image in the Cube view.

### ► To render an image:

1. While you analyze your 3D-Mode image, display the 3D-Mode tools set in the image management panel:
  - If you are on the Vevo Imaging System, press **Mode Settings**.
  - If you are on Vevo LAB, click **3D Settings**.
2. Click **Render**.
3. In the **Mode** section, select from the four modes as described in the following table:

Render mode	Description
Texture Mapping	<p>Texture Mapping mode displays the surface texture of the 3D image. Texture mapping mode is the default rendering mode for 3D acquisition.</p> <p><b>To apply texture mapping to a 3D image:</b></p> <p>Under <b>Mode</b>, click <b>Texture Mapping</b>. The Cube view displays data on the surface of each plane of the 3D image.</p> <div style="background-color: #ffffcc; padding: 10px;"><p><b>NOTE:</b> For 3D modes that apply color map overlays, the Thresholding tool appears. For more, see <i>Thresholding color-mapped 3D images</i> (page 484).</p></div>

Render mode	Description
Render	<p>Render mode displays the full 3D image in the Cube view.</p> <p><b>To render a 3D image:</b></p> <p>Under <b>Mode</b>, click <b>Render</b>.</p> <ul style="list-style-type: none"> <li>The Cube view traces each line of the data, perpendicular to the display for the full image.</li> <li>The image management panel adds the <b>Opacity &amp; Luminance</b> section for B-Mode image data under the <b>Mode</b> section.</li> </ul>  <p>Use the light-red <b>Opacity</b> curve to adjust the levels of transparency in the image. Use the light-blue <b>Luminance</b> to artificially adjust the light/dark contrast of the image.</p> <p><b>To adjust opacity and luminance of a rendered image:</b></p> <ul style="list-style-type: none"> <li>Left-click and drag a point along the curves and then left-click to lock the point to a new setting.</li> <li>Click <b>Reset</b> to return both curves to their default settings.</li> </ul> <p><b>For Contrast 3D-Modes, Color 3D-Mode and Power 3D-Mode:</b></p> <p>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.</p> 
MIP (Max)	<p>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.</p> <p><b>To apply MIP (Max) to a 3D image:</b></p> <p>Under Mode, click <b>MIP (Max)</b>.</p>

Render mode	Description
MIP (Min)	MIP (Min) (Minimum Intensity Persistence) enhances the contrast of an image by minimizing the brightest pixels in the image. Use this mode to better distinguish organs from their surrounding area when the organ objects are darker than their surrounding structures.

**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 a 3D image in the Cube view.

### ► To sculpt an image:

1. While you analyze your 3D-Mode image, display the 3D-Mode tools set in the image management panel:
  - If you are on the Vevo Imaging System, press **Mode Settings**.
  - If you are on Vevo LAB, click **3D Settings**.
2. Click **Sculpting**.
3. Select from the three available modes as described in the following table:

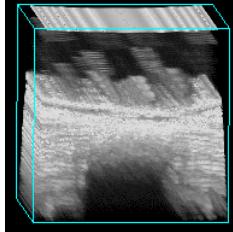
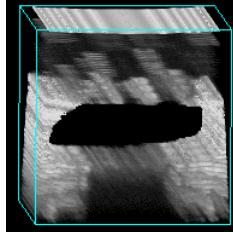
Sculpting mode	Description
Shave	Shave gives you fine control over the amount of data you want to cut away. This mode functions like an eraser: set the depth that the tool can shave the target and then use the tool on the image in Cube view.

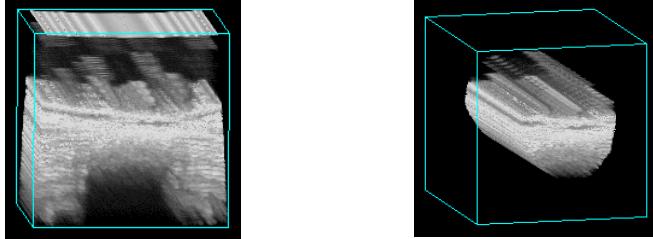
**To shave a 3D image dataset:**

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.

Sculpting mode	Description
Scalpel (Inside)	<p>Scalpel (Inside) mode functions like a cookie cutter. Select a depth, then outline an area within which to remove data.</p> <p><b>To scalpel inside a 3D image:</b></p> <ol style="list-style-type: none"> <li>4. Under Mode, click <b>Scalpel (Inside)</b>.</li> <li>5. Under Depth, set the slider to the required depth.</li> <li>6. Position the trackball cursor over the image.</li> <li>7. Drag the trackball cursor to create the outline of the area to be scalped.</li> <li>8. Release the trackball button. The outlined area is removed from the image.</li> </ol> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p><i>Image before scalpel</i></p> </div> <div style="text-align: center;">  <p><i>Image after scalpel (inside)</i></p> </div> </div>

Sculpting mode	Description
Scalpel (Outside)	<p>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.</p> <p><b>To scalpel outside a 3D image:</b></p> <ol style="list-style-type: none"> <li>Under Mode, click <b>Scalpel (Outside)</b>.</li> <li>Under Depth, set the slider to the required depth.</li> <li>Trackball over the image.</li> <li>Drag to create the outline of the area to be scalped.</li> <li>Release the trackball button.</li> </ol> <p>Data outside the outlined area is removed from the image.</p>  <div style="display: flex; justify-content: space-around;"> <span><i>Image before scalpel</i></span> <span><i>Image after scalpel (outside)</i></span> </div>

## Creating 3D volume measurements

 Vevo 2100  Vevo LAZR

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, Color 3D-Mode, Power 3D-Mode, PA-Mode 3D (NanoStepper) and Contrast 3D-Modes 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.

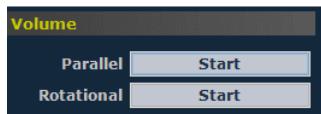
- When you segment the volume manually (in parallel segmentation only) you manually draw each contour of the volume.
- When you segment the volume semi-automatically the system draws multiple contours.

## Parallel segmentation

 Vevo 2100  Vevo LAZR

### ► To create a volume using parallel segmentation:

1. While you analyze your 3D-Mode image, display the 3D-Mode tools set in the image management panel:
  - If you are on the Vevo Imaging System, press **Mode Settings**.
  - If you are on Vevo LAB, click **3D Settings**.
2. Click **Volume**.
3. Ensure that the 3D data is displayed in the Cube view.
4. In the Volume section, for the **Parallel** option click **Start**.



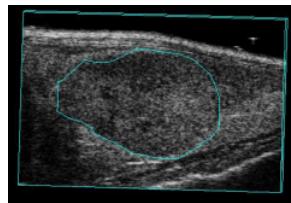
5. Ensure that the 3D data is displayed in the Cube view.
6. To create the first contour, start in the Cube view and then complete the following procedures:
  - a. Trace the contour you want to define and then right-click the last point, or left-click near the first point to complete the contour.

**TIP:** If you make an error while creating your volume, press the **Backspace** key as often as required to undo your contour until you are ready to move forward again.

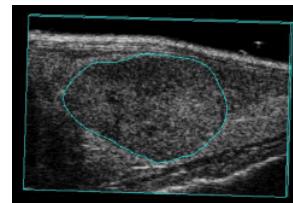
The contour is displayed in the Contour List as **Contour 001: 0°** if this is the first contour of the first volume measurement on the image.

- b. 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.

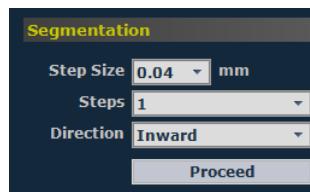


*Initial contour*



*Refined contour*

7. You can draw subsequent contours manually or semi-automatically. Select the preferred parallel segmentation parameters in the Segmentation area of the Volume tool.



- a. Set the Step Size. The default step size is the scan step size.
- b. Set the **Step Num** to a value of **2** or more.

When you use semi-automatic segmentation, the system generates the contours automatically. Each contour is refined before the next contour is drawn.

- c. Set the Direction of segmentation: Inward, Outward, or Both.
- d. Click **Proceed** to generate the additional contours you configured. The Contour List displays the additional contours.

**NOTE:** The distance specified next to the label of the contour identifies the distance from the first plane of the cube.

8. Repeat the previous step as necessary until the desired number of contours have been defined, and then click **Finish** to calculate the percent agent.

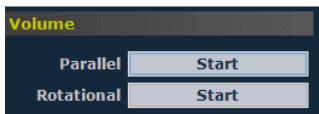
You have successfully created the first calculated volume set for the image. If you need a second volume you can create an additional set of contours.

## Rotational segmentation



► **To create a volume measurement using rotational segmentation:**

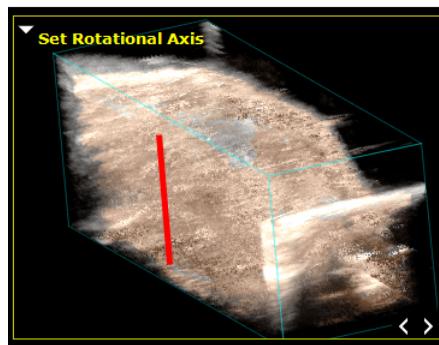
1. While you analyze your 3D-Mode image, display the 3D-Mode tools set in the image management panel:
  - If you are on the Vevo Imaging System, press **Mode Settings**.
  - If you are on Vevo LAB, click **3D Settings**.
2. Click **Volume**.
3. Ensure that the 3D data is displayed in the Cube view.
4. In the Volume section, for the Rotational option, click **Start**.



5. In the Cube view:
  - a. In the lower-right corner of the panel, click the <> tools to step to a slice that is not one of the outer slices of the cube.
  - b. Click **Start**.

The system prompts you to set a Rotational Axis. To set the axis click once at one end of the axis of rotation and then click at the other end.

The axis of rotation should run through entire volume region as shown in the following illustration:



- c. The yellow cube command prompts you to Draw First Contour.
- d. Click to create a point on the circumference of a contour and then trace the contour. The system adds points as you trace.

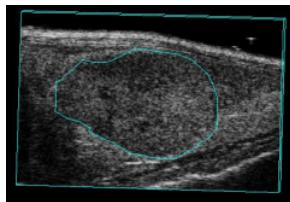
**TIP:** If you make an error while creating your volume, press the **Backspace** key as often as required to undo your contour until you are ready to move forward again.

- e. To complete the contour, right-click the last point, or left-click near the first point.

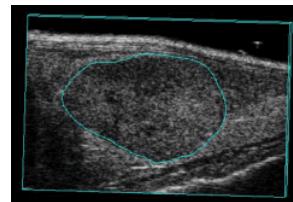
The contour is displayed in the Contour List as **Contour 001: 0°** if this is the first contour of the first volume measurement on the image. The contour color changes from blue to the specified color.

- f. (Optional) Click **Refine** to initiate the edge detection algorithm. This function detects the edge of the vessel or volume wall and attempts to closely fit the line to the outside wall of the vessel or volume. 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*



*Refined contour*

After you refine at least one contour, in the Contour List, select the volume and then click the appropriate recalculation command:

- **PA Recalc** for contrast images
- **PV Recalc** for Color Doppler Mode images and Power Doppler Mode images
- **PS Recalc** for PA-Mode images

6. In the Segmentation sub-section, configure the rotational segmentation parameters.
  - Set the **Angle** of rotation. The angle represents the degrees separating each contour.
  - Select the **Steps** value. This specifies the number of contours the system creates. By default, this parameter is set to **Auto**.
  - Select the **Direction** of rotation: Clockwise or Counterclockwise, relative to the axis of rotation.
7. Click **Proceed**.

The system draws the contours, based on the segmentation parameters you configured and displays the additional contours in the Contour List.

**NOTE:** The distance specified next to the label of the contour identifies the distance from the first plane of the cube.

8. Click **Finish** to calculate the percent agent.

## 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

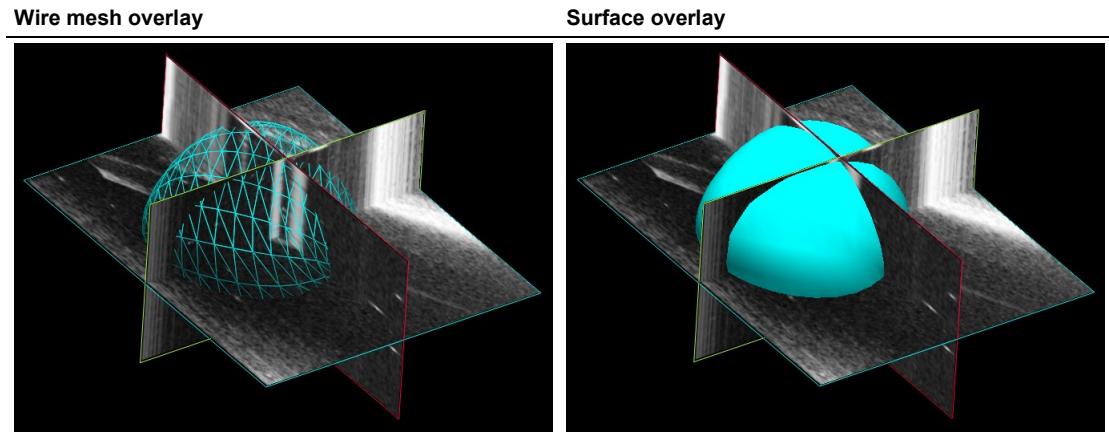


► **To display a volume measurement as a 3D object:**

1. On the visualization tools toolbar, click the Surface View icon.



The system compiles a 3D representation of the volume in the Surface view, and then displays the measured volume as a wire mesh overlay on the three planes.



2. Use the rotate, pan and zoom tools to modify the view of the object.

---

## Thresholding color-mapped 3D images

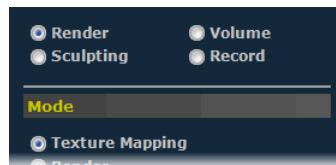
Vevo 2100 Vevo LAZR

Threshold provides a draggable control you can use to adjust the amount of color data that appears in images in the following 3D-Mode based imaging modes:

- PA-Mode 3D (only Single and Oxy-Hemo sub-modes)
- Color 3D-Mode
- Power Doppler 3D-Mode
- Linear Contrast 3D-Mode
- Nonlinear Contrast 3D-Mode

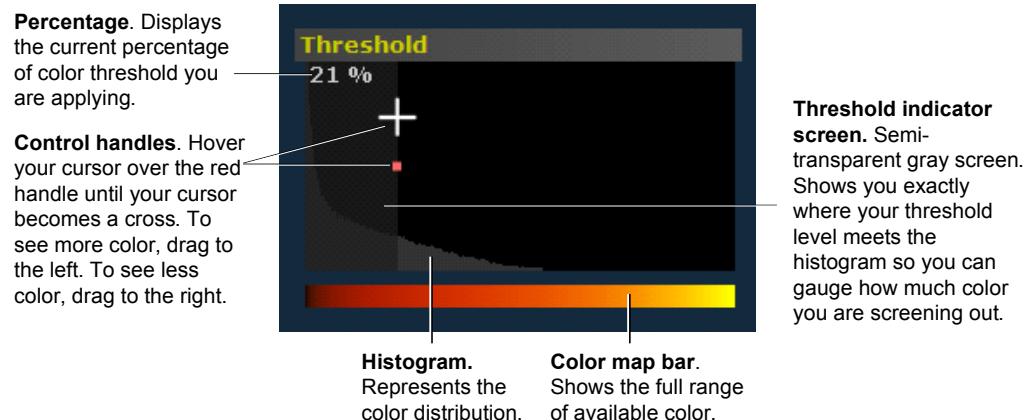
► **To control the threshold of a color-mapped 3D image:**

1. Open the 3D image and click the modes settings icon at the bottom of the image management panel to display the 3D settings.
2. Select **Render** and **Texture Mapping**.



The **Threshold** control panel appears.

3. Drag the control handle to adjust the threshold level as described in this illustration.



The color data on the 3D image changes dynamically as you adjust the threshold level.

**NOTE:** Because the system calculates volumes based on the amount of color data in an area, thresholding affects the volume calculations. The higher you set the threshold, the lower the calculated area volume of color data will be.

## Related information

- *Parallel segmentation* (page 479)
- *Acquiring 3D-Mode images* (page 457)
- *Analyzing 3D Mode images* (page 470)

## Adding generic 3D-Mode measurements



3D-Mode provides two generic measurement tools.

## Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want the default to be to hide them, go to **Prefs > Measurements** tab, clear the **Show Values and Labels** check box and save your edits in a custom measurement package.

- If you want to temporarily override the default, clear or select the **Show Values and Labels** check box at the bottom of the measurement panel.



► **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**. The system displays the measurement tools at the top of the image management panel. Hover over a tool to see the description label.

#### **Generic 3D-Mode measurements**

All generic measurements are described in the *Generic measurements* (page 597) appendix. The following generic measurements are available for 3D-Mode images:

- Linear distance measurement (page 614)
- 2D Area measurement (page 597)

## Section 16

# 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.

This mode is useful for blood flow applications such as:

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

### In This Section

Color Doppler Mode acquisition.....	488
Color Doppler Mode analysis.....	501

# Color Doppler Mode acquisition

 Vevo 1100    Vevo 2100    Vevo LAZR

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.

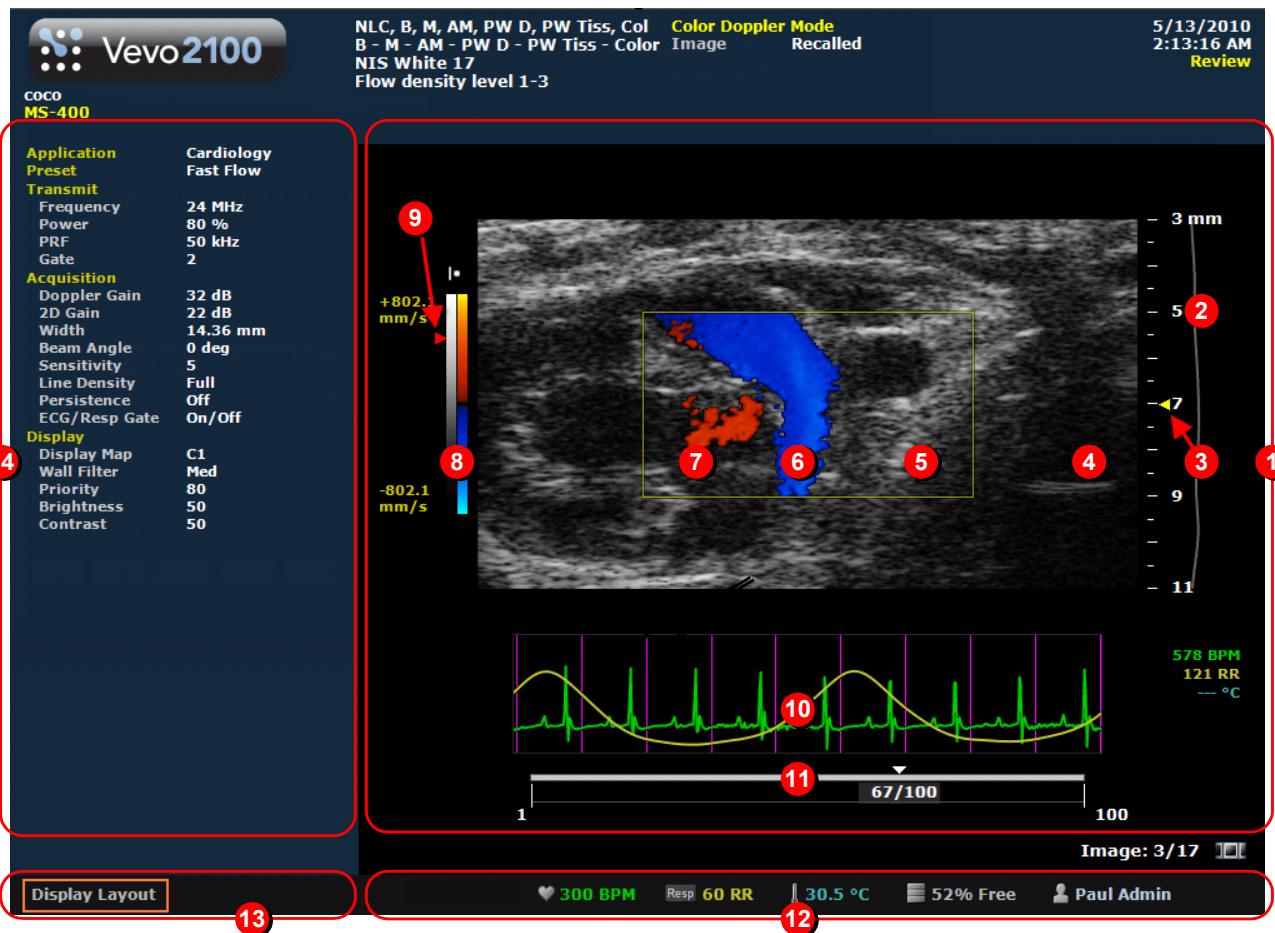
## In this chapter

Color Doppler Mode window workspace .....	489
Control panel controls for Color Doppler Mode.....	493
Color Doppler Mode settings .....	496
Typical Color Doppler Mode image acquisition session .....	498
Typical Color 3D-Mode image acquisition session.....	499

## Color Doppler Mode window workspace

Vivo 1100 Vivo 2100 Vivo LAZR

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.



### ① Image area

This large area:

- Displays image data
- Displays physiological data for the animal (if recorded during image acquisition)
- Provides cine loop range controls for acquired cine loops
- Provides a Browse Images tool for scrolling through an inset gallery of images without having to return to the Study Browser

If you export an image and select Image as your export type, the system includes the image area content along with header information.

## ② Image scale

Indicates in *mm* the distance from the face of the transducer.

## ③ Focus depth scale

Indicates the distance from the transducer face where the system maximizes image resolutions. The triangular arrow indicates the focal length(s) of the transducer. When you acquire image data, use the **Image Depth** control on the control panel to increase or decrease the depth that you can see.

## ④ Image data panel

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

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.

## ⑤ Region of interest color box overlay

The system applies the Color Doppler Mode based colors only to the image data within this box.

## ⑥ Vascular flow moving away from the transducer

Displayed in blue colors.

## ⑦ Vascular flow moving toward the transducer

Displayed in red colors.

## **⑧ Color and velocity scale**

The right column of the scale is the color scale. It follows the acronym **BART** color principle for Doppler (Blue=Away 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 707).

## **⑩ Physiological data trace panel**

Displays the animal's dynamic heart rate, temperature, respiration rate and blood pressure data. This data is gathered by the Advanced Physiological Monitoring Unit that connects 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. To only display the image frames in that range, drag the left and right vertical markers. For more information, see *Working with cine loops* (page 288).

## **⑫ Status bar**

Displays:

-  3D motor position, when the 3D motor is initialized (where 3D-Mode is supported)
- Monitored physiological values in real time during image acquisition

**PREREQUISITES:** Live physiological data is only available a) when you enable the inputs in the Physiological tab of the Preferences window; and b) when the animal is connected to the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station.

For more detailed information on physiological monitoring, see *Vevo Imaging Station description* (page 69), *Physiological preferences tab* (page 141) and *Setting up to acquire physiological data* (page 269).

- Percentage of **free space** to store image data so you can see when you should start to back up your image data to free up space on the system
-  User name, in blue, when **User Management Mode** is enabled (where User Management Mode is supported)
-  Elapsed session time when you hover over the displayed blue user name when User Management Mode is enabled.

### **13 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.
- Confirmation messages when you store an image.
- The updated parameter and system information when you make adjustments on the control panel.
- Control options in the acquisition mode you are using. To select, either a) cursor to the option and then click; or b) turn the **Screen Keys** dial to display the option, then press the dial.

In Color Doppler Mode, press the dial to cycle through three image states: B-Mode only, Color only and Both.

### **14 Image mode management panel**

Displays a unique set of controls and information sections depending on the control key you press, or the image management panel tab you click:

- 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 (where ECG Trigger is supported).
- Press **Image Process** to set the panel to display the controls for brightness, contrast, baseline, priority, display maps, display layouts, loading into 3D and TGC loading and saving.

- Press **Mode Settings** to set the panel to display the Mode settings. This is the default panel when you open a Mode window.

## 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.



### 1 Back

- Removes or cancels the last measurement point before you commit your measurement.
- Resets the parameters to the pre-defined values in the current preset.

### 2 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.

### ③ Screen Keys

Press the dial to cycle through three image states: Both, B-Mode Only, Color Only.

### ④ Display Map

Cycles through a predefined set of overlays and optimization maps that you can apply either while you acquire or review image data. Push up or pull down to cycle through the available maps for the active imaging mode.

### ⑤ Transmit Power

Adjusts the power of the ultrasound signal transmission.

Turn the dial 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%.

### ⑥ 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.

### ⑦ Color

Activates Color Doppler Mode acquisition and begins displaying the color box overlay over the B-Mode background image.

### ⑧ 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.

**9 Velocity**

Adjusts the PRF (pulse repetition frequency). The higher you set the PRF, the lower the signal resolution.

**10 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.

**11 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.

**12 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 element in the transducer. These carefully calibrated sequences can effectively *steer* the ultrasound beam in order to detect minute frequency shifts.

In Color Doppler Mode, this changes the color box.

**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.

**13 Priority**

Adjusts the priority relationship between the overlay data and the background B-Mode data so you can eliminate false readings. 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.

#### 14 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
- 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 settings

 Vevo 1100    Vevo 2100    Vevo LAZR

### ► To view the Color Doppler Mode settings:

Press **Mode Settings**. The settings panel displays the following parameters:

#### Transmit

Parameter	Description
Frequency	The ultrasound frequency, measured in MHz. Adjust with the <b>Frequency</b> control.
Power	The transmission power level of the ultrasound signal, displayed as a percentage of the maximum power. Adjust with the <b>Transmit Power</b> control.
PRF	The pulse repetition frequency (PRF) of the transmitted PW Doppler signal, measured in kilohertz. This parameter defines the maximum observable PW Doppler frequency shift and flow velocity. Adjust with the <b>Velocity</b> control.
Gate	Number of transmit cycles in the ultrasound pulse. Adjust the value with the <b>Sensitivity</b> control. The range of values depends on the transducer. Higher gate values deliver more detail sensitivity, but lower image resolution.

## Acquisition

Parameter	Description
Frame Rate	The number of image frames per second that the system is acquiring.
Extended Buffer	<del>On/Off</del> The state (On or Off) of the option to increase the size of the cine buffer or cine loop. Specify this option in the General tab in the Preferences window.
Doppler Gain	The PW Doppler frequency, measured in dB. Adjust with the <b>Doppler Gain</b> control.
2D Gain	The strength of the ultrasound signal when it returns to the face of the transducer. Range values vary by transducer. Adjust with the <b>2D Gain</b> control.
Width	The width of the acquired image area, measured in mm. Adjust with the <b>Image Width</b> control.
Beam Angle	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 <b>Beam Angle</b> control.
Sensitivity	The signal resolution level. Adjust with the <b>Sensitivity</b> control.
Line Density	The line density level. One of four settings: Quarter, Third, Half, Full. Adjust with the <b>Line Density</b> control.
Persistence	The state of the Persistence feature: Off, Low, Med, High, Max. Adjust with the <b>Persist</b> control.
ECG/Resp Gate	The state of the ECG trigger and respiration gating, respectively. Values: Off, On. For example, if both are on, the parameter displays On/On. To adjust, press <b>Physio Settings</b> and then select or clear the appropriate check boxes.
<b>NOTE:</b> On Vevo 1100, only the Resp Gate feature is available.	
TGC	The saved TGC control curve that has been manually loaded for the current image acquisition. Adjust in the <b>Image Process</b> panel. Click <b>Load</b> to apply a different TGC control curve.

## Display

Parameter	Description
Display Map	The selected predefined display map from the predefined set of maps. Adjust with the <b>Display Map</b> control.
Wall Filter	The level of low velocity signals, measured in Hz, filtered out of the spectral display. Adjust with the <b>Wall Filter</b> control.
Priority	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 <b>Priority</b> control.
Brightness	The image brightness level. Adjust with the <b>Brightness</b> slider in the image management panel after you press <b>Image Process</b> .
Contrast	The image contrast level. Adjust with the <b>Contrast</b> slider in the image management panel after you press <b>Image Process</b> .

## Typical Color Doppler Mode image acquisition session



### Before you begin acquiring data

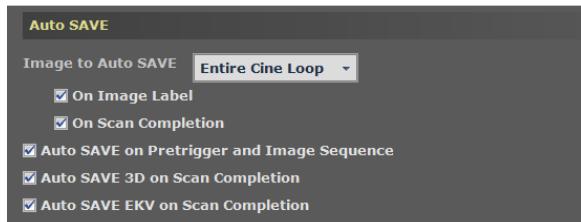
If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 269).
- Prepare your animal on the animal platform. For detailed information refer to the user manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 273).

### ► 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 493) to refine your image acquisition settings if required.
6. Press **Scan/Freeze** 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 a cine loop or image frame and also add a label, press **Image Label**.  
**NOTE:** To set or remove auto-save default preference, select your option in the Auto SAVE section (**Preferences** window > **General** tab > **Auto SAVE** section).



- To save the displayed image frame press **Frame Store**.
9. Press **Scan/Freeze** to resume scanning.
  10. Save images as required.
  11. In the function keys row, press **Close**. The system closes the series you are working on and displays the **Study Information** window.  
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 501)
- *Adding protocol measurements* (page 298)

## Typical Color 3D-Mode image acquisition session



Color 3D-Mode adds Color Doppler Mode data during a 3D-Mode scan so you can reconstruct a volume that integrates the Color Doppler Mode color data with the surrounding B-Mode 3D volume.

### ► To acquire a Color 3D-Mode image:

1. Set up for a 3D-Mode image acquisition session (page 465).
2. Follow the typical steps for a Typical Color Doppler Mode image acquisition session (page 498).

3. When you are satisfied with the Color Doppler Mode image, press **3D**.
4. Follow the typical steps for a 3D-Mode image acquisition (page 457).

### Related information

- *3D-Mode visualization tools* (page 470)
- *Typical 3D-Mode image acquisition session* (page 457)
- *Typical Linear Contrast 3D-Mode image acquisition session* (page 534)
- *Typical Power Doppler 3D-Mode image acquisition session* (page 517)
- *Typical Color Doppler Mode image acquisition session* (page 498)

# Color Doppler Mode analysis

 Vevo 1100    Vevo 2100    Vevo LAZR

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 .....	501
Adding protocol measurements.....	502

## Adding generic Color Doppler Mode measurements

 Vevo 1100    Vevo 2100    Vevo LAZR

Color Doppler Mode provides seven generic measurement tools. Use these tools when you want to add measurements that are not part of a measurement protocol.

### Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want the default to be to hide them, go to **Prefs > Measurements** tab, clear the **Show Values and Labels** check box and save your edits in a custom measurement package.
- If you want to temporarily override the default, clear or select the **Show Values and Labels** check box at the bottom of the measurement panel.



### ► 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 image management panel. Hover over a tool to see the description label.

### Generic Color Doppler Mode measurements

All generic measurements are described in the *Generic measurements* (page 597) appendix. The following generic measurements are available for Color Doppler Mode images:

- Linear distance (page 614)
- Traced distance (page 625)
- 2D Area (page 597)
- Angle (page 600)
- Time Interval for Color Doppler Mode images (page 623)
- Velocity (page 626)
- VevoColor area tool (page 317)
  - Coloring a measured area (page 627)

## Adding protocol measurements



Protocol measurements are labeled uniquely for a specific measurement protocol.

- ▶ **Step 1: 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**.
- ▶ **Step 2: Place the 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 measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement.

#### Next step

- *Reporting your analysis results* (page 319)

#### Related information

- *Analyzing image data* (page 286)
- *Protocol measurements* (page 297)

## Section 17

# Power Doppler Mode imaging and analysis



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

### In This Section

Power Doppler Mode acquisition .....	505
Power Doppler Mode analysis .....	519

# Power Doppler Mode acquisition

 Vevo 2100  Vevo LAZR

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

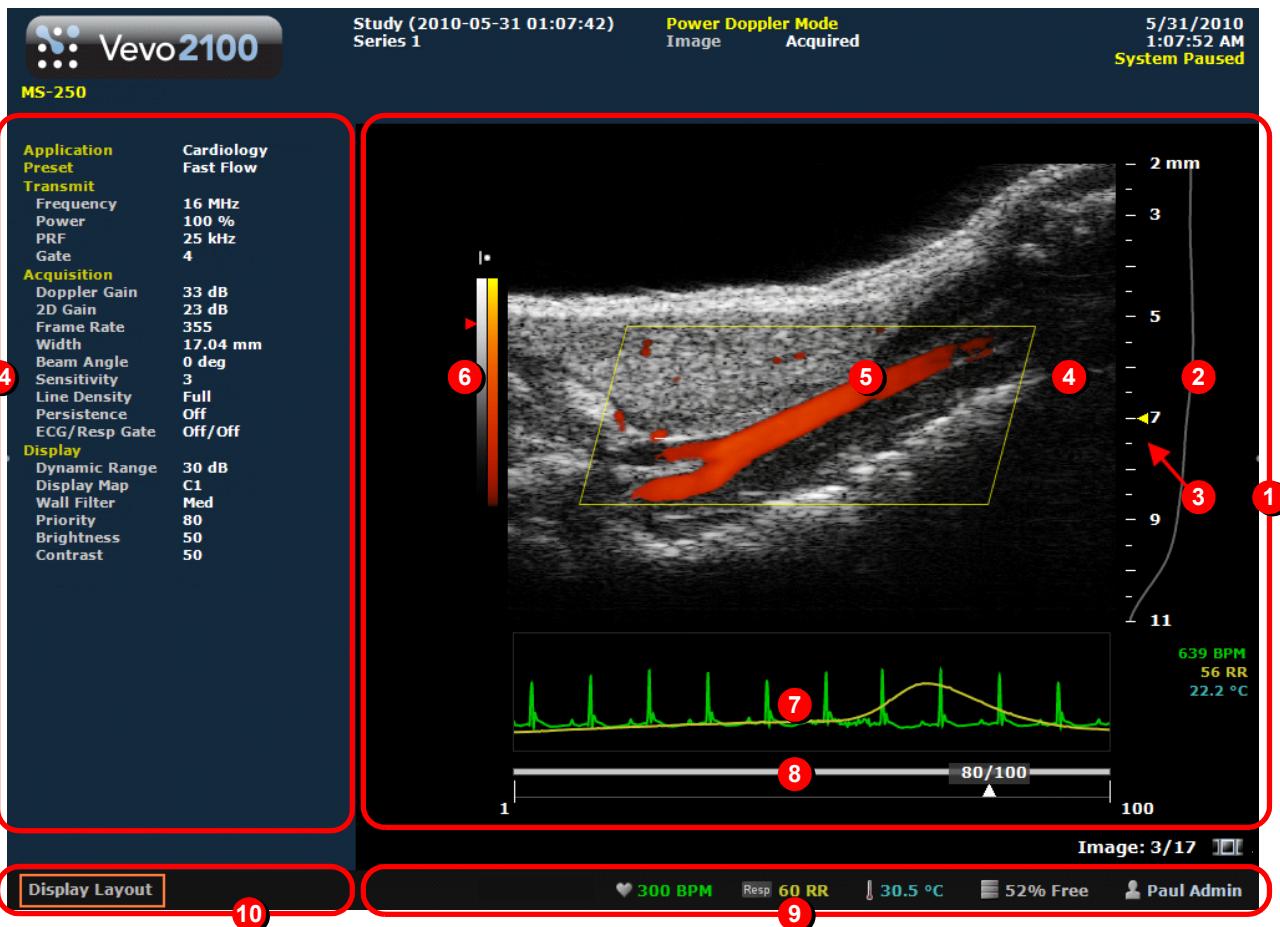
Power Doppler Mode window workspace .....	505
Control panel controls for Power Doppler Mode .....	510
Power Doppler Mode settings .....	513
Typical Power Doppler Mode image acquisition session .....	515
Typical Power Doppler 3D-Mode image acquisition session.....	517

---

## Power Doppler Mode window workspace

 Vevo 2100  Vevo LAZR

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.



### ① Image area

This large area:

- Displays image data
- Displays physiological data for the animal (if recorded during image acquisition)
- Provides cine loop range controls for acquired cine loops
- Provides a Browse Images tool for scrolling through an inset gallery of images without having to return to the Study Browser

If you export an image and select Image as your export type, the system includes the image area content along with header information.

## **② Image scale**

Indicates in *mm* the distance from the face of the transducer.

## **③ Focus depth scale**

Indicates the distance from the transducer face where the system maximizes image resolutions. The triangular arrow indicates the focal length(s) of the transducer. When you acquire image data, use the **Image Depth** control on the control panel to increase or decrease the depth that you can see.

When you reposition the ROI power box, the system automatically resets the focal depth to the vertical center of the box.

## **④ Image data panel**

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

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.

## **⑤ Power box overlay**

The system applies the Power Doppler Mode based colors only to the image data within this region-of-interest box.

## **⑥ Gray scale and power scale**

The right column of the scale is the power scale. The darker colors indicate lower frequency signals. The lighter colors indicate higher frequency signals. The left column of the scale is the gray scale for the B-Mode background image.

## **⑦ Physiological data trace panel**

Displays the animal's dynamic heart rate, temperature, respiration rate and blood pressure data. This data is gathered by the Advanced Physiological Monitoring Unit that connects to the Vevo Imaging Station.

## **8** 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. To only display the image frames in that range, drag the left and right vertical markers. For more information, see *Working with cine loops* (page 288).

## **9** Status bar

Displays:

- 3D motor position, when the 3D motor is initialized (where 3D-Mode is supported)
- Monitored physiological values in real time during image acquisition

**PREREQUISITES:** Live physiological data is only available a) when you enable the inputs in the Physiological tab of the Preferences window; and b) when the animal is connected to the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station.

For more detailed information on physiological monitoring, see *Vevo Imaging Station description* (page 69), *Physiological preferences tab* (page 141) and *Setting up to acquire physiological data* (page 269).

- Percentage of **free space** to store image data so you can see when you should start to back up your image data to free up space on the system
- User name, in blue, when **User Management Mode** is enabled (where User Management Mode is supported)
- Elapsed session time when you hover over the displayed blue user name when User Management Mode is enabled.

## **10** 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.
- Confirmation messages when you store an image.
- The updated parameter and system information when you make adjustments on the control panel.
- Control options in the acquisition mode you are using. To select, either a) cursor to the option and then click; or b) turn the **Screen Keys** dial to display the option, then press the dial.

## **⑪ Image mode management panel**

Displays a unique set of controls and information sections depending on the control key you press, or the image management panel tab you click:

- 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 (where ECG Trigger is supported).
- Press **Image Process** to set the panel to display the controls for brightness, contrast, baseline, priority, display maps, display layouts, loading into 3D and TGC loading and saving.
- Press **Mode Settings** to set the panel to display the Mode settings. This is the default panel when you open a Mode window.

## Control panel controls for Power Doppler Mode

Vevo 2100 Vevo LAZR

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 Back

- Removes or cancels the last measurement point before you commit your measurement.
- Resets the parameters to the pre-defined values in the current preset.

### 2 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.

### **3** Display Map

Cycles through a predefined set of overlays and optimization maps that you can apply either while you acquire or review image data. Push up or pull down to cycle through the available maps for the active imaging mode.

### **4** Screen Keys

Turn the dial to cycle through options for the current imaging mode and then press the dial to select. In **Power Doppler Mode**, cycles through the Display Layout options: Both, B-Mode Only, Color Only.

### **5** Transmit Power

Adjusts the power of the ultrasound signal transmission.

Turn the dial 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%.

### **6** 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.

### **7** 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.

#### **8** 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.
- Pull down to decrease the range by 5dB and increase contrast.

#### **9** 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.

#### **10** Power

Activates Power Doppler Mode acquisition and begins displaying the power box overlay over the B-Mode background image.

#### **11** Velocity

Adjusts the PRF (pulse repetition frequency). The higher you set the PRF, the lower the signal resolution.

#### **12** 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.

#### **13** 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.

#### **14** 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 element 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 reflected in the top-left corner of the B-Mode scout image. This is the angle between the ultrasound beam and the PW angle.

In Power Doppler Mode and Color Doppler Mode, this changes the color box.

Active during Color Doppler Mode, Power Doppler Mode, PW Doppler Mode and 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.

**15 Priority**

Adjusts the priority relationship between the overlay data and the background B-Mode data so you can eliminate false readings. 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.

**16 Sensitivity**

Adjusts the level of detail at deeper distances from the transducer head. The higher you set the sensitivity level, the lower the system sets the frame rate. Push up to increase sensitivity to *High*. Pull down to decrease sensitivity to *Standard* level.

---

## Power Doppler Mode settings



► **To view the Power Doppler Mode settings:**

Press **Mode Settings**. The settings panel displays the following parameters:

## Transmit

Parameter	Description
Frequency	The ultrasound frequency, measured in <i>MHz</i> . Adjust with the <b>Frequency</b> control.
Power	The transmission power level of the ultrasound signal, displayed as a percentage of the maximum power. Adjust with the <b>Transmit Power</b> control.
PRF	The pulse repetition frequency (PRF) of the transmitted PW Doppler signal, measured in kilohertz. This parameter defines the maximum observable PW Doppler frequency shift and flow velocity. Adjust with the <b>Velocity</b> control.
Gate	Number of transmit cycles in the ultrasound pulse. Adjust the value with the <b>Sensitivity</b> control. The range of values depends on the transducer. Higher gate values deliver more detail sensitivity, but lower image resolution.

## Acquisition

Parameter	Description
Doppler Gain	The strength of the ultrasound signal in <i>dB</i> increments when it returns to the face of the transducer. Adjust with the <b>Doppler Gain</b> control.
2D Gain	The strength of the ultrasound signal when it returns to the face of the transducer. Range values vary by transducer. Adjust with the <b>2D Gain</b> control.
Frame Rate	The number of image frames per second that the system is acquiring.
Extended Buffer	The state (On or Off) of the option to increase the size of the cine buffer or cine loop. Specify this option in the General tab in the Preferences window.
Width	The width of the acquired image area, measured in <i>mm</i> . Adjust with the <b>Image Width</b> control.
Beam Angle	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 <b>Beam Angle</b> control.
Sensitivity	The signal resolution level. Adjust with the <b>Sensitivity</b> control.
Line Density	The line density level. One of four settings: Quarter, Third, Half, Full. Adjust with the <b>Line Density</b> control.
Persistence	The state of the Persistence feature: Off, Low, Med, High, Max. Adjust with the <b>Persist</b> control.
ECG/Resp Gate	The state of the ECG trigger and respiration gating, respectively. Values: Off, On. For example, if both are on, the parameter displays On/On. To adjust, press <b>Physio Settings</b> and then select or clear the appropriate check boxes.
<b>NOTE:</b> On Vevo 1100, only the Resp Gate feature is available.	
TGC	The saved TGC control curve that has been manually loaded for the current image acquisition. Adjust in the <b>Image Process</b> panel. Click <b>Load</b> to apply a different TGC control curve.

## Display

Parameter	Description
Dynamic Range	The contrast of your image, measured in <i>dB</i> . Adjust with the <b>Dynamic Range</b> control.
Display Map	The selected predefined display map from the predefined set of maps. Adjust with the <b>Display Map</b> control.
Wall Filter	The level of low velocity signals, measured in Hz, filtered out of the spectral display. Adjust with the <b>Wall Filter</b> control.
Priority	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 <b>Priority</b> control.
Brightness	The image brightness level. Adjust with the <b>Brightness</b> slider in the image management panel after you press <b>Image Process</b> .
Contrast	The image contrast level. Adjust with the <b>Contrast</b> slider in the image management panel after you press <b>Image Process</b> .

## Typical Power Doppler Mode image acquisition session



### Before you begin acquiring data

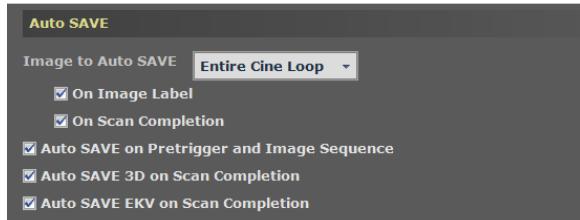
If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 269).
- Prepare your animal on the animal platform. For detailed information refer to the user manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 273).

### ► 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.
  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 510).
  7. Press **Scan/Freeze** 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 a cine loop or image frame and also add a label, press **Image Label**.  
**NOTE:** To set or remove auto-save default preference, select your option in the Auto SAVE section (**Preferences** window > **General** tab > **Auto SAVE** section).



- To save the displayed image frame press **Frame Store**.
10. Press **Scan/Freeze** to resume scanning.
  11. Save images as required.
  12. In the function keys row, press **Close**. The system closes the series you are working on and displays the **Study Information** window.  
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 519)
- *Adding protocol measurements* (page 298)

## Segmentation in Power 3D-Mode

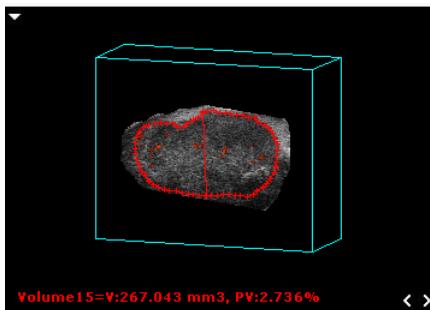
 

The segmentation feature is the only 3D image analysis tool in the system that can quantify vasculature.

### ► To segment a volume in Power 3D-Mode:

1. Acquire a Power 3D-Mode image.
2. Follow the same procedures for segmenting a volume in 3D-Mode:
  - Create a volume using rotational segmentation (page 480)
  - Create a volume using parallel segmentation (page 479)

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 Doppler 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 Doppler 3D-Mode image:

1. Set up for a 3D-Mode image acquisition session (page 465).

2. Follow the typical steps for a Power Doppler Mode image acquisition (page 515).
3. When you are satisfied with the Power Doppler Mode image, press **3D**.
4. Follow the typical steps for a 3D-Mode image acquisition (page 457).

### Related information

- *3D-Mode visualization tools* (page 470)
- *Typical 3D-Mode image acquisition session* (page 457)
- *Typical Color 3D-Mode image acquisition session* (page 499)
- *Typical Linear Contrast 3D-Mode image acquisition session* (page 534)

# Power Doppler Mode analysis



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.....519

Adding protocol measurements.....520

---

## Adding generic Power Doppler Mode measurements



Power Doppler Mode provides seven generic measurement tools. Use these tools when you want to add measurements that are not part of a measurement protocol.

### Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want the default to be to hide them, go to **Prefs > Measurements** tab, clear the **Show Values and Labels** check box and save your edits in a custom measurement package.
- If you want to temporarily override the default, clear or select the **Show Values and Labels** check box at the bottom of the measurement panel.



### ► 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 image management panel. Hover over a tool to see the description label.

### Generic Power Doppler Mode measurements

All generic measurements are described in the *Generic measurements* (page 597) appendix. The following generic measurements are available for Power Doppler Mode images:

- Time Interval for B-Mode images (page 623)
- Linear distance (page 614)
- Traced distance (page 625)
- 2D Area (page 597)
  - Mean and standard deviations (page 598)
- Angle (page 600)
- VevoColor area tool (page 317)
  - Coloring a measured area (page 627)

## Adding protocol measurements



Protocol measurements are labeled uniquely for a specific measurement protocol.

- ▶ **Step 1: 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**.
  
- ▶ **Step 2: Place the 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 measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement.

#### Next step

- *Reporting your analysis results* (page 319)

#### Related information

- *Analyzing image data* (page 286)
- *Protocol measurements* (page 297)

## Section 18

# Linear Contrast Mode imaging and analysis



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

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

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

### In This Section

Linear Contrast Mode acquisition.....	523
Linear Contrast Mode analysis.....	540

# Linear Contrast Mode acquisition

 Vevo 2100  Vevo LAZR

This chapter shows you how to acquire Linear Contrast Mode images.



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

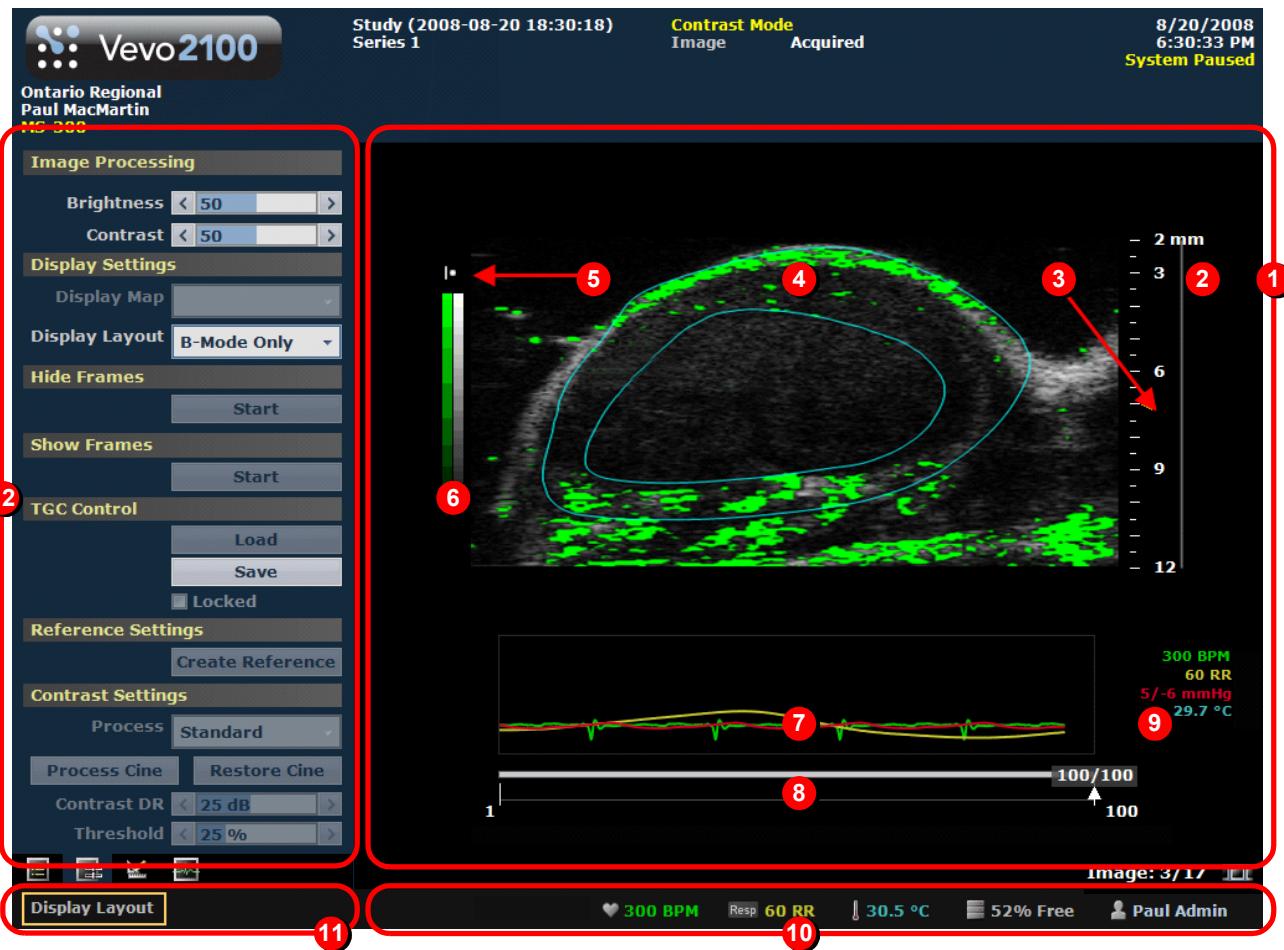
## In this chapter

Linear Contrast Mode window workspace .....	524
Control panel controls for Linear Contrast Mode and Nonlinear Contrast Mode .....	527
Linear Contrast Mode settings .....	529
Typical Linear Contrast Mode image acquisition session .....	531
Typical Linear Contrast 3D-Mode image acquisition.....	534
Contrast agent technology .....	535
Displaying contrast agents as an overlay .....	536
Adjusting the contrast overlay display .....	537

## Linear Contrast Mode window workspace



The Linear Contrast Mode window is the workspace you use whenever you view image data in Linear Contrast Mode. The following illustration and table describes the information and features in the Linear Contrast Mode window.



### ① Image area

This large area:

- Displays image data
- Displays physiological data for the animal (if recorded during image acquisition)
- Provides cine loop range controls for acquired cine loops
- Provides a Browse Images tool for scrolling through an inset gallery of images without having to return to the Study Browser

If you export an image and select Image as your export type, the system includes the image area content along with header information.

## ② Image scale

Indicates in *mm* the distance from the face of the transducer.

## ③ Focus depth scale

Indicates the distance from the transducer face where the system maximizes image resolutions. The triangular arrow indicates the focal length(s) of the transducer. When you acquire image data, use the **Image Depth** control on the control panel to increase or decrease the depth that you can see.

## ④ Image data panel

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

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.

## ⑤ Orientation icon

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.

## ⑥ Contrast scale

- The left column of the two-toned 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.

## ⑦ Physiological data trace panel

Displays the animal's dynamic heart rate, temperature, respiration rate and blood pressure data. This data is gathered by the Advanced Physiological Monitoring Unit that connects to the Vevo Imaging Station.

## **8** 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. To only display the image frames in that range, drag the left and right vertical markers. For more information, see *Working with cine loops* (page 288).

## **9** Live physiological data values

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

## **10** Status bar

Displays:

- 3D motor position, when the 3D motor is initialized (where 3D-Mode is supported)
- Monitored physiological values in real time during image acquisition

**PREREQUISITES:** Live physiological data is only available a) when you enable the inputs in the *Physiological* tab of the Preferences window; and b) when the animal is connected to the Advanced Physiological Monitoring Unit connected to the Vevo Imaging Station.

For more detailed information on physiological monitoring, see *Vevo Imaging Station description* (page 69), *Physiological preferences tab* (page 141) and *Setting up to acquire physiological data* (page 269).

- Percentage of **free space** to store image data so you can see when you should start to back up your image data to free up space on the system
- User name, in blue, when **User Management Mode** is enabled (where User Management Mode is supported)
- Elapsed session time when you hover over the displayed blue user name when User Management Mode is enabled.

## **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.
- Confirmation messages when you store an image.

- The updated parameter and system information when you make adjustments on the control panel.

Control options in the acquisition mode you are using. To select, either a) cursor to the option and then click; or b) turn the **Screen Keys** dial to display the option, then press the dial.

## **⑫ Image mode management panel**

Displays a unique set of controls and information sections depending on the control key you press, or the image management panel tab you click:

- 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 (where ECG Trigger is supported).
- Press **Image Process** to set the panel to display the controls for brightness, contrast, baseline, priority, display maps, display layouts, loading into 3D and TGC loading and saving.
- Press **Mode Settings** to set the panel to display the Mode settings. This is the default panel when you open a Mode window.

## **Control panel controls for Linear Contrast Mode and Nonlinear Contrast Mode**



Linear Contrast Mode, and Nonlinear Contrast Mode imaging is based on B-Mode data.

- Use the control panel controls for B-Mode (page 329) 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 Linear Contrast Mode imaging session (page 531).



### ① Back

- Removes or cancels the last measurement point before you commit your measurement.
- Resets the parameters to the pre-defined values in the current preset.

### ② Image Sequence

In Linear 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 Modes** preferences (page 138) section of the **General** tab in the **Preferences** window.
2. The destruction burst event (page 696) runs automatically:
  - Using a) the transducer that you connect to the front panel of the Vevo Imaging System, or using b) the *external* Vevo SonoGene 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)

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 **On Scan Completion** (**Preferences** window > **General** tab > **Auto SAVE** section).

#### To configure the control for Linear Contrast Mode:

- In the **Cine Loop Size** section (page 131) of the **General** tab in the **Preferences** window configure the size of the cine loop.
- In the **Contrast Mode** preferences section (page 138) of the **General** tab in the **Preferences** window configure the parameters for the destruction sequence.

#### ③ Pre Trigger

In B-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.

#### ④ 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.

## Linear Contrast Mode settings



### ► To view the Linear Contrast Mode settings:

Press **Mode Settings**. The settings panel displays the following parameters:

#### Transmit

Parameter	Description
Frequency	The ultrasound frequency, measured in MHz. Adjust with the <b>Frequency</b> control.

Parameter	Description
Power	The transmission power level of the ultrasound signal, displayed as a percentage of the maximum power. Adjust with the <b>Transmit Power</b> control.

## Acquisition

Parameter	Description
Gain	The strength of the ultrasound signal in <i>dB</i> increments when it returns to the face of the transducer. Adjust with the <b>2D Gain</b> control.
Frame Rate	The number of image frames per second that the system is acquiring. Adjust with the <b>Frame Rate</b> dial.
Extended Buffer	The state (On or Off) of the option to increase the size of the cine buffer or cine loop. Specify this option in the General tab in the Preferences window.
Depth	The distance, measured in <i>mm</i> , from the face of the transducer. Adjust with the <b>Image Depth</b> control.
Width	The width of the acquired image area, measured in <i>mm</i> . Adjust with the <b>Image Width</b> control.
Line Density	The line density level. One of four settings: Quarter, Third, Half, Full. Adjust with the <b>Line Density</b> control.
Persistence	The state of the Persistence feature: Off, Low, Med, High, Max. Adjust with the <b>Persist</b> control.
Sensitivity	The level of detail at deeper distances from the transducer head. Adjust with <b>Sensitivity</b> . The higher you set the sensitivity level, the lower the system sets the frame rate. Push up to increase sensitivity to High level. Pull down to decrease sensitivity to Standard level.
ECG/Resp Gate	The state of the ECG trigger and respiration gating, respectively. Values: Off, On. For example, if both are on, the parameter displays On/On. To adjust, press <b>Physio Settings</b> and then select or clear the appropriate check boxes.
TGC	The saved TGC control curve that has been manually loaded for the current image acquisition. Adjust in the <b>Image Process</b> panel. Click <b>Load</b> to apply a different TGC control curve.

## Display

Parameter	Description
Dynamic Range	The contrast of your image, measured in <i>dB</i> . Adjust with the <b>Dynamic Range</b> control.
Display Map	The selected predefined display map from the predefined set of maps. Adjust with the <b>Display Map</b> control.
Brightness	The image brightness level. Adjust with the <b>Brightness</b> slider in the image management panel after you press <b>Image Process</b> .
Contrast	The image contrast level. Adjust with the <b>Contrast</b> slider in the image management panel after you press <b>Image Process</b> .
Overlay	The contrast process that was applied: either Standard, Smooth, MIP or Cardiac.
Reference	The number of frames in the reference set.

## Typical Linear Contrast Mode image acquisition session



### Before you begin acquiring data

If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 269).
- Prepare your animal on the animal platform. For detailed information refer to the user manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 273).

#### ► To manually create a typical Linear Contrast Mode bolus injection cine loop:

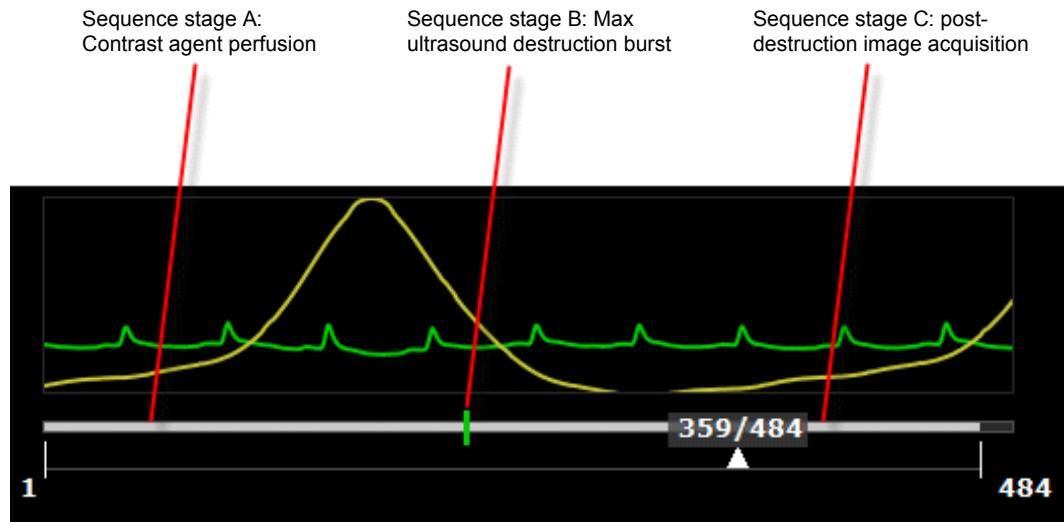
1. Inject the contrast agent. Refer to the appropriate VisualSonics Application Protocol document for complete information.
2. Press **Contrast** and begin acquiring image data.
3. Position the transducer and locate your region of interest.
4. Acquire 100 to 200 frames of data and then save and label the cine loop as **Baseline**.
5. Press **Pre Trigger** and inject the contrast agent.

**NOTE:** To set the system to save the cine loop automatically when the acquisition ends, select **Auto SAVE** on **Pretrigger and Image Sequence** on the **General** preferences tab (**Prefs** > **General** tab).

#### ► 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 the automated sequence based on the configuration you define 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**.

**NOTE:** To set the system to save the cine loop automatically when the acquisition ends, select **Auto SAVE** on **Pretrigger and Image Sequence** on the **General** preferences tab (**Prefs > General tab**).

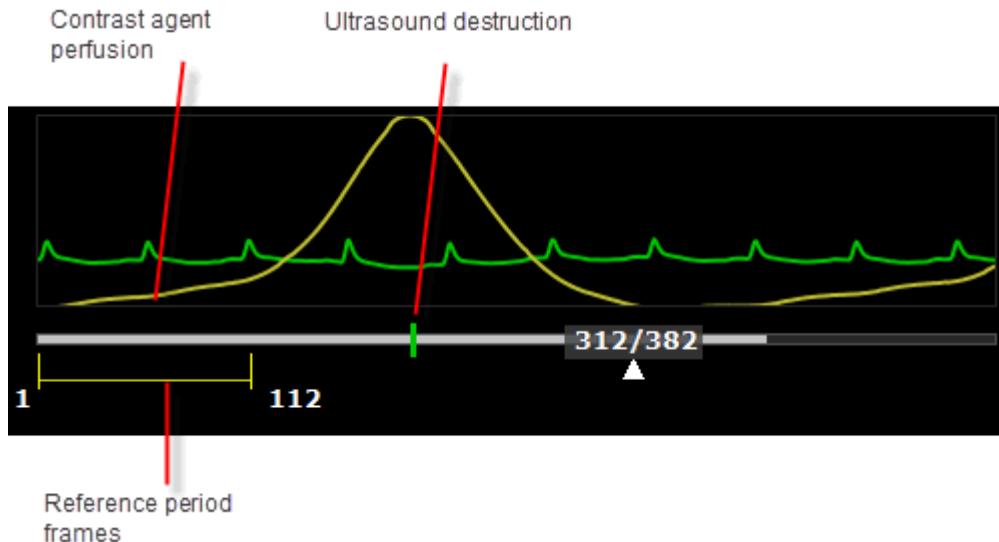
You have successfully acquired the contrast data that the system can work with to isolate the contrast agent ultrasound signal data from the tissue ultrasound signal data.

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 Image Processing 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**.
4. The transducer transmits a single ultrasound pulse burst at maximum setting for the period defined in the Contrast Mode preferences.
5. Press **Cine Store**.

#### Next steps

- *Displaying contrast agents as an overlay* (page 536)
- *Adjusting the contrast overlay display* (page 537)

#### Related information:

- *Typical Nonlinear Contrast Mode image acquisition session* (page 544)
- *Typical B-Mode image acquisition session* (page 335)
- *Auto SAVE preferences* (page 133)

---

## Typical Linear Contrast 3D-Mode image acquisition



Linear Contrast 3D-Mode adds Linear Contrast Mode scan data during a 3D-Mode scan so you can reconstruct a volume that integrates the Linear Contrast Mode data with the surrounding B-Mode 3D volume.

► **To acquire a Linear Contrast 3D-Mode image:**

1. Set up for a 3D-Mode image acquisition session (page 465).
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 457) 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 Linear 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 motor stage track and then returns the motor stage to the initial position.

8. Press **3D** to acquire post-destruction image data.
9. Press **Cine Store**.
10. Click **Create Reference**.
11. Press **Study Management** and then open the first Linear Contrast Mode cine loop you acquired before you ran the destruction sequence.
12. Click **Process Cine**.

The system generates the green contrast overlay data.

13. Press **Image Process** and in the image management panel in the **Contrast Settings** section click **Load Into 3D**.

The system generates the Linear Contrast 3D-Mode data and opens the image in the four-pane **Contrast 3D-Mode** window.

14. Review and manipulate the Linear Contrast 3D-Mode image data using the standard 3D-Mode image analysis tools (page 470).

#### Related information

- *3D-Mode visualization tools* (page 470)
- *Typical Linear Contrast Mode image acquisition session* (page 531)
- *Typical 3D-Mode image acquisition session* (page 457)
- *Typical Power 3D-Mode image acquisition session* (page 517)
- *Typical Color 3D-Mode image acquisition session* (page 499)

---

## Contrast agent technology



Linear 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

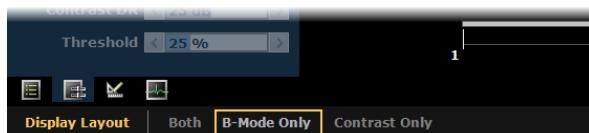


### Before you begin

1. Acquire your contrast data, as described in:
  - *Typical Linear Contrast Mode image acquisition session* (page 531)
  - *Typical Linear Contrast 3D-Mode image acquisition session* (page 534)
2. Create your reference set, as described in *Typical Linear Contrast 3D-Mode image acquisition session* (page 534).

#### ► 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.
2. Drag the frame indicator into the range of frames after the vertical green bar which identifies the destruction burst event.
3. Turn the **Screen Keys** dial to cycle through the following display options:

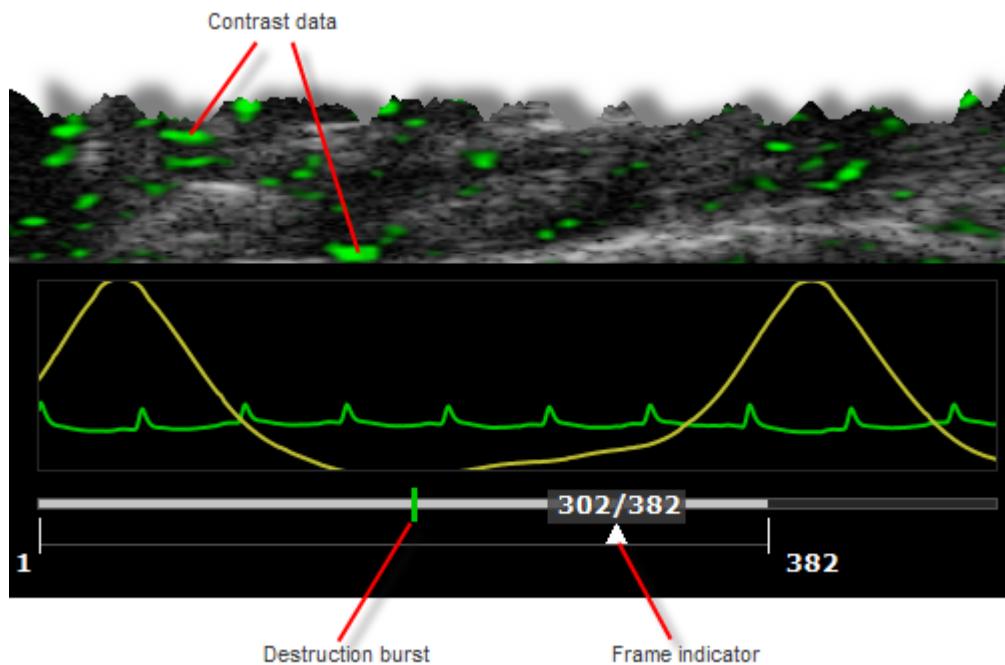


- Both: B-Mode image + Contrast overlay
- Contrast Only: Contrast overlay only
- B-Mode Only: B-Mode image only

#### ► To display the contrast data as an overlay using Vevo LAB:

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.

- Drag the frame indicator into the range of frames after the vertical green bar which identifies the destruction burst event.



- Click the tab to display the image processing panel and in the **Display Settings** section select the appropriate **Display Layout** option:
  - Both: B-Mode image + Contrast overlay
  - Contrast Only: Contrast overlay only
  - B-Mode Only: B-Mode image only

#### Related information

- Adjusting the contrast overlay display* (page 537)
- Image Sequence* (page 702)

---

## Adjusting the contrast overlay display

You can modify the amount and intensity of the contrast green overlay data in three ways:

- Select 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 change the process persistence setting:

1. In the **Process** box, select one of the following four options:

Setting	Description
Standard	Default. No additional filters are applied.
Smooth	Applies frame-to-frame averaging. Helpful when you want to remove transient bubble data from the image.
MIP	Applies a maximum intensity persistence to the images. Helpful when you want to trace bubble paths in vessel structures.
Cardiac	Applies a stronger filter. Helpful when you want to study fast moving cardiac structures.

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.

**NOTE:** To remove the processing, click **Restore Cine**.

### 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.

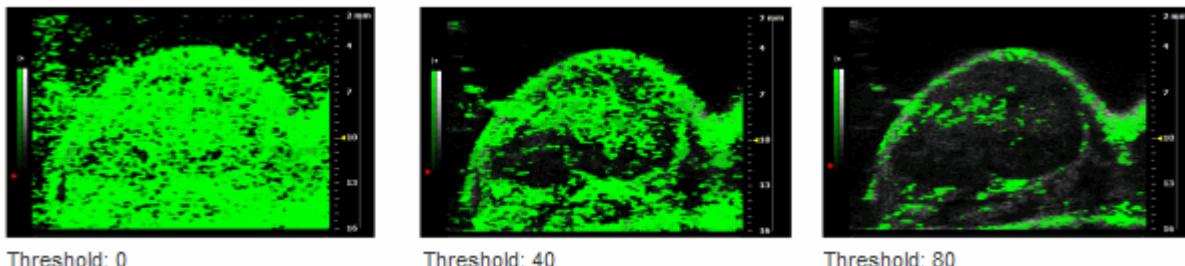
#### ► To adjust the contrast overlay dynamic range:

1. In the **Contrast DR** slider control, drag or click in the range bar to coarsely set the 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.



► **To adjust the contrast overlay data threshold:**

1. In the **Threshold** slider control, drag or click in the range bar to coarsely set the threshold.
2. Click the – or + controls to fine tune the parameter by increments of 1%.

**Related information**

- *Typical Linear Contrast Mode image acquisition session (page 531)*

# Linear Contrast Mode analysis



This chapter shows you how to analyze Linear Contrast Mode and Nonlinear Contrast Mode images that are saved to a study.

## In this chapter

Adding generic Contrast Mode measurements ..... 540

Adding protocol measurements ..... 542

---

## Adding generic Contrast Mode measurements



Linear Contrast Mode and Nonlinear Contrast Mode provide seven generic measurement tools. Use these tools when you want to add measurements that are not part of a measurement protocol.

### Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want the default to be to hide them, go to **Prefs > Measurements** tab, clear the **Show Values and Labels** check box and save your edits in a custom measurement package.
- If you want to temporarily override the default, clear or select the **Show Values and Labels** check box at the bottom of the measurement panel.



### ► To access the generic measurement tools for Linear Contrast Mode:

- If you are acquiring image data in either Linear Contrast Mode or Nonlinear Contrast Mode, 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 image management panel. Hover over a tool to see the description label.

### **Generic Linear Contrast Mode measurements**

All generic measurements are described in the *Generic measurements* (page 597) appendix. The following generic measurements are available for Linear Contrast Mode images:

- Time Interval (page 623)
- Traced distance (page 625)
- Linear distance (page 614)
- 2D Area (page 597)
  - Mean and standard deviations (page 598)
- Angle (page 600)
- Contrast region (page 603)
  - Copying and pasting linear and nonlinear contrast regions (page 606)
  - Creating a linear contrast region graph (on page 604)
  - Setting the X axis origin value to 0 seconds or frame 1 (on page 611)
  - Hiding and showing frames in the reference group (page 609)
  - Working with data in the linear contrast region analysis chart (page 606)
  - Exporting Linear Contrast Mode data (page 612)
- Cardiac region (page 601)
  - Creating a cardiac region analysis chart (page 603)
  - Working with data in the linear contrast region analysis chart (page 606)
- VevoColor area tool (page 317)
  - Coloring a measured area (page 627)

## Adding protocol measurements



Protocol measurements are labeled uniquely for a specific measurement protocol.

► **Step 1: 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**.

► **Step 2: Place the 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 measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement.

### Next step

- *Reporting your analysis results* (page 319)

### Related information

- *Analyzing image data* (page 286)
- *Protocol measurements* (page 297)

## Section 19

# Nonlinear Contrast Mode imaging and analysis



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

During acquisition the system modulates the amplitude of the ultrasound pulses, enabling a nonlinear response to microbubbles.

To acquire images in this mode you must use one of the following transducers: MS-200, MS-201, MS-250, MS-250S or LZ250.

### In This Section

Nonlinear Contrast Mode acquisition .....	544
Nonlinear Contrast Mode analysis .....	548

# Nonlinear Contrast Mode acquisition



This chapter shows you how to acquire Nonlinear 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 Nonlinear Contrast Mode image acquisition session ..... 544

---

## Typical Nonlinear Contrast Mode image acquisition session



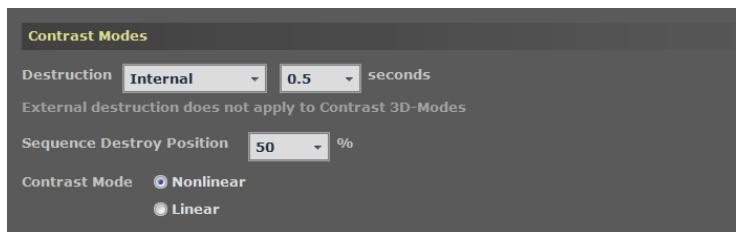
### Before you begin acquiring data

If you want to add physiological data to your image:

- Set up your system for physiological data acquisition (page 269).
- Prepare your animal on the animal platform. For detailed information refer to the user manual for your Vevo Imaging Station.
- For blood pressure setup, see *Blood Pressure section* (page 273).

### ► To start imaging in Nonlinear Contrast Mode:

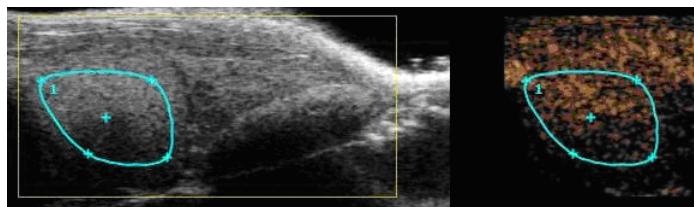
1. In **Prefs > Mode Settings tab > Contrast Modes** section, ensure that **Nonlinear** is selected.



2. Start imaging in B-Mode and adjust the presets and additional parameters in order to optimize the image for the region of interest.
3. Switch to Nonlinear Contrast Mode acquisition by pressing the Contrast key.
4. Select the appropriate preset for the study. The "presets" are sets of optimized values (for tissue type, depth, etc) for a variety of applications, such as tumour, heart, or kidney. For more information about the use of presets, refer to *Preset Settings* (page 171).
5. Press **Scan/Freeze** to start acquisition and inject the contrast agent according to the imaging protocol used for the experiment.
6. Save and label the cine loop.



*Nonlinear Contrast Mode before injecting the contrast agent*



*Nonlinear Contrast Mode after injecting the contrast agent, with a traced measurement*

**NOTE:** The images above were acquired after MicroMarker bolus injection (through the tail vein). For other types of experiments refer to the appropriate VisualSonics technical protocols. MicroMarker preparation or animal preparation protocols are not part of this document, please refer to the appropriate VisualSonics protocols for guidelines about the experimental set up.

The system also supports Nonlinear Contrast Mode acquisition using ECG and Respiration gating.

**NOTE:** The display, in the Nonlinear Contrast Mode window, can be set to Both, B-Mode Only, Contrast Only, Side by Side. The selection can be made using the Screen Keys dial on the keyboard or from the Image Process panel in the Vevo LAB application.

► **Workflow for acquisition with ECG and Respiration gating:**

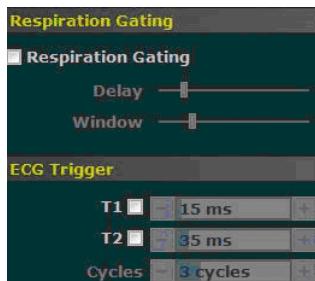
1. Start imaging in B-Mode. Adjust the presets and additional parameters in order to optimize the image for the region of interest.
2. Switch to Nonlinear Contrast Mode acquisition by pressing the **Contrast** key.
3. Select the appropriate preset for the study.

**NOTE:** The available presets are guidelines for different types of applications, optimized for various image depth and type of tissue, i.e. tumor, heart, kidney...etc.

4. Press **Scan/Freeze** to start acquisition and open the **Physio** panel by pressing the **Physio** key on the keyboard;

**To set the ECG triggers:** Check **T2** marker **ON** for acquisition at systole or **T1** for acquisition at diastole. The position of ECG triggers can be set anywhere in the cardiac cycle; by default, they are set at systole and diastole.

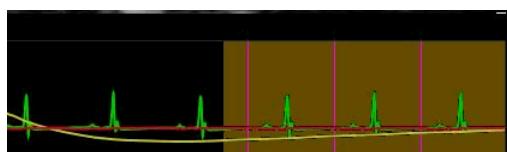
**To set Respiration gating:** Check the respiration gating **ON** and set the position of the sliders for the **Delay** and **Window** such that the acquisition only starts and ends in between two breaths (represented by the peaks).



*Physio panel display*



*Display of ECG trigger at systole*



## *Display of ECG trigger and Respiration gating*

5. Click **Scan/Freeze** to stop acquisition when desired and label the image pressing the **Image Label** key, typing a label, and clicking **OK**.

### **Working with contrast agent technology**

Nonlinear Contrast Mode and Linear Contrast Mode both support contrast agent technology. For more information see:

- *Contrast agent technology* (page 535)
- *Displaying contrast agents as an overlay* (page 536)
- *Adjusting the contrast overlay display* (page 537)
- *Typical Linear Contrast Mode image acquisition session* (page 531)

# Nonlinear Contrast Mode analysis



This chapter shows you how to analyze Nonlinear Contrast Mode images that are saved to a study.

Analysis of Nonlinear Contrast Mode data includes tracing one or more measurements in the region(s) of interest and displaying the graphs for the measurements.

The measurement used for Nonlinear Contrast Mode is available from the Contrast Measurements panel and appears displayed as .

## In this chapter

Adding generic Contrast Mode measurements .....	548
VeoCQ Analysis.....	550

## Adding generic Contrast Mode measurements



Linear Contrast Mode and Nonlinear Contrast Mode provide seven generic measurement tools. Use these tools when you want to add measurements that are not part of a measurement protocol.

### Viewing measurement values and labels

- By default, measurement values and labels are displayed in the factory measurement packages.
- If you want the default to be to hide them, go to **Prefs > Measurements** tab, clear the **Show Values and Labels** check box and save your edits in a custom measurement package.
- If you want to temporarily override the default, clear or select the **Show Values and Labels** check box at the bottom of the measurement panel.



► **To access the generic measurement tools for Linear Contrast Mode:**

- If you are acquiring image data in either Linear Contrast Mode or Nonlinear Contrast Mode, 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 image management panel. Hover over a tool to see the description label.

### Generic Linear Contrast Mode measurements

All generic measurements are described in the *Generic measurements* (page 597) appendix. The following generic measurements are available for Linear Contrast Mode images:

- Time Interval (page 623)
- Traced distance (page 625)
- Linear distance (page 614)
- 2D Area (page 597)
  - Mean and standard deviations (page 598)
- Angle (page 600)
- Contrast region (page 603)
  - Copying and pasting linear and nonlinear contrast regions (page 606)
  - Creating a linear contrast region graph (on page 604)
  - Setting the X axis origin value to 0 seconds or frame 1 (on page 611)
  - Hiding and showing frames in the reference group (page 609)
  - Working with data in the linear contrast region analysis chart (page 606)
  - Exporting Linear Contrast Mode data (page 612)
- Cardiac region (page 601)
  - Creating a cardiac region analysis chart (page 603)
  - Working with data in the linear contrast region analysis chart (page 606)
- VevoColor area tool (page 317)
  - Coloring a measured area (page 627)

## VevoCQ Analysis



VevoCQ Analysis is a software application designed for quantifying perfusion in small-animal models by contrast-enhanced ultrasound imaging.

This section describes how to use VevoCQ Analysis to process clips of contrast images that you acquire with the VisualSonics Vevo Imaging System.

### VevoCQ user guide



This document is designed as a user guide for processing clips of Nonlinear Contrast Mode 2D images acquired with the Vevo Imaging System.

#### Introduction



#### Intended use

VevoCQ Analysis is a software application designed for quantifying perfusion in small-animal models by contrast-enhanced ultrasound imaging. VevoCQ Analysis provides quantitative measurements by computing perfusion parameters by means of a dedicated curve-fitting algorithm applied on contrast-uptake kinetics (or time intensity curves).

In addition, VevoCQ Analysis offers the possibility to visualize the spatial distribution of these perfusion parameters as color-coded parametric images, useful for qualitative analyses. Finally, VevoCQ Analysis can save computed results in different forms (numerical data, images and clips) for statistical analysis and reporting purposes.

**NOTE:** The responsibility of interpreting VevoCQ Analysis results rests entirely with the user.

**NOTE:** You can only use VevoCQ Analysis with 2D Nonlinear Contrast Mode images.

#### Main features

The processing unit in VevoCQ Analysis is divided into 3 main modules: Clip Editor, automatic Motion Correction and Quantification. These components are called in a consecutive manner to provide perfusion-quantification results.

The first module (Clip Editor) allows inclusion-exclusion of images into/from the quantification mode and allows the tracing of the ROI. The second module (Motion Correction) applies a movement compensation by spatially realigning successive images in order to minimize respiration artifacts.

The third module (Quantification) performs a quantitative analysis of contrast agent perfusion, both at the pixel level and in regions of interest, by computing amplitude and time-related perfusion parameters with a curve-fitting algorithm.

This algorithm is based on mathematical models for either bolus-kinetics or replenishment-kinetics following microbubble destruction under infusion mode.

### Imaging protocol

To ensure reliable perfusion quantification results with VevoCQ Analysis, it is essential to follow certain rules during the acquisition of contrast-enhanced clip with the Vevo Imaging System. If the primary objective of the study is to perform therapeutic monitoring or screening of bioactive agent, make sure that:

- the imaging settings of the ultrasound system remain identical in the course of the study;
- the chosen scanning plane is optimal in order to minimize any out of plane motion by keeping respiratory movement within the plane;
- the scanning plane is the same from one exam to another on a given animal;
- the duration of the recorded clips is at least 20 s;
- the probe is kept steady for the whole duration of the recording.

### Clip Editor interface



### Clip editing

Button	Command	Description
Edit Clip	Clip editor	Mode where the clip can be edited prior to entering the Quantification mode. The Clip Editor function will be used to include / exclude images in/from the quantification process.

### Copy/Paste

Button	Command	Description
Copy ROIs	Copy	Copies a selected set of ROIs into the clipboard.
Paste ROIs	Paste	Pastes a selected set of ROIs from the clipboard.

## Image Processing

Button	Command	Description
	Motion correction	Applies spatial realignment in order to minimize motion artifacts from the images within the clip to be analyzed.
	Quantify	Starts the quantification process for the clip of interest.
	Cancel	Cancels the current processing state and restores the previous mode.

## Data Management

Button	Command	Description
	Export	Exports data in various formats: image, clip, numerical, to a user-defined location.
	Save	Stores data associated to the current study to a defined location on the system.

## Study Management

Button	Command	Description
	Previous clip	Navigates current opened cine loops.
	Next clip	Navigates current opened cine loops.
	Close	Closes the current cine loop or the VeoCQ Analysis application and return to Veo Imaging System application.

## VeoCQ Analysis Clip Editor workflow

- **Play the cine loop** using the  (play) or  (fast play) controls.
- **Edit the clip** to exclude images from the analysis (if need be) using the Clip Editor controls:  exclude and  include. With the exclude button pressed on all frames scrolled through will be marked with red and excluded from the analysis. A red frame around the whole image area will also suggest the exclusion.
  - **To reverse the state of the frame**, use the include button to mark the frame with green.
  - **To change the state for a range of frames**, move the cursor on the red/green border,  , and drag to the desired position on the cine loop bar.

- Draw a **region of interest (ROI)** on the image by selecting one of the predefined shapes:



**Tracing the contour** is similar to placing measurements within the Vevo application:

1. Select the region.
  2. Left-click to place the first point.
  3. Follow the shape on the image while placing the rest of the points.
  4. When you are done, click twice to complete the measurement.

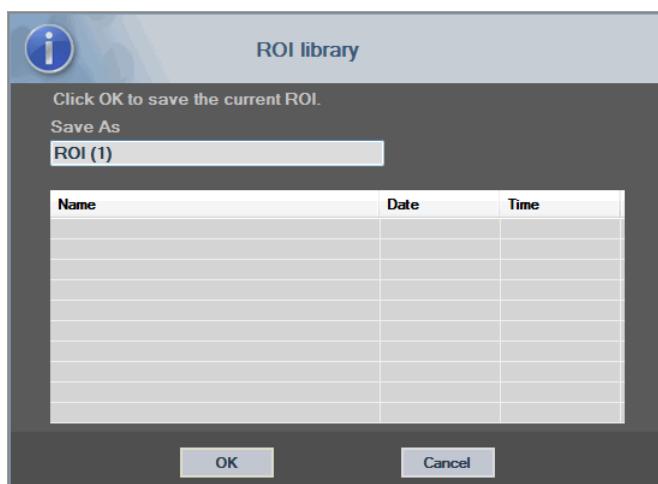
The ROI can be traced on either the B-Mode or Contrast image as they will be replicated in the other image simultaneously.

A default label will be placed next to the contour selection bar. The label can be edited in the window or later in the analysis window.

A set of ROIs can be saved for reuse.

**To reuse the regions of interest on multiple images, use the Copy and Paste controls from the Menu bar.**

When you select either Copy or Paste, the ROI library window appears. Here you can save or retrieve a region of interest depending on the control you selected.



- **Motion correction** is part of the available post-processing tools. When you activate this feature it applies spatial realignment to all the frames in the cine loop. You can reverse this type of processing at any time during analysis.

**To activate motion correction, press**

## Functional reference



VevoCQ is interfaced with the Study Browser of the Vevo Imaging System, which allows one or more clips (max. 5) to be processed.

**NOTE:** VevoCQ can also be started in the measurement panel of the mode window with a Nonlinear Contrast Mode cine loop.

► **The typical workflow to perform perfusion quantification comprises the following steps:**

1. Start VevoCQ on a selected image in the Study Browser
2. Edit the clip for excluding images from the analysis (if need be)
3. Draw Regions of Interest
4. Apply motion correction
5. Perform quantification
6. Export data
7. Save results

### Start VevoCQ

► **To start VevoCQ:**

1. Select a clip in the Vevo **Study Browser**.
2. Click the **VevoCQ** button in the main toolbar of the Study Browser or press **Measure** and click **VevoCQ** below the measurement tools.

### Clip editor

The Clip Editor module allows you to limit the analysis to a specified time window, and also to exclude unwanted images from processing (either isolated or in ranges).

In graph (a) below, the clip editor may be used to include, within the wash-in and wash-out phases of a bolus, only the images within a relevant time interval. If the destruction-replenishment technique is applied during the experiment, the clip editor automatically detects selectable replenishment segments by including images between two destruction events only as depicted in graph (b) below.

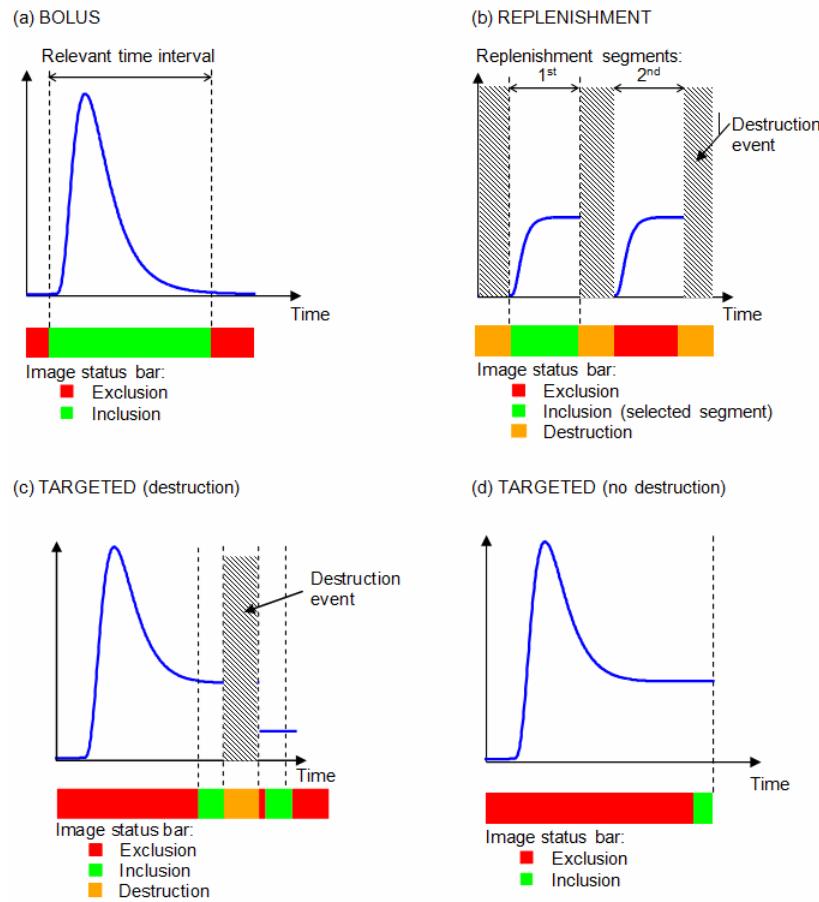
For Targeted analysis, using targeted microbubbles, the clip editor automatically proposes a selection of images to be processed. This selection depends on the presence or absence of destruction frames in the clip. During the imaging process, it is useful to apply destruction frames in a late phase, after the bubble-binding process has been completed and most of the circulating bubbles have been washed-out to maximize destruction of all bound bubbles.

The images before destruction display signal from both bound and circulating microbubbles while the images after destruction correspond to bubbles still in circulation at that moment and also represent any residual tissue-echoes, which are not representative of the binding process.

VevoCQ, in the Targeted mode, is able to express the specific binding as a difference between the echo power averaged in a segment before destruction and the residual echo power averaged in a segment after destruction. Graph (c) depicts the case with destruction frames, where the clip editor proposes two sets of images: one right before and another at 1s after the destruction frames. By default, the numbers of frames included in each set are remembered from the previous analysis.

In the case where there are negligible contributions from circulating bubbles or residual tissue-echoes, the investigator may have omitted to apply destruction frames. VevoCQ is also able to process such clips, by applying quantification in a single segment of frames in a late phase. As shown in graph (d), VevoCQ proposes, in this case, a set of frames for assessing microbubble-binding at the end of the clip.

Note that in all cases above, the segments can be modified manually by adjusting the transitions on the frame status bar. The active segments (green) may be moved as a whole by pressing the (Shift) key while dragging.



## Clip editor interface elements



*Workspace for clip editing mode.*

## Image display

Element	Name	Function
60 / 286	Image number	Shows the number of the currently displayed frame as well as the total number of images available in the clip.
2.8 s	Time indicator	Shows the time instant of the currently displayed frame.
	Zoom in	Increases the image size
	Zoom out	Restores the initial image size.
	Image slider	Selects the frame to be displayed. If the cursor points to an excluded image, a red frame appears around it.
	Frame status bar	Shows excluded and included frame in red and green, respectively. Destruction images are shown in orange.
	Play	Runs the movie player.
	Fast play	Runs the movie player in fast mode, up to 8x.

## Clip editor

Element	Name	Function
	Exclude	Sets the exclusion mode.
	Include	Sets the inclusion mode.
	Reset	Reset the clip edition to default (for targeted mode only)
	Replenishment	Enables the destruction / replenishment mode (only available if clip contains destruction images)
	Bolus	Enables the bolus mode.
	Targeted	Enables the targeted mode.
	Replenishment selector	Selects the previous/next replenishment segment (only available if the clip includes destruction-replenishment segments)

## Modifying images

► **To exclude a range of images:**

1. Move the image slider to the first image to be excluded
2. Click .
3. Move the image slider to the last image to be excluded.

► **To include a range of images:**

1. Move the Image slider to the first image to be included
2. Click .
3. Move the Image slider to the last image to be included

► **To change the range of excluded images:**

1. Move the mouse pointer over the Image status bar to any border of a range of excluded images (
2. When the pointer's shape changes to a vertical split +, drag the border to change the range of excluded images.

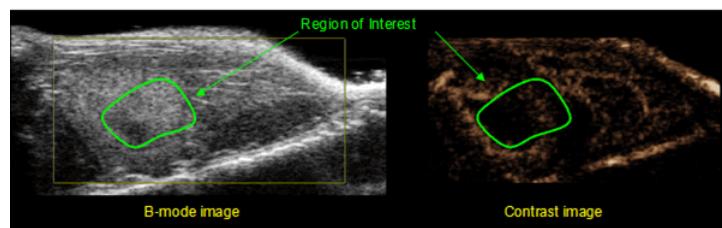
► **To move the range of excluded images:**

1. Move the mouse pointer over the Image status bar to any border of a range of excluded images (
2. When the pointer's shape changes to a vertical split +:
  - Drag to include or exclude more frames, depending on the direction of the move

- Press **SHIFT** to move the current selected exclusion range, with no change in the number of frames that are excluded

## Regions of interest (ROIs)

With the help of the ROI toolbar, one to four Regions of Interest (ROI) may be drawn on the B-Mode image (left side) or the Contrast Mode image (right side). As the B-Mode and Contrast Mode images represent the same anatomical location, a ROI drawn in one image is automatically duplicated on the other image, as shown in the following illustration.



## Interface elements

The ROI toolbar (located in the upper-left corner of the image viewer) offers four different drawing tools. The ROI label on the right of the toolbar identifies the current region to be drawn, and may be edited by clicking on it.



### ROI toolbar buttons

Button	Name	Function
	Select	Allows to select / modify a region of interest.
	Rectangle	Draws a rectangular shape.
	Ellipse	Draws an elliptical shape.
	Polygon	Draws a polygonal shape.
	Closed curve	Draws a closed curvilinear shape.

## Drawing ROIs

### ► To draw a rectangular or elliptical ROI:

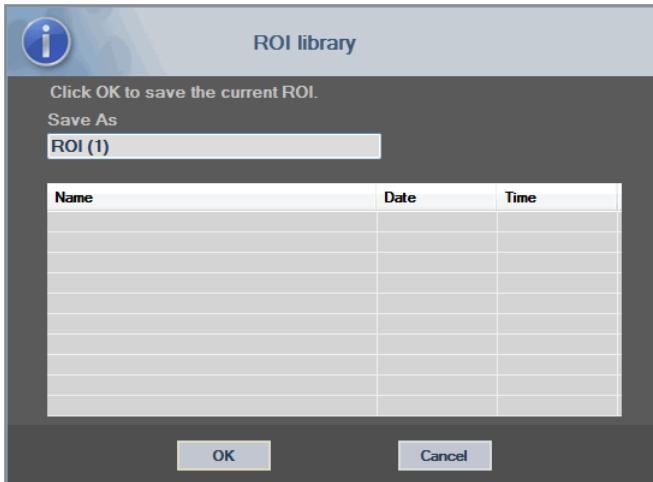
1. Select a shape in the ROI toolbar ( or )
2. Move the mouse pointer to the desired location in the B-Mode image (left side) or the Contrast Mode image (right side).

3. Click and drag to draw the ROI.
- **To draw a polygonal or closed curved ROI:**
1. Select a shape in the ROI toolbar ( or )
  2. Move the mouse pointer to the desired location in the B-Mode image (left side) or the Contrast Mode image (right side)
  3. To add anchor points, click repeatedly while moving the mouse pointer.
  4. Double-click at any time to close the shape.
- **To delete a ROI:**
1. Right click in the image to set the ROI selection mode or click the  button.
  2. Move the mouse pointer to any border of the ROI.
  3. Select the ROI using the left or right mouse button.
  4. Press either the DELETE or BACKSPACE keys.
- **To change the location of a ROI:**
1. Right click in the image to set the ROI selection mode or click the  button.
  2. Move the mouse pointer to any border of the ROI.
  3. When the pointer shape changes to a double-arrow, click and drag the ROI to a new location.
- **To change the location of anchor points of a ROI:**
1. Right click in the image to set the ROI selection mode or click the  button.
  2. Move the mouse pointer to any anchor point of the ROI.
  3. When the pointer shape changes to a cross, click and drag the anchor point to a new location.

Regions of interest can be copied into a ROI library and pasted at a later time point.

► To copy all the ROIs currently drawn:

1. Click 

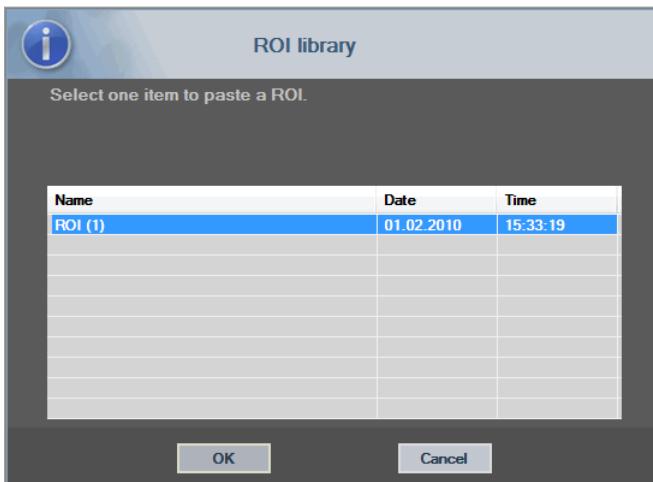


2. Set a name or accept the default generated one and press the OK button.

► To paste ROIs from the library:

1. Click 

2. Select the item in the list and press the OK button.



## Motion correction

This section describes the Motion correction module, which is a key tool for allowing reliable perfusion assessments. Motion in a clip can be due to internal organ movements, such as breathing, or to slight probe movements. Manual alignment of the individual images is extremely time-consuming and thus not practical. VevoCQ provides an automatic motion correction tool to spatially realign images with respect to a user-selected reference image.

### ► To apply Motion correction:

1. Move the Image slider to choose a reference image.



2. Click **Correct Motion**.
3. Once motion correction is applied, native clip editor is replaced by motion corrected clip editor, where resulting clip from the motion correction process can be further edited. At this stage, colors of the Image status bar (red and green) representing excluded and included image ranges are set to blue and violet, respectively.
4. Check the accuracy of the motion correction by scrolling through the clip using the Image slider (motion correction is considered a success if the images are spatially realigned and any residual motion is deemed acceptable).
5. If the motion correction is unsuccessful, try one of the following:
  - Select another reference image and click the **Correct Motion** button again to re-apply Motion correction.
  - Use the Clip editor to exclude any images thought to be degrading the result of motion correction, such as out of plane movements, and then re-apply Motion correction.

## Quantification

The Perfusion quantification module represents the core of the VevoCQ functionality and performs quantification in two steps. Video data is first converted into echo-power data, a quantity directly proportional to the instantaneous concentration of contrast agent concentration at each location in the field of view.

This conversion process, called linearization, takes into account the dynamic range used for clip acquisition and compensates for contrast gain as well as mean Time-Gain Compensation (TGC) value within the contrast box, as long as pixel intensity is not truncated or saturated. The echo-power data as a function of time, or Linearized signals, are then processed to assess blood perfusion, using a curve-fitting approach with a parametric Perfusion model.

The parameters derived from such a model are called Perfusion parameters and are useful for relative estimates of local perfusion (e.g. in terms of relative blood volume or relative blood flow). For instance, these parameters may be particularly useful for assessing the efficacy of given therapeutic agents at different times. The concepts of linearized signal, perfusion modeling and parametric imaging are explained further in the next sections.

### **Linearized signal**

A linearized (or echo-power) signal represents echo-power data as a function of time at either the pixel level or in a region of interest. The linearized signal results from a linearization process of the video data and is proportional to the local ultrasound agent concentration. As it is expressed in arbitrary units, only relative measurements are possible.

For instance, let's consider echo-power amplitudes at a given instant both in a tumor and in surrounding parenchyma. If the echo-power amplitude is twice as high in the tumor than the parenchyma, this means that the concentration of ultrasound contrast agent in the lesion is close to double that in the parenchyma.

### **Perfusion modeling**

Perfusion estimates in VevoCQ are made by a curve fitting process that adjusts the parameters of a mathematical model function to best fit the experimental linearized signal.

In the context of ultrasound contrast imaging, the mathematical function is called Perfusion model and is chosen to represent either bolus kinetics or replenishment kinetics following bubble destruction. Such a model serves to estimate a set of Perfusion parameters for quantification purposes.

These parameters can be divided into three categories: amplitude, time and combination of amplitude and time. Firstly, amplitude related parameters are expressed as relative echo-power. Typical amplitude parameters are the peak enhancement in a bolus kinetics, or the plateau value in a replenishment kinetics, which may be associated with relative blood volume.

Secondly, time related parameters are expressed in seconds and refer to the timing of the contrast-uptake kinetics. As an example of time parameter, the mean transit time measures the average time that blood takes to transit through a portion of tissue.

Finally, amplitude and time parameters may be combined so as to produce quantities related to the blood flow (= blood volume / mean transit time) for replenishment kinetics or the wash-in rate (= peak enhancement / rise time) for bolus kinetics.

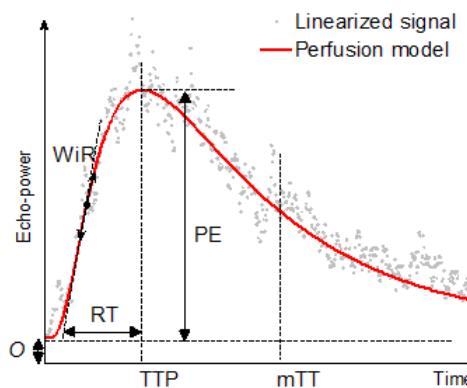
## Bolus perfusion model

Quantification is defined as:

$$f(t) = O + AUC \frac{1}{st\sqrt{2\pi}} e^{-\frac{(\ln(t)-m)^2}{2s^2}}$$

where

$$m = \ln(mTT) - \frac{s^2}{2}$$



with the following definitions:

Abbreviation	Definition	Unit
$f(t)$	Best-fit function of echo-power (or fitted signal)	[a.u, dB]
$t$	Time variable	[s]
$AUC$	Area Under the Curve to infinite time	[a.u]
$mTT$	Mean Transit Time corresponding to the center of gravity of $f(t)$	[s]
$O$	Offset amplitude	[a.u]

Additional perfusion parameters, derived from the bolus perfusion model, available in VevoCQ are:

PE	Peak Enhancement – representative of Blood Volume	[a.u, dB]
WiAUC	Area Under the Curve (Wash-in)	[a.u, dB]
RT	Rise Time	[s]
TTP	Time To Peak	[s]
WiR	Wash-in Rate (maximum slope)	[a.u, dB]
WiPI	Wash-in Perfusion Index (WiAUC / RT) – representative of blood flow	[a.u, dB]
QOF	Quality Of Fit between the echo-power signal and $f(t)$	[%]

where [a.u] and [s] are arbitrary unit and second, respectively.

The following optional parameters may be enabled in the User Settings.

**NOTE:** The optional parameters are calculated from the fitted curve using extrapolated data and they can vary with size of cine loop:

AUC	Area Under the Curve	[a.u, dB]
-----	----------------------	-----------

AUC	Area Under the Curve	[a.u, dB]
mTT	mean Transit Time	[s]
PI	Perfusion Index (AUC / mTT)	[a.u, dB]
Fit	Fitted Signal	[a.u, dB]
Lin	Linearized signal	[a.u, dB]

## The Destruction-replenishment perfusion model

Quantification is defined as:

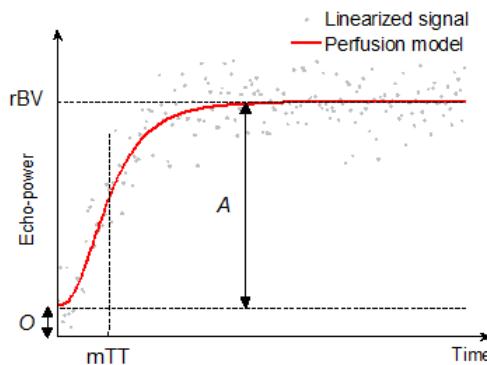
$$f(t) = O + \frac{A}{2} \left[ 1 + \operatorname{erf} \left( \frac{\ln(t) - m}{s\sqrt{2}} \right) \right]$$

where

$$m = \ln(mTT) - \frac{s^2}{2}$$

with the error function  $\operatorname{erf}$ , defined as

$$\operatorname{erf}(t) = \frac{2}{\sqrt{\pi}} \int_0^t e^{-u^2} du$$



with the following definitions:

Abbreviation	Definition	Unit
$f(t)$	Best-fit function of echo-power (or fitted signal)	[a.u]
$t$	Time variable	[s]
$A$	Amplitude of the plateau	[a.u]
$mTT$	Mean Transit Time	[s]
$O$	Offset amplitude	[a.u]

The perfusion parameters, derived from the destruction-replenishment model, available in VevoCQ are:

rBV	relative Blood Volume ( $A + O$ )	[a.u]
mTT	mean Transit Time	[s]
rBF	relative Blood Flow ( rBV / mTT)	[a.u]
QOF	Quality Of Fit between the echo-power signal and $f(t)$	[%]

where [a.u] and [s] are arbitrary unit and second, respectively.

## **Targeted contrast imaging**

Targeted contrast imaging may be quantified with VevoCQ in the late phase, in two possible modes: as "Targeted Enhancement" and "differential Targeted Enhancement".

Late phase Targeted Enhancement reflects the average signal intensity, proportional to the quantity of bubbles (i.e. including targeted bubbles attached to specific receptors), remaining after a given period of time. This parameter is calculated by computing the mathematical expectation (or mean) of the experimental linearized signal over the last 2 seconds in the clip being analyzed.

Note that this default time interval is a suggestion only and may be extended, shortened or moved according to user's preferences. Note also that reflects the quantity of attached bubbles as well as any residual bubbles still in circulation.

Differential Targeted Enhancement, or dTE, is computed for estimating the quantity of targeted bubbles after subtraction of any residual contribution from circulating bubbles. For that purpose, a destruction of all targeted bubbles must be applied during acquisition, in order to assess, immediately after the flash, the quantity of bubbles still in circulation and replenishing the region under observation.

Therefore, the calculation requires the definition of two time intervals: one immediately before the destruction flash, and another one shortly after, when any bubbles still in circulation have replenished the region. In this way, by subtracting the mean signal intensity coming from circulating bubbles, from the signal intensity reflecting both circulating and targeted microbubbles, it provides a better estimate of the quantity of target bubbles alone.

Note that a delay of 1 s is introduced by default after the agent destruction phase, so as to exclude the replenishment phase from the analysis. Again, these periods are suggestions only and may be modified at will.

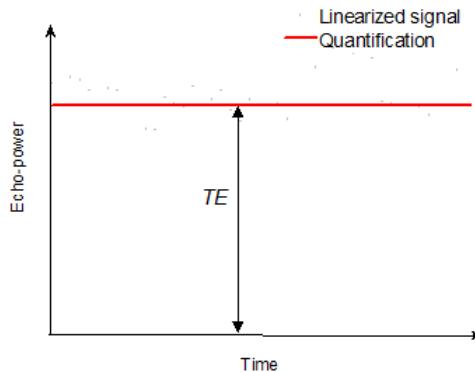
## Late phase targeted enhancement

Quantification is defined as:

$$TE = E[s(t)]$$

where  $E[\cdot]$  is the mathematical expectation (mean)

$$CV(TE) = \frac{E[(s(t) - TE)^2]}{TE}$$



with the following definitions:

Abbreviation	Definition	Unit
$t$	time variable	[s]
$s(t)$	linearized signal	[a.u]
$TE$	Targeted Enhancement (mean value of $ep(t)$ )	[a.u]
$CV(TE)$	Coefficient of Variation (standard deviation of $ep(t)$ normalized by $TE$ ) [%]	

where [a.u] and [s] are arbitrary unit and second, respectively.

## Differential targeted enhancement

Quantification of differential targeted enhancement (destruction applied) is defined as:

$$\Delta TE = TE_{bd} - TE_{ad}$$

with

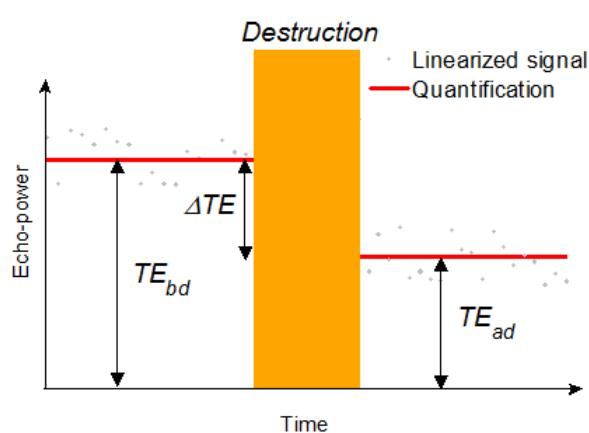
$$TE_{bd} = E[s_{bd}(t)]$$

and

$$TE_{ad} = E[s_{ad}(t)]$$

where  $E[\cdot]$  is the mathematical expectation (mean)

$$CV(\Delta TE) = \frac{E[(s_{bd}(t) - TE_{bd})^2]}{\Delta TE}$$



with the following definitions:

Abbreviation	Definition	Unit
$t$	time variable	[s]
$s_{bd}(t)$	linearized signal before destruction	[a.u]
$s_{ad}(t)$	linearized signal after destruction	[a.u]
$\Delta TE$	differential Targeted Enhancement	[a.u]
$CV(\Delta TE)$	Coefficient of Variation before destruction (standard deviation of $ep_{bd}(t)$ normalized by $\Delta TE$ )	[%]

where [a.u] and [s] are arbitrary unit and second, respectively.

### Parametric imaging

VevoCQ can perform spatial rendering of any perfusion parameter, in the form of a parametric map. This map synthesizes the time sequence of images into a single parametric image. Parametric imaging may enhance the information content of the contrast examination.

This technique may be particularly useful for making qualitative analysis in the course of a therapeutic monitoring performed on a given small-animal.

In the example of using the destruction-replenishment technique, the efficacy of a substance inhibiting angiogenesis may be assessed by observing parametric images of relative blood volume (rBV) in a tumor, before and in the course of therapeutic treatment, reflecting the state of tumor perfusion resulting from the neo-vasculature.

A second benefit of parametric images is the spatial visualization of tumor response to the treatment, or its effects on healthy surrounding parenchyma.

Note that in order to perform qualitative analysis on the basis of parametric images, certain conditions must be met:

- the clips must represent the same anatomical cross-section from one exam to another on a given small-animal;
- acquisition of contrast-ultrasound sequences must be performed using identical system settings (transmit power, display settings, gain, TGC and dynamic range);
- only parametric images of the same perfusion parameter can be compared.

## Interface elements

### Quantification mode

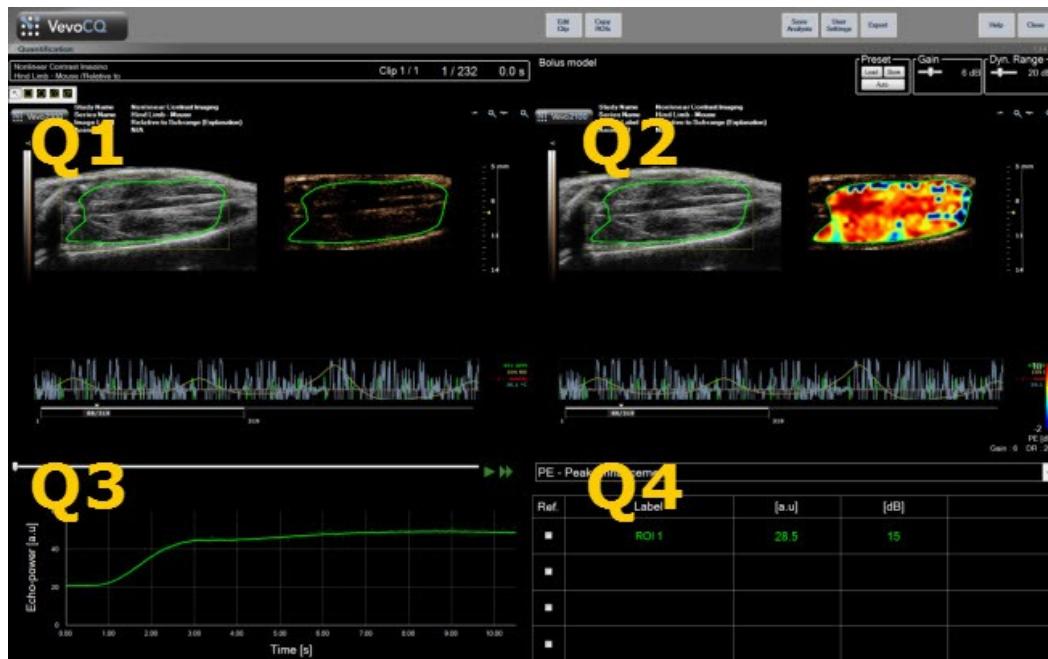
Once the perfusion quantification processing is completed, VevoCQ switches from the Clip Editing mode to the Quantification mode. The display-layout in the Quantification mode comprises of four quadrants (Q1-Q4). The four-quadrant representation combines all results within one display, namely

- Original clip (Q1);
- Processed clip or parametric image (Q2);
- Chart displaying time intensity curves (linearized and fitted signals) in each ROI (Q3);
- Table listing the computed value in each ROI (Q4).

Q1 displays the original clip and Q2 the processed clip or the parametric image, depending on the selection in the Parametric image view menu. Each parametric image has its own color map, which is rendered in the color bar located in the lower-right corner of Q2. For amplitude perfusion parameters, the colormap ranges from blue to red, representing low to high amplitudes, respectively; for the time parameters, the colormap is a reversed version of the previous one, from red to blue, low-high.

In Q3, with the colors matching the traces from the ROI, are the graphs representing the linearized and fitted signals. When a ROI is moved or modified, the calculated values are automatically updated corresponding to the position and displayed in Q4. The ROI labels may be changed by editing the name in the Label column (Q4).

Above Q2, sliders are provided to adjust the Gain and the Dynamic range (log-compression) of the processed image displayed in Q2, in a way similar to a standard ultrasound scanner.



User interface in analysis window.

Slider / control	Name	Function
	Preset	Stores / restores display preset (gain and dynamic range of all parametric images).
	Gain	Controls the gain applied to the current processed image (Q2).
	Dynamic range	Controls the dynamic range of log-compressed applied to the current processed image (Q2).
	Parametric image view	Allows the selection of parameter to be displayed.

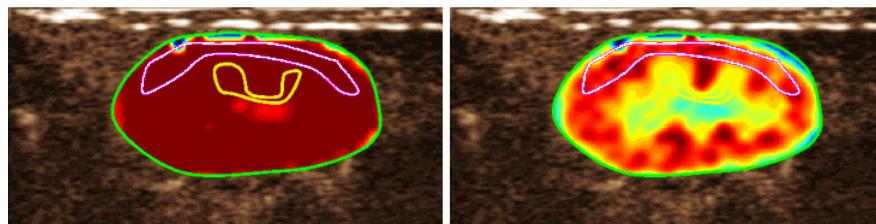
Relative measurements can also be displayed in the Q4 table by selecting a reference ROI (in the Ref. column). Relative values are displayed in [%] and [dB] for amplitude-related parameters and in [%] for time-related parameters.

WiR - Wash-in Rate				
Ref.	Label	[a.u]	Ref [%]	Ref [dB]
<input type="checkbox"/>	Whole Kidney	79.4	266.52	4.26
<input checked="" type="checkbox"/>	Medulla	29.8	100.00	0.00
<input type="checkbox"/>	Cortex	91.9	308.34	4.89

*Relative measurements for an amplitude-related parameter (WiR)*

#### Auto-scaled display presets

Display presets (i.e. Gain & Dynamic Range) for each parametric image are automatically adjusted once the perfusion quantification processing is completed using the built-in auto-scaling function. However, this adjustment is to be seen as a suggestion and may need further manual fine tuning. Below, an example of a parametric image prior and after auto-scaling is applied:



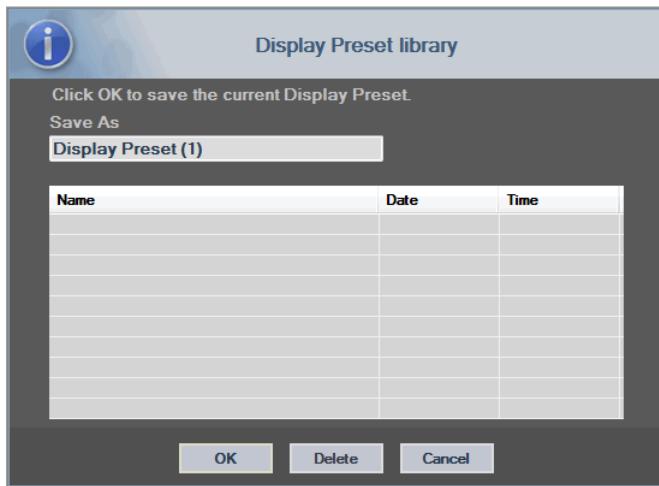
*Parametric image prior and after display presets auto-scaling*

#### Storing / loading display preset

Display preset can be stored into a dedicated library and loaded at a later time point. To store the preset for all parametric images:

1. Click the **Load** button in the preset toolbar.

- Set a name or accept the default generated one and press the OK button.



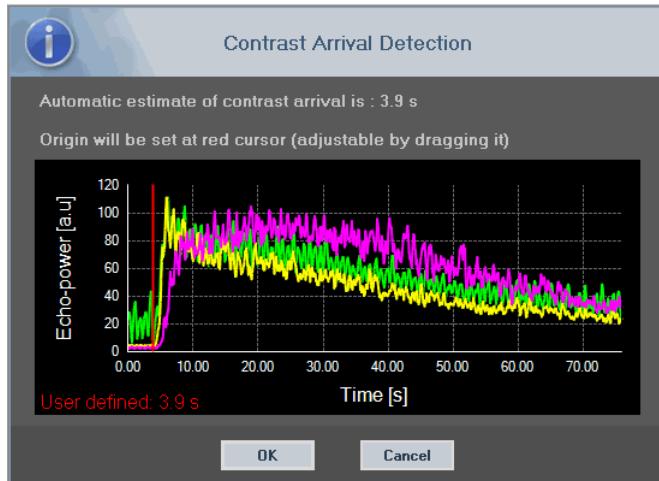
► **To load display presets from the library:**

- Click the **Store** button in the preset toolbar.
- Select the item in the list and press OK.

**Contrast arrival detection (for bolus only)**

At the beginning of the perfusion quantification process, the arrival of contrast is detected within the ROIs. The time of contrast arrival is automatically determined as the instant when the echo-power amplitude rises above the background (wash-in phase), and is represented by a red line.

As shown in the **Contrast arrival detection** dialog box, this instant remains a suggestion which may be modified by dragging the red cursor line. After pressing the OK button, all images preceding the selected instant will be excluded from the analysis and the clip time origin will be updated accordingly.



► **To launch Perfusion quantification:**

1. Click the  button.
2. In the Contrast arrival detection dialog box, click the OK button to accept the new time origin or IGNORE to skip it.

### Exporting analysis data

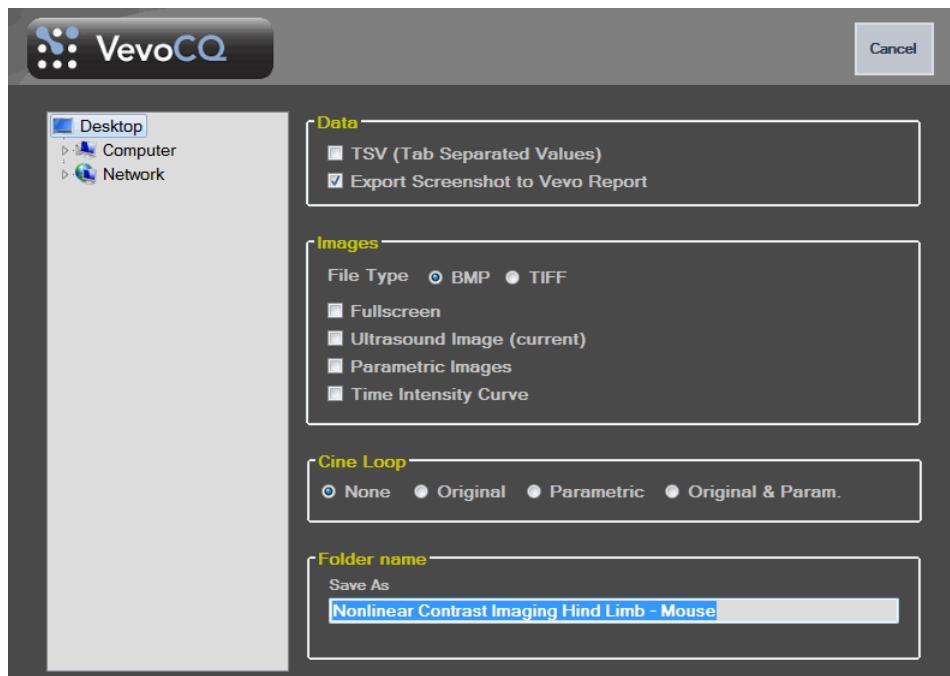
VevoCQ offers the possibility to export numerical, image and clip data to a user defined directory. For example, the numerical data are particularly useful for carrying out further analysis in a spreadsheet type program.

The image data are a set of screen capture containing both the regions of interest and parametric images. These images allow qualitative comparisons between successive studies in the course of a therapeutic follow-up on a given small-animal.

As a second example of qualitative analysis, the processed clips may provide a better assessment of the contrast-uptake over time.

Finally, still images or processed clips may be also useful for documentation or presentation purposes.

### Interface elements



Export screen

## Available export formats

TSV	Exports a tabulated text file (XLS extension) including time intensity curves and perfusion estimates.
Export Screen capture to Vevo Report	Exports a screen capture of the current analysis to Vevo Report.

## Images

Full screen	Exports a screen capture of the front panel (All 4 quadrants).
Ultrasound image (current)	Exports the current ultrasound image with its ROIs (Quadrant 1).
Parametric images	Exports all parametric images (Quadrant 2).
Time Intensity Curve	Exports an image of the chart (Quadrant 3)

## Clip

None	Does not export the cine loop
Original	Exports the original cine loop.
Parametric	Exports the processed cine loop.
Original & Parametric	Exports the original and the processed cine loops in a side-by-side view mode.

## Option

Save as      Indicates the directory name under which the result files will be saved.

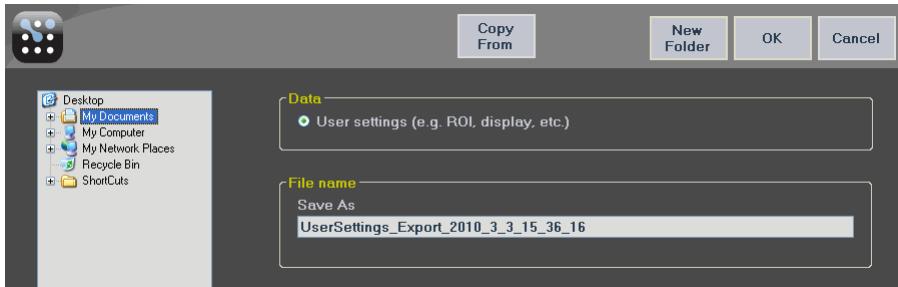
### ► To export data:

1. Click the  button.
2. Select a target directory in the image management panel.
3. Under Data, Images and cine loop in the right panel, choose the type of results to export.
4. Under Folder Name, type a folder result name.
5. Click the OK button in the main toolbar to export the results in the specified folder result name.

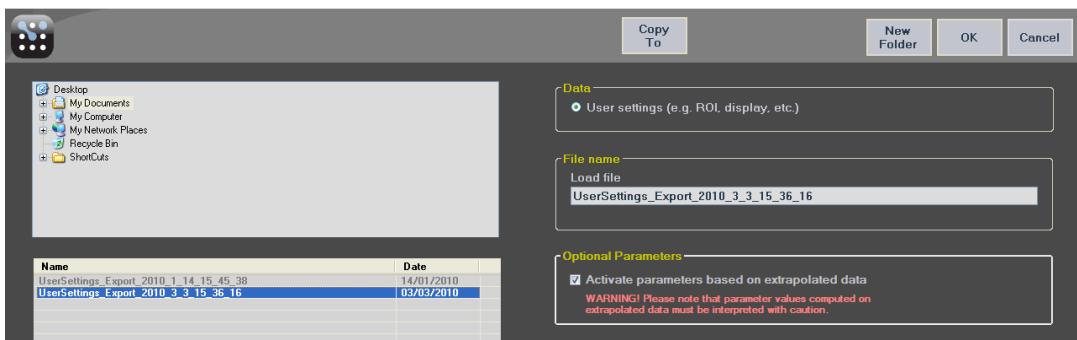
## Exporting/importing user settings

User settings such as ROI library and display presets library can be exported and imported at a later time point or on a different machine.

## Interface elements

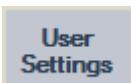


*Export user settings user interface*



*Import user settings user interface*

### ► To export user settings:



1. Click the **User Settings** button.
2. Select a target directory in the image management panel.
3. Update the default file name if needed.
4. Click the OK button in the main toolbar to export the user settings.

### ► To import user settings:

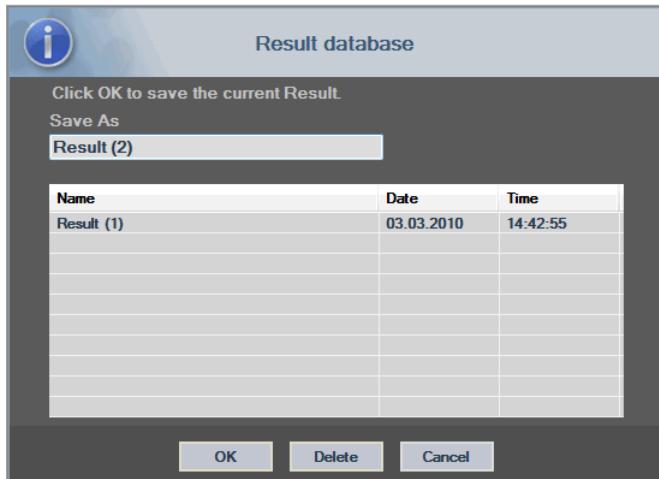


1. Click the **User Settings** button.
2. Click the **Copy From** button.
3. Select the user settings file location in the image management panel.
4. Pick the user settings file in the bottom panel list.
5. Click the OK button to import the user settings.

## Saving results

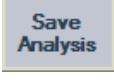
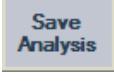
Each clip associates a result database in which the whole context of each analysis result can be stored. This enables restoration of the result at a later time by selecting the corresponding clip (previously analyzed) in the Study Browser.

### Interface elements

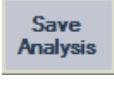


*Result database dialog box*

► **To save the current result:**

- 
1. Click the  button in the main toolbar.
  2. Under Save as, type the result name.
  3. Click the OK button.

► **To overwrite a result:**

- 
1. Click the  button in the main toolbar.
  2. Select a result in the list.
  3. Click the OK button.

► **To remove a result:**

- 
1. Click the  button in the main toolbar.
  2. Select a result in the list.

3. Click the **DELETE** button.

## Quick guide



This section describes the two typical workflows, Perfusion and Targeted, to perform an analysis with VevoCQ Analysis.

### Perfusion quantification

#### ► Bolus analysis

1. Select a clip in the **Study Browser**.
2. Click the **VeoCQ** button in the main toolbar.
3. Define the frames to be included/excluded from the analysis in the **Clip editor** window.
4. Draw ROIs successively as desired.

**NOTE:** For cine loops that display motion artifacts use the **Correct Motion** function.  
Note that the quantification can be done without running the motion correction.

5. Move the **Image slider** to choose a reference image for motion correction.

6. Click the button.

7. Review the motion corrected clip using the **Image slider**.

8. If the **Motion correction** is unsuccessful, try one of the following:

- Select another reference image and click the button again to re-apply **Motion correction**.
- Use the **Clip editor** to exclude any images thought to be degrading the result of motion correction, such as out of plane movements, and then re-apply **Motion correction**.

9. Click the button.

10. Accept or select another instant in the **Contrast arrival detection** dialog box.

11. If needed, adjust the **Gain** and **Dynamic range** sliders for each parametric image or check **Apply preset** to apply the user preferences.

12. Click the button to export data



13. Click the **Save Analysis** button to store the context.

## ► Replenishment analysis

1. Select a clip in the **Study Browser**.
2. Click the **VevoCQ** button in the main toolbar.
3. Select the replenishment segment to be analyzed ( ).
4. Draw ROIs successively as desired.
5. Move the **Image slider** to choose a reference image for motion correction.



6. Click the **Correct Motion** button.
7. Review the motion corrected clip using the **Image slider**.
8. If the **Motion correction** is unsuccessful, try one of the following:



- Select another reference image and click the **Correct Motion** button again to re-apply **Motion correction**.
- Use the Clip editor to exclude any images thought to be degrading the result of motion correction, such as out of plane movements, and then re-apply Motion correction.



9. Click the **Quantity** button.
10. If needed, adjust the **Gain** and **Dynamic range** sliders for each parametric image or check **Apply preset** to apply the user preferences.



11. Click the **Export** button to export data.



12. Click the **Save Analysis** button to store the context.

## Targeted

## ► Targeted enhancement (no destruction)

1. Select a clip in the **Study Browser**.
2. Click the **VevoCQ** button in the main toolbar.
3. Define the images to be excluded by means of the **Clip editor**.
4. Draw ROIs successively as desired.

5. Move the **Image slider** to choose a reference image for motion correction.

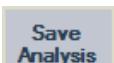
A small blue rectangular button labeled "Quantify" in white text.

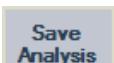
6. Click the  button.

7. If needed, adjust the **Gain** and **Dynamic range** sliders for each parametric image or check **Apply preset** to apply the user preferences.

A small blue rectangular button labeled "Export" in white text.

8. Click the  button to export data

A small blue rectangular button labeled "Save Analysis" in white text.

9. Click the  button to store the context.

## ► Differential targeted enhancement (destruction)

1. Select a clip in the **Study Browser**.

2. Click the **VevoCQ** button in the main toolbar.

3. Select the destruction segment to be analyzed ().

4. Draw ROIs successively as desired.

5. Move the **Image slider** to choose a reference image for motion correction.

A small blue rectangular button labeled "Quantify" in white text.

6. Click the  button.

7. If needed, adjust the **Gain** and **Dynamic range** sliders for each parametric image or check **Apply preset** to apply the user preferences.

A small blue rectangular button labeled "Export" in white text.

8. Click the  button to export data.

A small blue rectangular button labeled "Save Analysis" in white text.

9. Click the  button to store the context.

## Section 20

# EKV Mode imaging and analysis



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

By acquiring data over multiple heart cycles and extracting data at specific time points, EKV-mode produces a cine loop that is representative of a typical heart cycle.

EKV Mode is not a source image acquisition mode. Rather, EKV Mode takes the cine loop data that you acquire in a source imaging mode and then processes it into the representative one-heart-cycle cine loop.

To analyze an EKV Mode image, you use the same analysis tools that you would use to analyze an image in the source image acquisition mode.

### In This Section

EKV Mode acquisition.....	581
EKV Mode analysis.....	588

# EKV Mode acquisition



This chapter shows you how to acquire EKV Mode images.

**REMINDER:** You begin acquiring image data in the source image acquisition mode and then run the EKV Mode scan.

## In this chapter

Typical EKV Mode acquisition from B-Mode .....	581
EKV Mode image refinement tools.....	584

## Typical EKV Mode acquisition from B-Mode



The key to understanding EKV Mode is remembering that EKV Mode is not a source image acquisition mode. Rather, EKV Mode takes the cine loop data that you acquire in a source imaging mode and then synthesizes it into the representative one-heart-cycle cine loop.

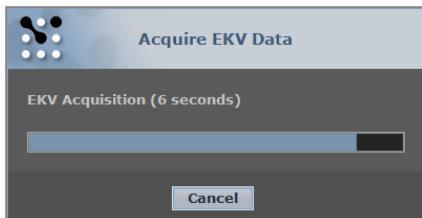
### ► To create an EKV Mode image from B-Mode source image data:

1. Prepare the animal and begin acquiring B-Mode image data as described in *B-Mode acquisition* (page 325).
2. When you have completed your image optimizations and refinements press **EKV**. The **EKV Acquisition Setup** dialog box appears.
3. Choose the appropriate acquisition settings as described in the following table:

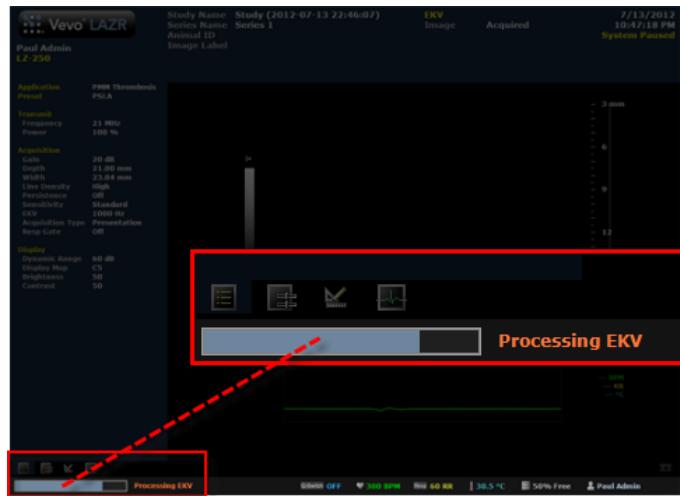
Setting	Level	Description
Acquisition Type	Quick	Adjusts some settings to produce a quality EKV image very quickly.
	Standard	Adjusts settings to produce a good quality EKV image at the default speed.
	Presentation	Adjusts settings to produce a high-quality EKV image as quickly as possible.

Setting	Level	Description
Line Density	High	Increases the resolution of the image by increasing the number of lines of image data the transducer acquires over your image area.
	Standard	Sets the line density to the default level.
Frame Rate	700	Frames per second
	1000	"
	3000	"
	5000	"
	8000	"
	10000	"
Process Quality	Sharp	Emphasizes quality of detail in each cine loop frame.
	Smooth	Emphasizes smoothness of movement through the cine loop.
	Very Smooth	Maximizes smoothness of movement through the cine loop.

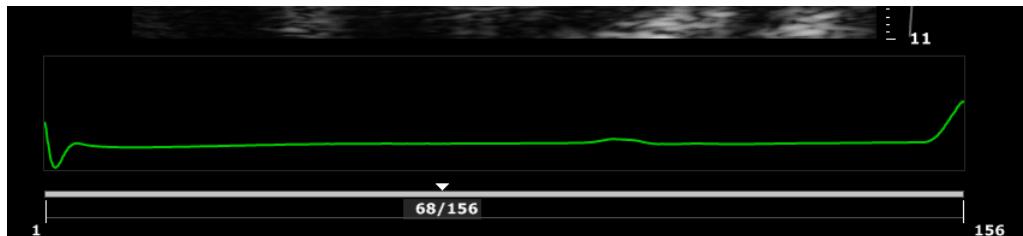
4. Click **Scan**. The system completes three processes on its own. First, the **Acquire EKV Data** dialog box appears and the progress bar tracks the completion of the scan.



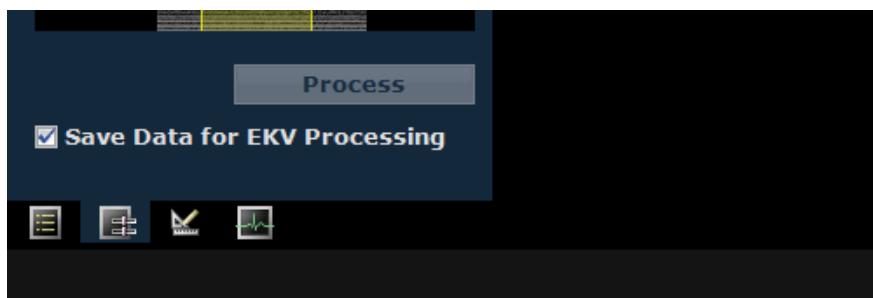
Second, when the scan is done, the system completes the process of synthesizing all the images of all the heart cycles into one heart cycle cine loop. During this process, the top area is dimmed and the Processing EKV progress bar appears in the lower-left corner of the screen.



Third, the system displays the EKV-averaged one-heart-cycle cine loop.

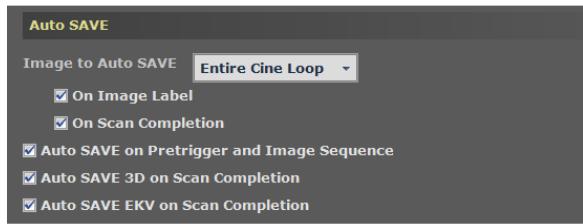


5. If you want to be able to modify the properties of the EKV image after you store the loop, click the Image Process tab and ensure that the **Save Data for EKV Processing** check box is selected.



6. 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 a cine loop or image frame and also add a label, press **Image Label**.  
**NOTE:** To set or remove auto-save default preference, select your option in the Auto SAVE section (**Preferences** window > **General** tab > **Auto SAVE** section).



- To save the displayed image frame press **Frame Store**.

## EKV Mode image refinement tools

Vevo 2100 Vevo LAZR

EKV Mode provides two image post-processing tools that help you refine image quality and create new EKV Mode images:

- EKV processing quality
- EKV respiration gate adjustment

**NOTE:** You can only use these tools on a stored EKV Mode loop if the **Save Data for EKV Processing** check box in the image processing tools panel was selected before the loop was stored.

### ► To check if the tools are available for an image:

1. From the **Study Browser**, open the EKV Mode image.
2. In the image management panel click the Image Processing tab at the bottom of the image management panel. The available image processing tools appear.

3. Check the tools that appear, as shown in the following illustration:



#### Related information

- *Typical EKV Mode acquisition from B-Mode source image data* (page 581)

### Refining EKV image detail quality

**NOTE:** You can only use this EKV Mode image refinement tool if the system saved the EKV image processing data.

► **To refine the quality of an EKV image:**

1. From the **Study Browser**, open the EKV Mode image.
2. In the image management panel click the Image Processing tab at the bottom of the image management panel. The available image processing tools appear.

3. In the **EKV Processing** section, choose the appropriate setting in the **Quality** drop-down list as described in the following table:

Setting	Description
Sharp	Emphasizes quality of detail in each cine loop frame.
Smooth	Emphasizes smoothness of movement through the cine loop.
Very Smooth	Maximizes smoothness of movement through the cine loop.

### Related information

- *EKV Mode image refinement tools* (page 584)
- *Typical EKV Mode acquisition from B-Mode* (page 581)

## Refining EKV image respiration effects



The natural act of respiration can affect the heart cycle image slightly as the diaphragm and chest cavity moves the position of the heart.

The EKV respiration gate is an image processing tool you can use to reduce this effect. Based on the data acquired during an EKV Mode scan, this gating tool gives you controls to select heart cycle data that is least affected by respiration.

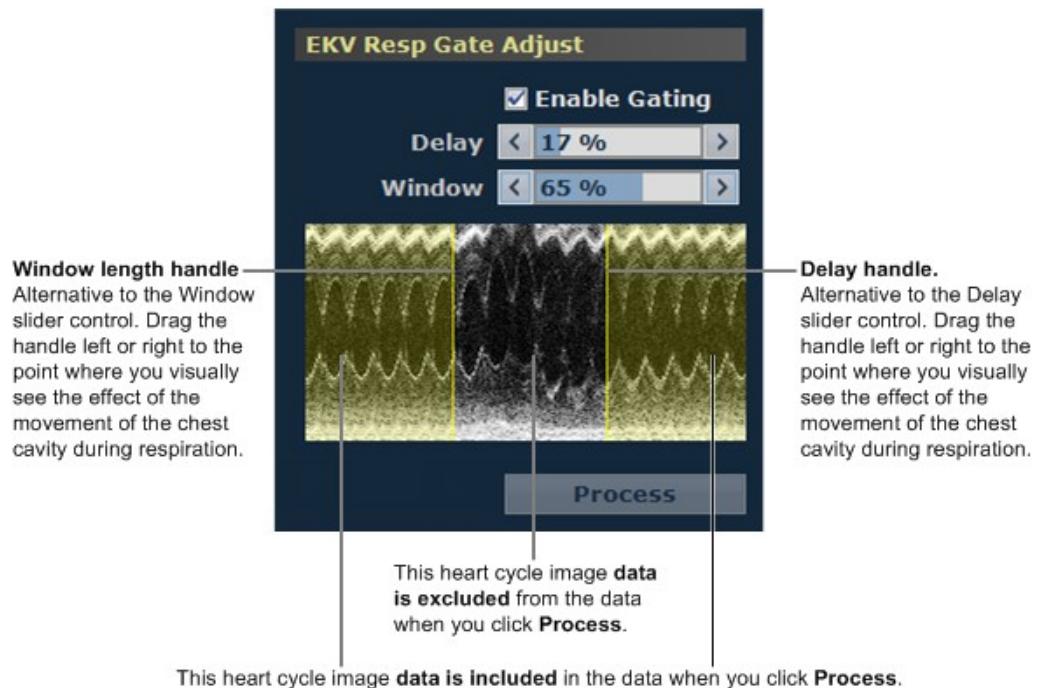
Typically, you do not need to directly adjust the Delay and Window controls. For most acquisitions, it is sufficient to select the Process Quality settings in the EKV Acquisition Setup dialog box during your scan setup. The refinement described in this section is most useful for complicated situations.

### ► To refine the image by adjusting the EKV respiration gate:

1. From the **Study Browser**, open the EKV Mode image.
2. In the image management panel click the Image Processing tab at the bottom of the image management panel. The available image processing tools appear.
3. In the **EKV Resp Gate Adjust** section, the **Enable Gating** check box is selected and the **Delay** slider tool, the **Window** slider tool and the window handles become available.

**NOTE:** Enable Gating is selected automatically when the system detects a respiration signal during EKV scanning.

- a. As shown below, adjust the gate window to create the respiration gate. Work back and forth between the window length controls and the delay controls to refine the adjustment so that you include (by dragging the yellow transparency over) the heart cycle data that is least affected by the movement of the chest cavity during respiration.



- b. Click **Process**. The system synthesizes all the scan data into a new EKV Mode cine loop based on the respiration gate refinements you made.

### Related information

- *EKV Mode image refinement tools* (page 584)
- *Typical EKV Mode acquisition from B-Mode* (page 581)
- *M-Mode imaging and analysis* (page 403)

## EKV Mode analysis



When you analyze an EKV Mode image, you use the same analysis tools that you would use to analyze an image in the source image acquisition mode.

### In this chapter

Adding measurements to EKV Mode images .....	588
--	-----

---

## Adding measurements to EKV Mode images



EKV Mode images do not have dedicated acquisition or analysis tools because they are derived from another foundational imaging mode.

Therefore, when you want to analyze an EKV Mode image, use the analysis tools of the foundational imaging mode:

- ▶ **To add measurements to B-Mode based EKV Mode images:**
  - See *B-Mode analysis* (page 341)

## Section 21

# RF-Mode imaging and analysis



Digital RF-Mode provides data in RF, Raw and IQ format for further analysis. Digital RF-Mode allows users to acquire, digitize and view the raw RF data from the high-frequency ultrasound signal.

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

### In This Section

RF-Mode acquisition .....	590
RF-Mode analysis .....	593

# RF-Mode acquisition

 Vevo 2100  Vevo LAZR

This chapter shows you how to acquire RF-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 RF-Mode image acquisition session.....	590
--	-----

---

## Typical RF-Mode image acquisition session

 Vevo 2100  Vevo LAZR

RF-Mode data acquisition is available in all modes, except AM-Mode and EKV-Mode. Press the RF key to toggle RF acquisition 'On' or 'Off'.

With RF-Mode enabled and when entering any of the frame based modes, i.e. B-Mode, Power Doppler Mode, the screen displays the envelope signal from the gray scale data as an A-scan line appearing in yellow at the position in the image indicated by the red arrow at the top of the field of view.

Also, the screen label will be prefaced with RF to the name of the active mode. Furthermore in the spectrum based modes, M-Mode, PW Doppler Mode, the A-scan line will be associated with the image in the Scout window, however the data in the Scout window is not saved as part of the RF data set.

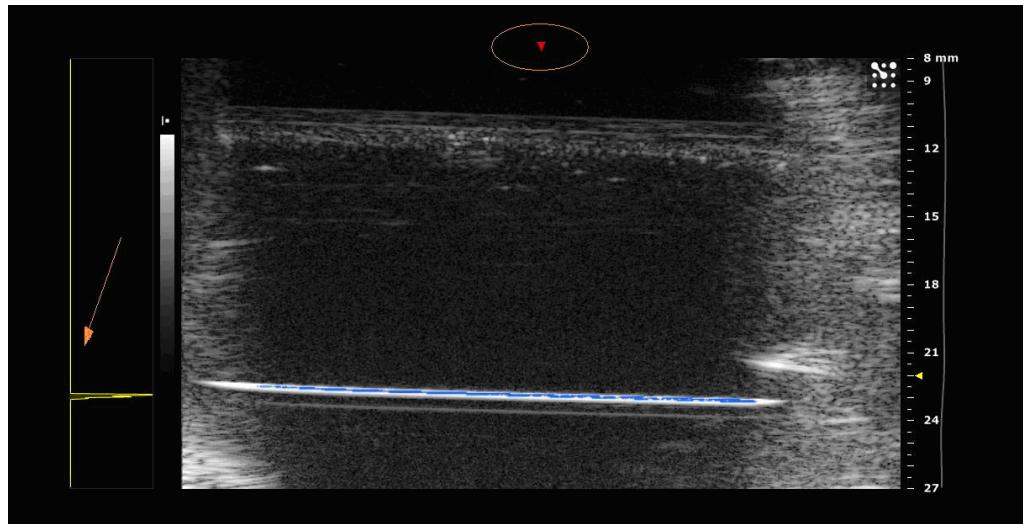
Saturation of the image is evident in the A-scan line as a plateau in any of the peaks; saturation is also indicated on the image by a blue overlay.

The overlay is displayed together with the A-scan line and can be disabled using the **RF Overlay** screen key when the scanning is paused.

 RF Overlay |  On  Off

*RF Overlay screen key*

The A-scan line indicator, red arrow in the following image, may be relocated by left-clicking on the triangle and moving it left and right, as desired.



*RF B-Mode: the red arrow at the top of the field of view indicates the position of the data displayed in the A-scan line to the left of the image. Saturation is seen as a plateau in the A-scan peak, as well as by the blue overlay on the actual image.*

Acquiring RF data is similar to acquiring images without RF data, enter the mode of interest and ensure that RF-mode is enabled; the data is acquired by pressing the **Scan/Freeze** button, and is saved using the **Cine Store** or **Frame Store** buttons on the keyboard. The RF data will be saved for all the data lines in the image, 512 lines when the Line Density is set High, and 256 lines if the Line Density is set Standard.

In the Study Browser, the saved RF-Mode files will appear with the prefix *RF* added for easy identification.

first test cardio/abdo	1/13/2009 11:25:20 AM 11:24:46 AM 11:20:30 AM 11:16:11 AM 11:11:54 AM	corina corina corina corina corina	RF PW Doppler ... 3.32 Seconds RF B-Mode 100 Frames RF Power Doppl... 100 Frames RF B-Mode 100 Frames RF M-Mode 4.92 Seconds
------------------------	--	--	--

*RF data files listed in the Study Browser*

► **To acquire an RF-Mode image:**

1. Start imaging by pressing the B-Mode key.
2. Press **RF** to begin acquiring data in RF B-Mode.
3. To turn off RF acquisition, press **RF**.

RF data acquisition can be switched on and off during the imaging session, in the same series or study by clicking the **RF** key.

**NOTE:** It is recommended that the RF data acquisition not be set to ON at all times as the files size is significantly larger than the regular file size (approximately 3 times larger).

# RF-Mode analysis



This chapter shows you how to analyze RF-Mode images that are saved to a study.

## In this chapter

Exporting RF-Mode data from the Study Browser .....	593
---	-----

---

## Exporting RF-Mode data from the Study Browser

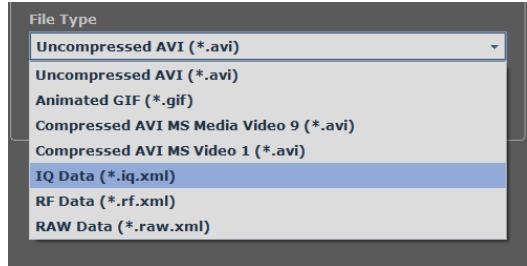


RF data files may be exported from open images or directly from the Study Browser by pressing the **Export** key.

### ► To export RF-Mode data from the Study Browser:

1. In the **Study Browser**, select the images you want to export.
  - To select one item, click it
  - To select a collection of individual items, press and hold **CTRL** and then click to select each item
  - To select a consecutive group of items, click to select the first item, press and hold **SHIFT** and then click to select the last item in the range
2. Click **Export**. The **Export Image** window appears.
3. Browse to, and then select, the folder that will contain the export.
4. (Optional) To add a subfolder, click **New Folder**, name the folder and then click **OK**.
5. In the **Export Type** section, click the type of content you are exporting and then, if needed, in the File Type box, select the desired RF data file format. Depending on the source mode that was acquiring data when you began acquiring in RF-Mode, the following file formats are available:
  - a. RAW data file - data file used to display the log compressed data as gray scale

- b. RF data file - Reconstructed RF data - most useful when the original frequency information is required
- c. IQ data file - The IQ data format can be used for analysis as the most unprocessed data format. This format is required for Doppler processing and phase analysis. The IQ format also provides the highest bit resolution of the 3 data formats. The data is organized as IQ pairs with the Q value leading the I value.



The following table lists the available RF data files formats:

File extension	Imaging mode
*.iq.bmode	B-Mode, PA-Mode (Single, NanoStepper, Oxy-Hemo, Spectro sub-modes), Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode, EKV Mode, RF-Mode
*.rf.bmode	B-Mode, Linear Contrast Mode, Nonlinear Contrast Mode
*.raw.bmode	B-Mode, PA-Mode (Single, NanoStepper, Oxy-Hemo, Spectro sub-modes), Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
*.iq.color	B-Mode, PA-Mode (Single, NanoStepper, Oxy-Hemo, Spectro sub-modes), M-Mode, PW Doppler Mode, 3D-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
*.raw.color	Color Doppler Mode, Power Doppler Mode
*.raw.power	Power Doppler Mode
*.rf.contrast, *.raw.contrast	Nonlinear Contrast Mode
*.iq.pw	PW Doppler Mode, PW Tissue Doppler Mode
*.iq.mmode, *.rf.mmode, *.raw.mmode	M-Mode
*.iq.pamode	B-Mode, PA-Mode (Single, NanoStepper, Spectro sub-modes)
*.raw.pamode	PA-Mode (Single, NanoStepper, Oxy-Hemo, Spectro sub-modes)
*.rf.3d.bmode	3D-Mode (B-Mode, Linear Contrast Mode, Nonlinear Contrast Mode)
*.iq.3d.bmode	3D-Mode (B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, PA-Mode [Single, NanoStepper sub-modes])

<b>File extension</b>	<b>Imaging mode</b>
*.raw.3d.bmode	3D-Mode (B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode, PA-Mode [Single, NanoStepper, Oxy-Hemo sub-modes])
*.iq.3d.color	3D-Mode, Color Doppler Mode, Power Doppler Mode
*.raw.3d.color	Color Doppler Mode
*.raw.3d.power	Power Doppler Mode
*.rf.3d.contrast, *.raw.3d.contrast	3D-Mode (Nonlinear Contrast Mode)
*.iq.3d.pamode	PA-Mode 3D (Single, NanoStepper sub-modes)
*.raw.3d.pamode	PA-Mode 3D (Single, NanoStepper, Oxy-Hemo sub-modes)
*.raw.paoxy	PA-Mode (Oxy-Hemo sub-mode)
*.iq.physio, *.rf.physio, *.raw.physio, *.iq.event, *.rf.event, *.raw.event	Physiological data and event information
*.iq.xml, *.rf.xml, *.raw.xml	Parameter XML

6. Click **OK**. The system exports to the folder you selected and then presents the **Image Export Report**.
7. Click **OK**.

## Section 22

# Appendices



This section includes the following reference content.

### In This Section

Generic measurements .....	597
Measurement package protocols.....	631
Control panel keys and controls.....	693
Multiplexer control panel descriptions .....	716
Product safety testing and electrical testing .....	717
Safety.....	720
Specifications .....	728
Technical support and user maintenance .....	732
Troubleshooting .....	740

## Appendix A

# Generic measurements

 Vevo 1100  Vevo 2100  Vevo LAZR

Generic measurements are the measurements you can apply to any image frame acquired in a specific imaging mode.

This appendix lists all the available generic measurements and describes how to add each one.

### ► To view the available generic measurements for an image:

1. Display an image:
  - If you are in the **Study Browser** open an image and then stop the cine loop at the frame you want to work with. The image appears.
  - If you are acquiring image data, press **Scan/Freeze** on the control panel. The acquired image appears.
2. Under the image management panel click the Measurements tab . The measurement tools appear at the top of the panel.

---

## 2D Area measurement

 Vevo 1100  Vevo 2100  Vevo LAZR

2D Area is measured in  $mm^2$ .

### ► To place a 2D area measurement:

1. Click the 2D area measurement tool .
2. Click on the image to place the initial caliper.
3. Trackball along the contour of the 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.

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 measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement.
5. If you need to move an entire measurement, click on the measurement line, then drag and drop.

#### Related information

- *Complete procedure for adding a generic measurement* (page 296)

## ROI histogram mean and standard deviations



For images you acquire in this mode you can:

- Measure the mean and standard deviation of gray levels for area measurements
- View a histogram of a selected area measurement.

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

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

**NOTE:** In Power Doppler Mode, the system applies the Image Data preference at all times, even when you select Raw Data.

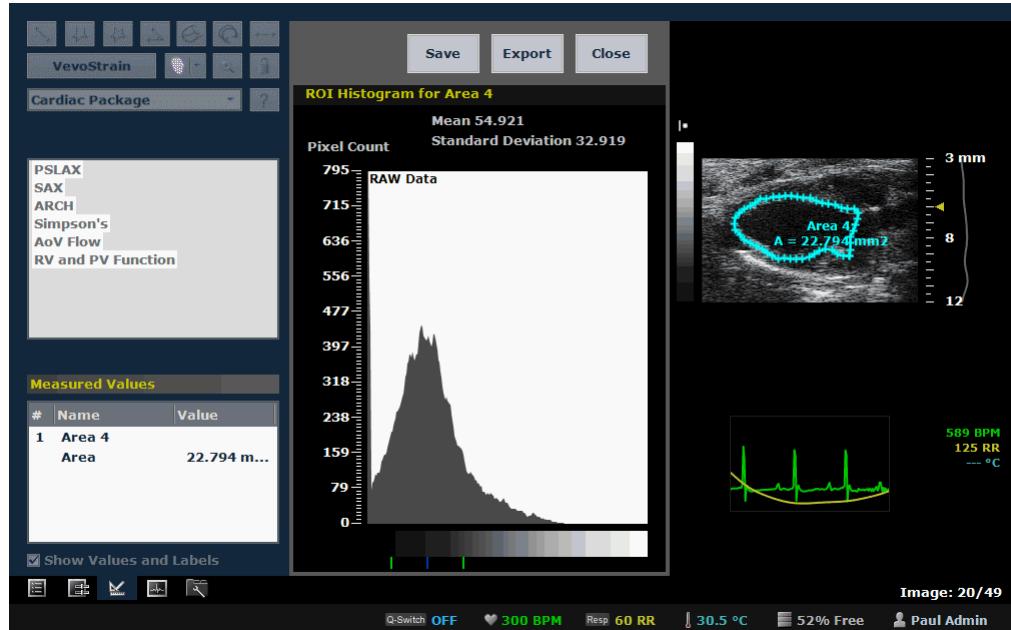
- **Image Data** calculates the histogram from a combination of the original image data plus any modifications you make after you press **Image Process**. For example, if you modify the Brightness value, the system creates the histogram based on the original image data plus the modified brightness.

For more information, see Histogram preferences.

#### ► To create the mean and standard deviations ROI histogram:

1. 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



*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 save a TIFF image of the histogram to your report:**

Click **Save**.

► **To export an image of the histogram plot:**

1. Click **Export**.

2. In the **Export** window:

- In the browse window, browse to the directory location where you want to export the file and select that directory.
- In the **Options** area, select the file type.
- In the **Save As** box, if you want to create a unique file name, type the name.

3. Click **OK**.

## Acceleration measurement



Use the acceleration measurement tool to determine the acceleration of heart tissue movement. Acceleration is measured in  $mm/s^2$ .

### ► 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 tool . The system highlights the button until you complete your measurement.
3. Click on the 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 measurement panel in the mode window (note that this option is on by default for all factory-set measurements), 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, type a new name while the label text is selected, and then click outside the label to commit the label.
6. If you want to move the measurement or the label, select it, then drag and drop it.

#### Next step

- *Reporting your analysis results* (page 319)

#### Related information

- *Analyzing image data* (page 286)

## 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 tool .
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 measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement.
5. If you need to move an entire measurement, click on the measurement line, then drag and drop.

**Related information**

- *Complete procedure for adding a generic measurement* (page 296)

---

## Cardiac region measurement



The Cardiac Region measurement traces a region of interest in a Nonlinear Contrast Mode frame or Linear Contrast Mode frame, consisting of two separate traces. The system then measures the difference in area between the outer trace and the inner trace.

► **To place a single cardiac region measurement:**

1. Click 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 image management panel.

6. If you need to move an entire measurement, click on the measurement line, then drag and drop.

► **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 the first three caliper points for every contour in the same direction. For example if you start out adding the first three points for the outer wall in a clockwise direction, add the points for the inner wall in a clockwise direction also.

2. In the cine loop, move forward or backward to a frame that displays the next point of maximum systole and create a second cardiac region measurement.

**IMPORTANT:** Add the first three caliper points for these contours in the same direction you added the contours for the first cardiac region.

3. Right-click the contour and then select **Replicate Forward 1 Cycle** or **Replicate Reverse 1 Cycle**.

The 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.

Direction	Description
Replicate Forward 1 Cycle	Starts from the end of the half cardiac cycle and applies the system-calculated contours to the next cardiac cycle.
Replicate Reverse 1 Cycle	Starts from the start of the half cardiac cycle and applies the system-calculated contours to the previous cardiac cycle.

- If you want to modify a contour in the sequence, you can add, delete or move points and then right-click **Refine Forward** or **Refine Reverse** on the contour to view the results.

## Cardiac region analysis 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:

- On the Linear Contrast Mode image, right-click the contour or the image label and select **Region Graph**.
- The system calculates the contrast intensity within the boundaries of the region curve and displays the data in the **Cardiac Region Analysis** window.




---

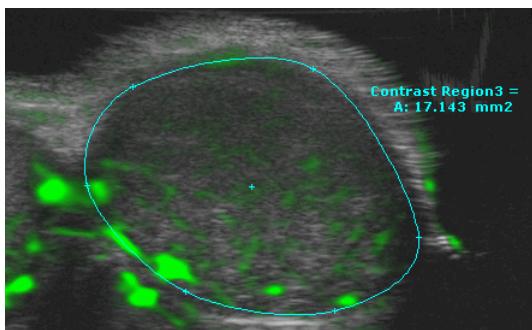
## Contrast region measurement

The contrast region measurement traces a region of interest in a Nonlinear Contrast Mode frame or Linear Contrast Mode frame. The system then measures the total area of the defined contrast region.

► **To place a contrast region measurement:**

1. Click the contrast region measurement tool .
2. Click on your image to place the initial caliper along the boundary of the region you want to define.
3. Click approximately one-third the way around the boundary of the region.
4. Click across to another point on the boundary. You have now created a defined region.
5. Typically you will continue to click to add a few more points to define the boundary of your region more precisely.
6. To complete the region, right-click your final point.



7. If you need to move an entire measurement, click on the measurement line, then drag and drop.
8. Modify the points on your contour (page 303), or modify the contour (page 304) as required.

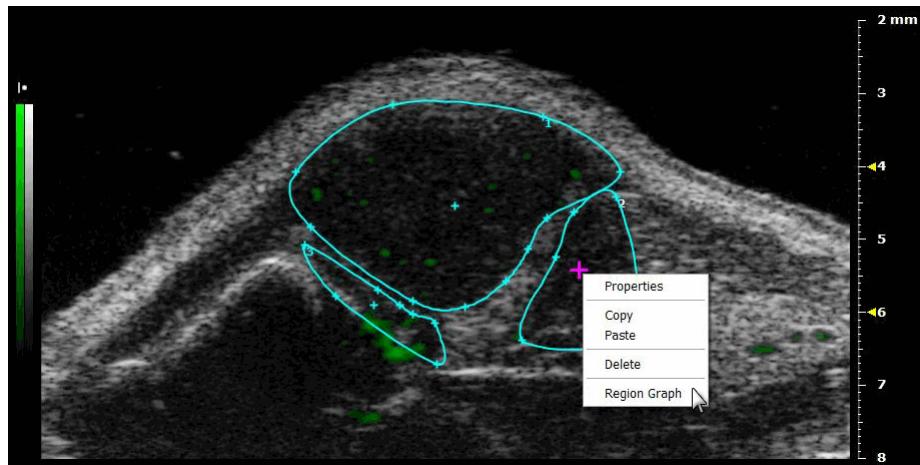
## Creating a linear contrast region graph

 Vevo 2100  Vevo LAZR

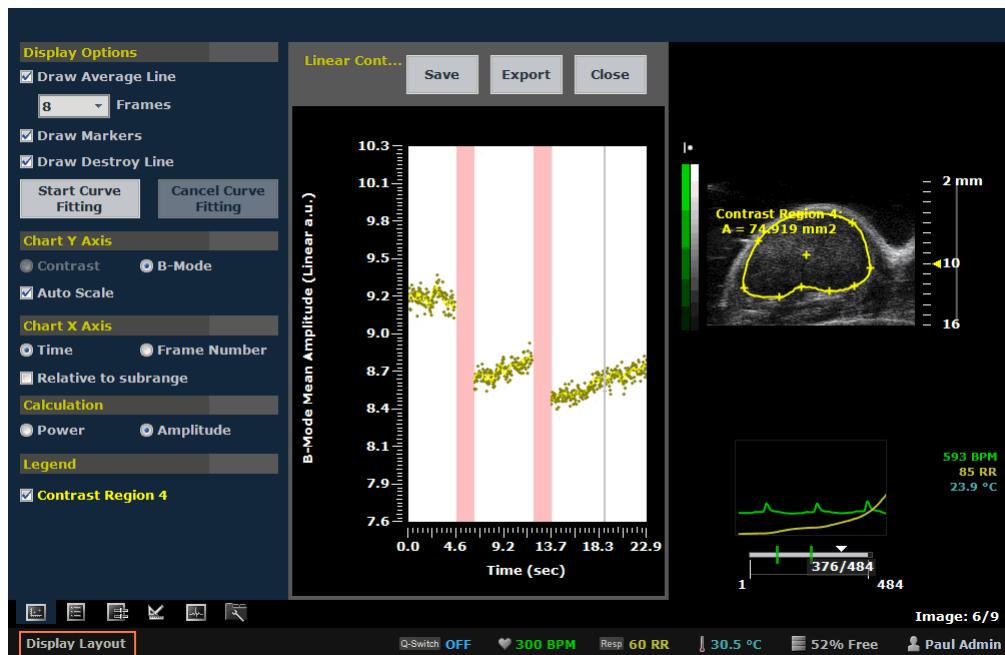
The contrast region graph plots the contrast intensity data of a contrast region over the course of a complete cine loop.

► To create a contrast region graph:

On the Linear Contrast Mode image, right-click the contour or the image label and select **Region Graph**.



The system calculates the contrast intensity within the boundaries of the region curve and displays the data in the **Linear Contrast Region Analysis** window.



► To save a TIFF image of the chart to a report:

Click **Save**.

► To export the linear 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 the 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 the report.
4. Click **OK**. The system exports the analysis report for the image you are viewing.

## Copying and pasting linear and nonlinear contrast regions

 Vevo 2100  Vevo LAZR

### Conditions

- You can copy a contrast region from a Nonlinear Contrast Mode image and paste it to a Nonlinear Contrast Mode image
- You can copy a contrast region from a Linear Contrast Mode image and paste it to a Linear Contrast Mode image
- You cannot copy and paste between images of different types

#### ► 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 paste a copied contrast region to the same image and then move it to a different location.

### Related information

- *Copying measurements on Linear Contrast Mode images* (page 306)

## Working with data in the linear contrast region analysis chart

 Vevo 2100  Vevo LAZR

The linear contrast region analysis chart provides four sets of controls located to the right of the cart:

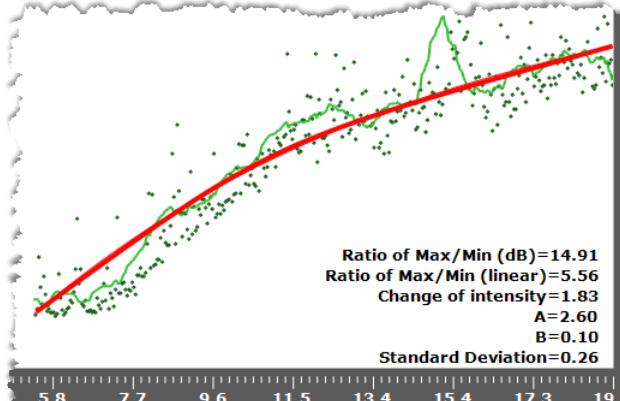
- Display Options

- Chart Y Axis
- Chart X Axis
- Calculation

Use these controls to achieve different views of the contrast intensity data.

## Display Options

Setting	Description
Draw Average Line	Draws a moving average line through the data points.
Frames	Sets the number of frames over which to complete the average. Select from 2, 4, 8, 16, 32
Draw Markers	Draws markers on the actual data points.
Draw Destroy Line	Displays a vertical red line at the frame number at which the destruction event occurred, if the event did occur.

Setting	Description
Curve Fitting	<p>Calculates and plots a perfusion curve based on the following formula*:</p> $y = C + A ( 1 - e^{-B ( t - t_0 )} ), \text{ where:}$ <p>y = Contrast signal (pixel intensity)  A = Plateau of the curve  B = Slope of the curve  C = Contrast signal offset  t = Time  t<sub>0</sub> = Time offset</p> <p><b>To create the curve:</b></p> <ol style="list-style-type: none"> <li>1. Click <b>Start Curve Fitting</b> and select a data point on the graph at the transition from the base line to the perfusion period.</li> <li>2. Click a data point where the data begins to plateau and then click <b>Finish Curve Fitting</b>.</li> </ol> <p>The system calculates and plots the red perfusion curve.</p>  <p>5.8    7.7    9.6    11.5    13.4    15.4    17.3    19.2</p> <p>Ratio of Max/Min (dB)=14.91  Ratio of Max/Min (linear)=5.56  Change of intensity=1.83  A=2.60  B=0.10  Standard Deviation=0.26</p>

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

Setting	Description
Contrast	Select to plot the contrast intensity information from the contrast data, and to make the Percent Area controls and the Calculation controls available.
B-Mode	Select to plot the grayscale intensity data from the B-Mode image.
Auto Scale	Select to view a system-calculated best-fit scale value.

## Chart X Axis

Setting	Description
Time	Select to scale the length of the cine loop in second increments.
Frame Number	Select to scale the length of the cine loop in single frame increments.
Relative to subrange	Select to change the origin value from the original recorded value in seconds or frames to a temporary value of 0 seconds or frame 1. For more, see <i>Setting the X axis origin value to 0 seconds or frame 1</i> (on page 611).

## Calculation

Setting	Description
Power	Sets the Y axis to B-Mode mean power (linear a.u.)
Amplitude	Sets the Y axis to B-Mode mean amplitude (linear a.u.)

## Hiding and showing frames in the reference group



In Linear Contrast Mode and Nonlinear Contrast Mode you can temporarily hide frames in your reference range of cine frames (minimum two frames). This feature can be useful when you want to exclude outlier data that unrealistically skews your graph and data analysis.

**NOTE:** This feature does not delete the data that you hide; it only prevents it from displaying in the graph.

### ► To hide a reference range of cine frames:

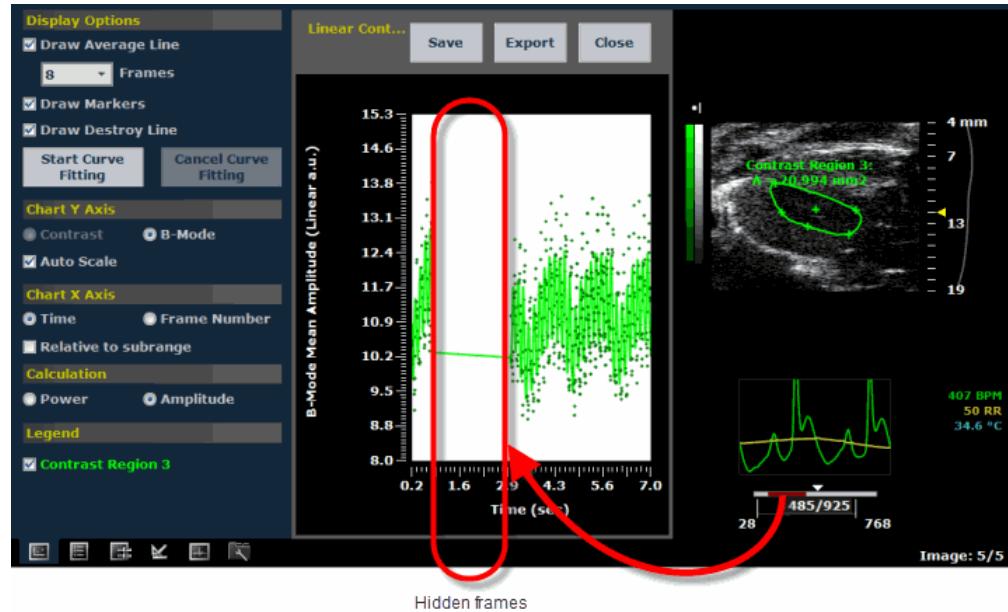
1. In the cine loop range control, drag the cine frame marker or use the **Cine Loop Review** control and then click to set the first frame of the range you want to hide.
2. Press **Image Process** and in the Hide Frames section click **Start**.

- Drag the frame marker forward or backward to the last frame in the range you want to hide and then click. The system applies red to the frames bar to identify the selected range.



- In the Hide Frames section click **Stop**.
- (Optional) Repeat the process to hide additional frame sets.

When you create a region graph ("Creating a linear contrast region graph" on page 604), the system removes the plotted data from the frames you hid.



### Showing a range of hidden frames

To restore a range of hidden frames, follow the same Start-Stop procedure but use the Start-Stop control in the Show Frames section of the Image Processing panel.

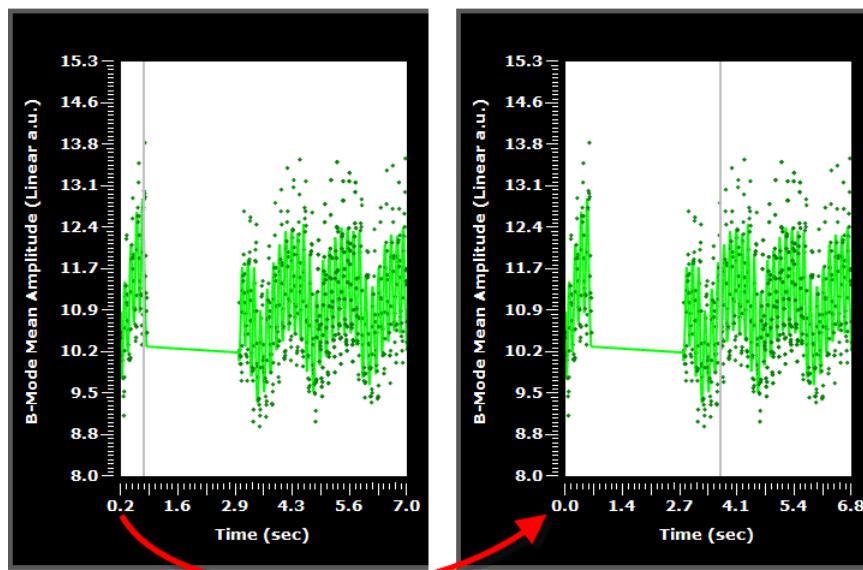
## Setting the X axis origin value to 0 seconds or frame 1



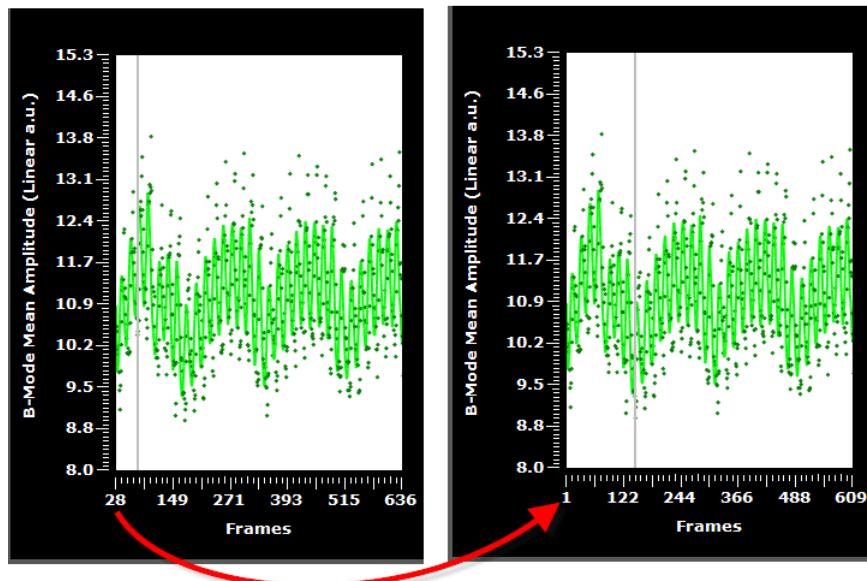
To simplify graph analysis of the sub-range of the stored cine loop you are working with in your contrast measurement, you can change the origin value from the original recorded value in seconds or frames to a temporary value of 0 seconds or frame 1.

### ► To set the X axis origin to either 0 seconds or frame 1:

1. Right-click your contrast region measurement and select Region Graph.
2. In the image management panel in the Chart X Axis section:
  - a. Select the units you want the X axis to measure: Time or Frame Number.
  - b. Select the Relative to subrange check box.
3. The system resets the origin value of the X axis.



The absolute value of the start of the X axis in this example is 0.2 seconds. After you select **Relative to subrange**, the X axis begins at 0 seconds.



The value of the start of the X axis in this example is frame 28. After you select **Relative to subrange**, the X axis begins at frame 1.

## Exporting Linear 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

---

## Depth interval measurement



Depth interval is measured in *mm*.

► **To place a depth interval measurement:**

1. Click the depth interval measurement tool . The system highlights the button until you complete your measurement.
2. Click on the 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 an entire measurement, click on the measurement line, then drag and drop.

**Related information**

- *Complete procedure for adding a generic measurement* (page 296)
- *Adding generic M-Mode measurements* (page 416)

---

## 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 tool .
2. Click on the 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 an entire measurement, click on the measurement line, then drag and drop.

**Related information**

- *Complete procedure for adding a generic measurement* (page 296)

---

## Lens radius measurement



The lens radius measurement is only available in the Ophthalmology measurement package for B-Mode images. Lens radius is measured in *mm*.

► **To place a lens radius measurement:**

1. Open an existing eye image or begin acquiring an eye ultrasound image and then press **Scan/Freeze**.
2. Press **Measure**.
3. In the drop-down list of measurement packages select **Ophthalmology**.
4. In the list of measurements click **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 an entire measurement, click on the measurement line, then drag and drop.

---

## Linear distance measurement



Linear distance is measured in *mm*.

► **To place a linear distance measurement:**

1. Click the linear distance measurement tool .
2. Click on the image to place the initial caliper.
3. Trackball to the location where you want to end the measurement and then click to place the end caliper. If you selected the **Show Values and Labels** option in the measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement.

4. If you need to move an entire measurement, click on the measurement line, then drag and drop.

#### Related information

- *Complete procedure for adding a generic measurement* (page 296)

---

## LV Area long axis measurement

 Vevo 1100    Vevo 2100    Vevo LAZR

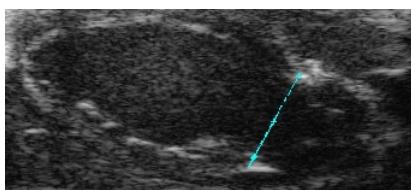
Use the LV wall trace measurement to trace the endocardial wall through multiple cardiac cycles, semi-automatically or manually.

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:

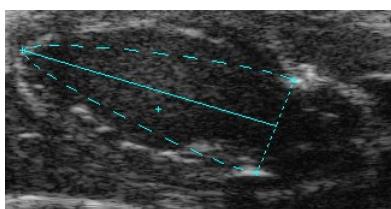
1. While you view a saved image from the Study Browser or an image that is acquired but not stored during an image acquisition session, press **Measure** and toggle to view the measurement tools panel.
2. Click the LV area long axis measurement tool . The system highlights the button until you complete 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.

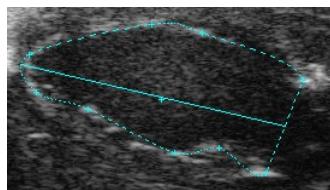


*If you selected the short axis view for analysis, the system does not insert an annulus line*

4. Click a point toward the apex on the interior wall. This creates the basic curve.



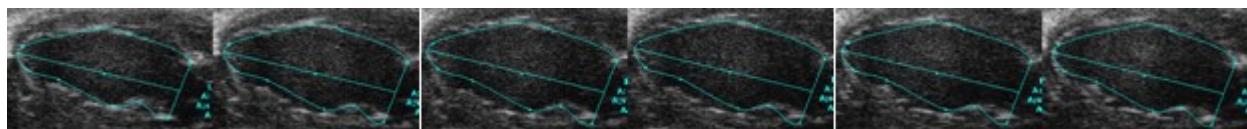
- Continuing to click along the wall to create a contour that traces the area of the wall.



*In this example, six wall points have been added to the trace curve*

Right-click the final point on the contour to complete the measurement. If you selected the **Show Values and Labels** option in the measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement **LV Long Area #**, where # is a sequential number.

- If you want to rename the label, type a new name while the label text is selected, and then click outside the label to commit the label.
- If you want to move the measurement or the label, select it, then drag and drop it.
- Move to another frame in the cine loop and place another LV area long axis measurement.
- 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.



Frame 1: traced manually

The system traces the remaining frames automatically

- Modify the contour or points on the contour if required and then select **Replicate Forward** again to complete the automatic wall trace.
- 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 319)*

## Related information

- Analyzing image data (page 286)

## Modifying points on an LV area trace

 Vevo 1100    Vevo 2100    Vevo LAZR

### ► 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

## Modifying the LV area trace

 Vevo 1100    Vevo 2100    Vevo LAZR

### ► 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 long axis measurement

 Vevo 1100    Vevo 2100    Vevo LAZR

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:

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.

## Next step

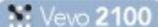
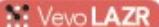
- *Reporting your analysis results (page 319)*

## Related information

- *Analyzing image data (page 286)*

---

## LV Area short axis measurement

 Vevo 1100    Vevo 2100    Vevo LAZR

### ► 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 tool . 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 measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement.
6. If you want to rename the label, type a new name while the label text is selected, and then click outside the label to commit the label.
7. If you want to move the measurement or the label, select it, 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 319)*

## Related information

- *Analyzing image data (page 286)*

---

## 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 tool . 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
- Refine the trace

► **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.

## **PA region measurement**

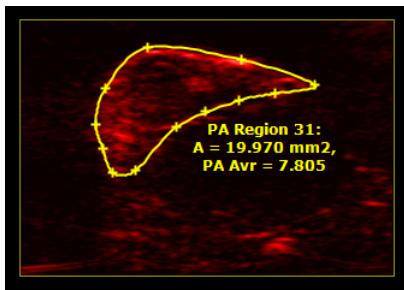


The PA (photoacoustics) region measurement traces a region of interest in a photoacoustics frame. The system then measures the total area of the defined contrast region.

► **To place a PA region measurement:**

1. Click the PA region measurement tool
2. Click on your image to place the initial caliper along the boundary of the region you want to define.
3. Click approximately one-third the way around the boundary of the region and then click across to another point on the boundary. You have now created a defined region. Typically you will continue to click to add a few more points to define the boundary of your region more precisely.

- To complete the region, right-click your final point.



- If you need to move an entire measurement, click on the measurement line, then drag and drop.

**NOTE:** When you add a PA region measurement on a frame in a PA-Mode cine loop, the PA average value changes when you view another frame in the cine loop. This can cause inconsistencies if you save the loop after working in a different frame.

To prevent inconsistencies, resave the loop at the same frame you were working on when you first saved your measurements.

#### ► To export a PA region measurement:

- Right-click the measurement and click **Export Region Values**.
- In the **Export PA Region** page, browse to the location where you want to export the data and select the folder.
- In the **Options** section, type the name of the region.
- Click **OK**. The system exports the region measurement values.

**NOTE:** The PA measurements are cine loop measurements. The values displayed in the report or the exported report correspond to the frame as saved in the thumbnail image.

**NOTE:** You can copy and paste a PA region measurement from one PA-Mode image to another PA-Mode image.

#### Related information

- *Modifying points on a contour measurement* (page 303)
- *Modifying a contour measurement* (page 304)
- *Measuring blood oxygenation* (page 396)

---

## Resolution tool



The resolution tool is a B-Mode-only feature that automatically refines image data and applies a range of color mapping to the refined areas.

► **To activate the resolution tool:**

1. When you are viewing an image (stored or during acquisition) in the image management panel, click the image processing tab 
2. In the **Resolution Tool** section select the **Resolution Tool** check box. (To hide the resolution tool effects, clear the **Resolution Tool** check box.)



---

## 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 tool . The system highlights the button until you complete your measurement.
3. Click on the image to place the single caliper dot. If you selected the **Show Values and Labels** option in the measurement panel in the mode window (note that this option is on by default for all factory-set measurements), 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, type a new name while the label text is selected, and then click outside the label to commit the label.
5. If you want to move the measurement or the label, select it, then drag and drop it.

#### Next step

- *Reporting your analysis results* (page 319)

#### Related information

- *Analyzing image data* (page 286)

---

## Time Interval measurement for B-Mode images



Time interval is measured in *ms*.

► **To place a time interval measurement:**

1. Click the time interval measurement tool . 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 an entire measurement, click on the measurement line, then drag and drop.

#### Related information

- *Complete procedure for adding a generic measurement* (page 296)

---

## Time Interval measurement for Color Doppler Mode images



Time interval is measured in *ms*.

► **To place a time interval measurement:**

1. Click the time interval measurement tool . 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 measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement.
4. If you need to move an entire measurement, click on the measurement line, then drag and drop.

**Related information**

- *Complete procedure for adding a generic measurement* (page 296)

---

## Time Interval measurement for M-Mode images



Time interval is measured in *ms*.

► **To place a time interval measurement:**

1. Click the time interval measurement tool . 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 an entire measurement, click on the measurement line, then drag and drop.

**Related information**

- *Complete procedure for adding a generic measurement* (page 296)

---

## Time Interval measurement for PW Doppler Mode images



Time interval is measured in *ms*.

► **To place a time interval measurement:**

1. Click the time interval measurement tool . 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 an entire measurement, click on the measurement line, then drag and drop.

### Related information

- *Complete procedure for adding a generic measurement* (page 296)

---

## Traced distance measurement



Traced distance is measured in *mm*.

► **To place a traced distance measurement:**

1. Click the traced distance measurement tool .
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 measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement.
4. If you need to move an entire measurement, click on the measurement line, then drag and drop.

## Related information

- *Complete procedure for adding a generic measurement* (page 296)

## Velocity measurement

 Vevo 1100    Vevo 2100    Vevo LAZR

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 tool .
2. Click on the image to place the initial caliper.
3. Trackball to the location where you want to end the measurement and then click to place the end caliper.
4. If you need to move an entire measurement, click on the measurement line, then drag and drop.

## Related information

- *Complete procedure for adding a generic measurement* (page 296)

## VevoColor area tool

 Vevo 1100    Vevo 2100    Vevo LAZR

VevoColor is a tool you can use to:

- Add color to any area of interest on an image frame
- Add color to any area on any frame in a cine loop so you can track how the area morphs over the period between the frames on the cine loop

The tool does not provide area measurements.

### ► To add a VevoColor area to an image:

1. Click the VevoColor tool . To change the area color, click the drop-down and select the color you want to apply.
2. Click on your image to place the initial caliper along the boundary of the region you want to define.

3. Click approximately one-third the way around the boundary of the region and then click across to another point on the boundary. You have now created a defined region. Typically you will continue to click to add a few more points to define the boundary of your region more precisely.
4. To complete the region, right-click your final point. The system applies the color area to all frames in the cine loop.
5. (Optional) To move the entire area, place the cursor near the center of the area until the cursor changes to a cross and then drag the area.
6. (Optional) To add a label or modify the area properties, right-click the area, select **Properties** and complete your changes.

► **To morph a VevoColor area over a range of frames:**

1. Move the cine loop to a frame where you can start a range of frames and then add your first VevoColor area.
2. Move the cine loop to an end frame for the range.
3. Move the area or change the boundary points to define the changed area.
4. To view the area morphing, drag the cine loop between the two points.
5. Repeat the area redefinition procedures on any frame in the cine loop. The system will apply the morphing between each of the frames where you have defined the area properties.

## Coloring a measured area



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

- Traced Distance
- 2D Area
- Angle

► **To add a color to a measurement:**

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

- 100=totally opaque

---

## VTI measurement with automatic frequency trace



When you want to measure VTI over a series of cycles, use the automatic frequency trace feature to instantly plot the caliper points on the frequency waveform before you apply the VTI measurement.

- **To place a VTI measurement with automatic frequency trace:**
1. 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 450).
- IMPORTANT** You must select a **Peak** and **Mean** option other than **none** to activate the auto-trace functionality for an acquired image.
3. Click the VTI tool . 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. The system plots individual caliper points along the range. If you selected the **Show Values and Labels** option in the measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement **VTI #**, where # is a sequential number.
  7. If you want to rename the label, type a new name while the label text is selected, and then click outside the label to commit the label.
  8. If you want to move the measurement or the label, select it, then drag and drop it.

## Next step

- *Reporting your analysis results* (page 319)

## Related information

- *Analyzing image data* (page 286)
- *Applying automatic traces to the frequency waveform* (page 450)

---

## VTI measurement without real-time frequency trace enabled

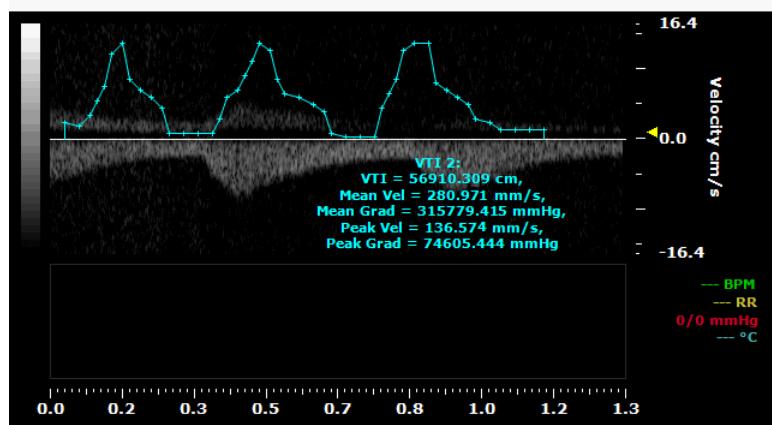


The VTI (Velocity Time Integral) is measured through a manual trace when no real-time traces are selected.

### ► 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 tool . 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.

- 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 measurement panel in the mode window (note that this option is on by default for all factory-set measurements), the system displays the measurement value and editable label for the measurement VTI #, where # is a sequential number.



*The system constrains your VTI measurement to either the top or bottom side of the baseline, depending on the placement of the initial caliper. The system prevents your trace from crossing the baseline.*

- If you want to position points more accurately over regions where the signal changes rapidly, drag them into position.
- If you want to rename the label, type a new name while the label text is selected, and then click outside the label to commit the label.
- If you want to move the measurement or the label, select it, then drag and drop it.

#### Next step

- *Reporting your analysis results* (page 319)

#### Related information

- *Analyzing image data* (page 286)

## Appendix B

# Measurement package protocols

 Vevo 1100  Vevo 2100  Vevo LAZR

This appendix details the measurement and calculation definitions for each measurement package that is available with the Vevo Imaging System.

### In this appendix

Abdominal Measurement Package .....	631
Cardiac Measurement Package .....	650
Embryology Measurement Package .....	670
Ophthalmology Measurement Package .....	671
Vascular Measurement Package.....	673

---

## Abdominal Measurement Package

 Vevo 2100  Vevo LAZR

This section provides the measurements and calculations information for the protocols in the Abdominal measurement package.

### Liver protocol

 Vevo 2100  Vevo LAZR

#### Measurement definitions

Label	Description	Units	Generic type	Mode
Liver Sagg	Sagittal length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode

Liver Trans	Transverse length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Hepatic Vel	Hepatic vein velocity	mm/s	Velocity	PW Doppler Mode
Hepatic Diam	Hepatic vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Hepatic Diam	Hepatic vein diameter	mm	Depth	M-Mode, AM-Mode
RHV Vel	Right hepatic vein velocity	mm/s	Velocity	PW Doppler Mode
RHV Diam	Right hepatic vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RHV Diam	Right hepatic vein diameter	mm	Depth	M-Mode, AM-Mode
LHV Vel	Left hepatic vein velocity	mm/s	Velocity	PW Doppler Mode
LHV Diam	Left hepatic vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LHV Diam	Left hepatic vein diameter	mm	Depth	M-Mode, AM-Mode
CHA Vel	Common hepatic artery velocity	mm/s	Velocity	PW Doppler Mode
CHA PS Vel	Common hepatic artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
CHA LD Vel	Common hepatic artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
CHA VTI	Common hepatic artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Common hepatic peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Common hepatic mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Common hepatic peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Common hepatic mean gradient	mmHg	VTI	PW Doppler Mode
CHA Diam	Common hepatic artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
CHA Diam	Common hepatic artery diameter	mm	Depth	M-Mode, AM-Mode
RHA Vel	Right hepatic artery velocity	mm/s	Velocity	PW Doppler Mode
RHA PS Vel	Right hepatic artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode

RHA LD Vel	Right hepatic artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
RHA VTI	Right hepatic artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right hepatic peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right hepatic mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right hepatic peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right hepatic mean gradient	mmHg	VTI	PW Doppler Mode
RHA Diam	Right hepatic artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RHA Diam	Right hepatic artery diameter	mm	Depth	M-Mode, AM-Mode
LHA Vel	Left hepatic artery velocity	mm/s	Velocity	PW Doppler Mode
LHA PS Vel	Left hepatic artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LHA LD Vel	Left hepatic artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
LHA VTI	Left hepatic artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left hepatic peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left hepatic mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left hepatic peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left hepatic mean gradient	mmHg	VTI	PW Doppler Mode
LHA Diam	Left hepatic artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LHA Diam	Left hepatic artery diameter	mm	Depth	M-Mode, AM-Mode
MPV Vel	Main portal vein velocity	mm/s	Velocity	PW Doppler Mode
MPV Diam	Main portal vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
MPV Diam	Main portal vein diameter	mm	Depth	M-Mode, AM-Mode
RPV Vel	Right portal vein velocity	mm/s	Velocity	PW Doppler Mode
RPV Diam	Right portal vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RPV Diam	Right portal vein diameter	mm	Linear	M-Mode, AM-Mode
LPV Vel	Left portal vein velocity	mm/s	Velocity	PW Doppler Mode

LPV Diam	Left portal vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LPV Diam	Left portal vein diameter	mm	Depth	M-Mode, AM-Mode
Gast Vel	Gastroduodenal artery velocity	mm/s	Velocity	PW Doppler Mode
Gast PS Vel	Gastroduodenal artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
Gast LD Vel	Gastroduodenal artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
Gast VTI	Gastroduodenal artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Gastroduodenal peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Gastroduodenal mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Gastroduodenal peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Gastroduodenal mean gradient	mmHg	VTI	PW Doppler Mode
Gast Diam	Gastroduodenal artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Gast Diam	Gastroduodenal artery diameter	mm	Depth	M-Mode, AM-Mode

### Calculation definitions

Label	Description	Formula
CHA RI	Common Hepatic Artery Resistive Index	(CHA PSV - CHA LDV)/CHA PSV
CHA PI	Common Hepatic Artery Pulsatility Index	(CHA PSV - CHA LDV)/CHA VTI, Mean velocity
LHA RI	Left Hepatic Artery Resistive Index	(LHA PSV - LHA LDV)/LHA PSV
LHA PI	Left Hepatic Artery Pulsatility Index	(LHA PSV - LHA LDV)/LHA VTI, mean velocity
RHA RI	Right Hepatic Artery Resistive Index	(RHA PSV - RHA LDV)/RHA PSV
RHA PI	Right Hepatic Artery Pulsatility Index	(RHA PSV - RHA LDV)/RHA VTI, mean velocity
Gast RI	Gastroduodenal Artery Resistive Index	(Gast PSV - Gast LDV)/Gast PSV
Gast PI	Gastroduodenal Artery Pulsatility Index	(Gast PSV - Gast LDV)/ Gast VTI, mean velocity

## Spleen protocol

 Vevo 2100  Vevo LAZR

### Measurement definitions

Label	Description	Units	Generic type	Mode
Spleen Sag	Sagittal length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Spleen Trans	Transverse length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Splenic Artery Vel	Splenic artery velocity	mm/s	Velocity	PW Doppler Mode
Splenic PS Vel	Splenic artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
Splenic LD Vel	Splenic artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
Splenic VTI	Splenic artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Splenic peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Splenic mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Splenic peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Splenic mean gradient	mmHg	VTI	PW Doppler Mode
Splenic Artery Diam	Splenic artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Splenic Artery Diam	Splenic artery diameter	mm	Depth	M-Mode, AM-Mode

### Calculation definitions

Label	Description	Formula
SA RI	Splenic artery resistive index	(Splenic PSV - Splenic LDV)/Splenic PSV
SA PI	Splenic artery pulsatility index	(Splenic PSV - Splenic LDV)/ Splenic VTI, mean velocity

## Gallbladder protocol

 Vevo 2100  Vevo LAZR

### Measurement definitions

Label	Description	Units	Generic type	Mode
GB Sag	Gallbladder sagittal length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
GB Trans	Gallbladder transverse length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
GB Wall Thickness	Gallbladder wall thickness	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
CBD	Common bile duct diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode

# Kidney protocol

 Vevo 2100  Vevo LAZR

## Measurement definitions

Label	Description	Units	Generic type	Mode
R Kidney Sag	Right Kidney sagittal length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
R Kidney Trans	Right Kidney transverse length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RRA PSV	Right Kidney Renal Artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RRA LDV	Right Kidney Renal Artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
RRA VTI	Right Kidney Renal artery mean systolic velocity	mm	VTI	PW Doppler Mode
Peak Vel	Right Renal peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right Renal mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right Renal peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right Renal mean gradient	mmHg	VTI	PW Doppler Mode
RRA Diam	Right Kidney Renal Artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RRA Diam	Right Kidney Renal Artery diameter	mm	Depth	M-Mode, AM-Mode
RRV PSV	Right Kidney Renal Vein peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RRV DV	Right Kidney Renal Vein diastolic velocity	mm/s	Velocity	PW Doppler Mode
RRV Diam	Right Kidney Renal Vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RRV Diam	Right Kidney Renal Vein diameter	mm	Depth	M-Mode, AM-Mode

L Kidney Sag	Left Kidney sagittal length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
L Kidney Trans	Left Kidney transverse length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LRA PSV	Left Kidney Renal Artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LRA LDV	Left Kidney Renal Artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
LRA VTI	Left Kidney Renal artery mean systolic velocity	mm	VTI	PW Doppler Mode
Peak Vel	Left Renal peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left Renal mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left Renal peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left Renal mean gradient	mmHg	VTI	PW Doppler Mode
LRA Diam	Left Kidney Renal Artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LRA Diam	Left Kidney Renal Artery diameter	mm	Depth	M-Mode, AM-Mode
LRV Diam	Left Kidney Renal Vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LRV Diam	Left Kidney Renal Vein diameter	mm	Depth	M-Mode, AM-Mode

## Calculation definitions

Label	Description	Formula
RRA RI	Right Renal artery resistive index	(RRA PSV – RRA LDV) / RRA PSV
RRA PI	Right Renal artery pulsatility index	(RRA PSV – RRA LDV) / RRA VTI, mean velocity
LRA RI	Left Renal artery resistive index	(LRA PSV – LRA LDV) / LRA PSV
LRA PI	Left Renal artery pulsatility index	(LRA PSV – LRA LDV) / LRA VTI, mean velocity

# Adrenal Glands protocol

 Vevo 2100  Vevo LAZR

## Measurement definitions

Label	Description	Units	Generic type	Mode
RAG Sag	Right adrenal glands sagittal length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RAG Trans	Right adrenal glands transverse length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RAA Vel	Right adrenal artery velocity	mm/s	Velocity	PW Doppler Mode
RAA PS Vel	Right adrenal artery peak systole velocity	mm/s	Velocity	PW Doppler Mode
RAA LD Vel	Right adrenal artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
RAA VTI	Right adrenal artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right adrenal peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right adrenal mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right adrenal peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right adrenal mean gradient	mmHg	VTI	PW Doppler Mode
RAA Diam	Right adrenal artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RAA Diam	Right adrenal artery diameter	mm	Depth	M-Mode, AM-Mode
RAV Vel	Right adrenal artery velocity	mm/s	Velocity	PW Doppler Mode
RAV Diam	Right adrenal artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RAV Diam	Right adrenal artery diameter	mm	Depth	M-Mode, AM-Mode

Lag Sag	Left adrenal glands sagittal length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Lag Trans	Left adrenal glands transverse length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LAA Vel	Left adrenal artery velocity	mm/s	Velocity	PW Doppler Mode
LAA PS Vel	Left adrenal artery peak systole velocity	mm/s	Velocity	PW Doppler Mode
LAA LD Vel	Left adrenal artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
LAA VTI	Left adrenal artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left adrenal peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left adrenal mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left adrenal peak gradient	mmhg	VTI	PW Doppler Mode
Mean Grad	Left adrenal mean gradient	mmhg	VTI	PW Doppler Mode
LAA Diam	Left adrenal artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LAA Diam	Left adrenal artery diameter	mm	Depth	M-Mode, AM-Mode
LAV Vel	Left adrenal vein velocity	mm/s	Velocity	PW Doppler Mode
LAV Diam	Left adrenal vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LAV Diam	Left adrenal vein diameter	mm	Depth	M-Mode, AM-Mode

### Calculation definitions

Label	Description	Formula
RAA RI	Right Adrenal Artery resistive index	(RAA PSV-RAA LDV)/RAA PSV
RAA PI	Right Adrenal Artery pulsatility index	(RAA PSV-RAA LDV)/RAA VTI, mean velocity
LAA RI	Left Adrenal Artery resistive index	(LAA PSV-LAA LDV)/ LAA PSV
LAA PI	Left Adrenal Artery pulsatility index	(LAA PSV-LAA LDV)/LAA VTI, mean velocity

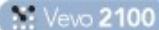
## Pancreas protocol

 Vevo 2100  Vevo LAZR

### Measurement definitions

Label	Description	Units	Generic type	Mode
Pancreas Sag	Pancreas sagittal length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Pancreas Trans	Pancreas transverse length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Duct	Pancreatic duct diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode

## Female Reproductive protocol

 Vevo 2100  Vevo LAZR

### Measurement definitions

Label	Description	Units	Generic type	Mode
Uterus Sag	Uterus sagittal length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode

Uterus Trans	Uterus transverse length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
UA Vel	Uterine artery velocity	mm/s	Velocity	PW Doppler Mode
UA PS Vel	Uterine artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
UA LD Vel	Uterine artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
UA VTI	Uterine artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Uterine artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Uterine artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Uterine artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Uterine artery mean gradient	mmHg	VTI	PW Doppler Mode
UA Diam	Uterine artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
UA Diam	Uterine artery diameter	mm	Depth	M-Mode, AM-Mode
UV Vel	Uterine vein velocity	mm/s	Velocity	PW Doppler Mode
UV Diam	Uterine vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
UV Diam	Uterine vein diameter	mm	Depth	M-Mode, AM-Mode
ROv Sag	Right ovary sagittal	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
ROv Trans	Right ovary transverse	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
ROv Art Vel	Right ovarian artery velocity	mm/s	Velocity	PW Doppler Mode
ROv PS Vel	Right ovarian artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode

ROv LD Vel	Right ovarian artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
ROv VTI	Right ovarian artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right ovarian artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right ovarian mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right ovarian peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right ovarian mean gradient	mmHg	VTI	PW Doppler Mode
ROv Art Diam	Right ovarian artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
ROv Art Diam	Right ovarian artery diameter	mm	Depth	M-Mode, AM-Mode
ROv Vein Vel	Right ovarian vein velocity	mm/s	Velocity	PW Doppler Mode
ROv Vein Diam	Right ovarian vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
ROv Vein Diam	Right ovarian vein diameter	mm	Depth	M-Mode, AM-Mode
LOv Sag	Left ovary sagittal	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LOv Trans	Left ovary transverse	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LOv Art Vel	Left ovarian artery velocity	mm/s	Velocity	PW Doppler Mode
LOv PS Vel	Left ovarian artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LOv LD Vel	Left ovarian artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
LOv VTI	Left ovarian artery mean systolic velocity	mm	VTI	PW Doppler Mode
Peak Vel	Right ovarian peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right ovarian mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right ovarian peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right ovarian mean gradient	mmHg	VTI	PW Doppler Mode

LOv Art Diam	Left ovarian artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LOv Art Diam	Left ovarian artery diameter	mm	Depth	M-Mode, AM-Mode
LOv Vein Vel	Left ovarian vein velocity	mm/s	Velocity	PW Doppler Mode
LOv Vein Diam	Left ovarian vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LOv Vein Diam	Left ovarian vein diameter	mm	Depth	M-Mode, AM-Mode

### Calculation definitions

Label	Description	Formula
UA RI	Uterine artery resistive index	(UA PSV – UA LDV)/ UA PSV
UA PI	Uterine artery pulsatility index	(UA PSV – UA LDV)/ UA VTI, mean velocity
ROv RI	Right ovarian artery resistive index	(ROv PSV – ROv LDV)/ ROv PSV
ROv PI	Right ovarian artery pulsatility index	(ROv PSV – ROv LDV)/ ROv VTI, mean velocity
LOv RI	Left ovarian artery resistive index	(LOv PSV – LOv LDV)/ LOv PSV
LOv PI	Left ovarian artery pulsatility index	(LOv PSV – LOv LDV)/ LOv VTI, mean velocity

# Male Reproductive protocol

 Vevo 2100  Vevo LAZR

## Measurement definitions

Label	Description	Units	Generic type	Mode
Prostate Sag	Prostate sagittal	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Prostate Trans	Prostate transverse	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RVG Sag	Right vesicular glands sagittal	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RVG Trans	Right vesicular glands transverse	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RVA Vel	Right vesicular artery velocity	mm/s	Velocity	PW Doppler Mode
RVA PS Vel	Right vesicular artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RVA LD Vel	Right vesicular artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
RVA VTI	Right vesicular artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right vesicular peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right vesicular mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right vesicular peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right vesicular mean gradient	mmHg	VTI	PW Doppler Mode

RVA Diam	Right vesicular artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RVA Diam	Right vesicular artery diameter	mm	Depth	M-Mode, AM-Mode
RVV Vel	Right vesicular vein velocity	mm/s	Velocity	PW Doppler Mode
RVV Diam	Right vesicular vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RVV Diam	Right vesicular vein diameter	mm	Depth	M-Mode, AM-Mode
LVG Sag	Left vesicular glands sagittal	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LVG Trans	Left vesicular glands transverse	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LVA Vel	Left vesicular artery velocity	mm/s	Velocity	PW Doppler Mode
LVA PS Vel	Left vesicular artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LVA LD Vel	Left vesicular artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
LVA VTI	Left vesicular artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left vesicular peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left vesicular mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left vesicular peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left vesicular mean gradient	mmHg	VTI	PW Doppler Mode
LVA Diam	Left vesicular artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LVA Diam	Left vesicular artery diameter	mm	Depth	M-Mode, AM-Mode
LVV Vel	Left vesicular vein velocity	mm/s	Velocity	PW Doppler Mode

LVV Diam	Left vesicular vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LVV Diam	Left vesicular vein diameter	mm	Depth	M-Mode, AM-Mode
R Test Sag	Right testicle sagittal	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
R Test Trans	Right testicle transverse	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RTA Vel	Right testicular artery velocity	mm/s	Velocity	PW Doppler Mode
RTA PS Vel	Right testicular artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RTA LD Vel	Right testicular artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
RTA VTI	Right testicular artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right testicular peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right testicular mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right testicular peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right testicular mean gradient	mmHg	VTI	PW Doppler Mode
RTA Diam	Right testicular artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RTA Diam	Right testicular artery diameter	mm	Depth	M-Mode, AM-Mode
RTV Vel	Right testicular vein velocity	mm/s	Velocity	PW Doppler Mode
RTV Diam	Right testicular vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RTV Diam	Right testicular vein diameter	mm	Depth	M-Mode, AM-Mode

L Test Sag	Left testicle sagittal	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
L Test Trans	Left testicle transverse	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LTA Vel	Left testicular artery velocity	mm/s	Velocity	PW Doppler Mode
LTA PS Vel	Left testicular artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LTA LD Vel	Left testicular artery lowest diastolic velocity	mm/s	Velocity	PW Doppler Mode
LTA VTI	Left testicular artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left testicular peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left testicular mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left testicular peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left testicular mean gradient	mmHg	VTI	PW Doppler Mode
LTA Diam	Left testicular artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LTA Diam	Left testicular artery diameter	mm	Depth	M-Mode, AM-Mode
LTV Vel	Left testicular vein velocity	mm/s	Velocity	PW Doppler Mode
LTV Diam	Left testicular vein diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LTV Diam	Left testicular vein diameter	mm	Depth	M-Mode, AM-Mode
Epid Head	Epididymis head length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Epid Head	Epididymis head depth	mm	Depth	M-Mode, AM-Mode

Epid Tail	Epididymis tail length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Epid Tail	Epididymis tail depth	mm	Depth	M-Mode, AM-Mode

### Calculation definitions

Label	Description	Formula
RVA RI	Right vesicular artery resistive index	(RVA PSV-RVA LDV)/RVA PSV
RVA PI	Right vesicular artery pulsatility index	(RVA PSV-RVA LDV)/RVA VTI, mean velocity
LVA RI	Left vesicular artery resistive index	(LVA PSV-LVA LDV)/LVA PSV
LVA PI	Left vesicular artery pulsatility index	(LVA PSV-LVA LDV)/LVA VTI, mean velocity
RTA RI	Right testicular artery resistive index	(RTA PSV-RTA LDV)/RTA PSV
RTA PI	Right testicular artery pulsatility index	(RTA PSV-RTA LDV)/RTA VTI, mean velocity
LTA RI	Left testicular artery resistive index	(LTA PSV-LTA LDV)/LTA PSV
LTA PI	Left testicular artery pulsatility index	(LTA PSV-LTA LDV)/LTA VTI, mean velocity

### Mammary Gland protocol



### Measurement definitions

Label	Description	Units	Generic type	Mode
Cervical Diam	Mammary glands	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Thoracic Diam	Thoracic diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode

Abdominal Diam	Abdominal diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Inguinal Diam	Inguinal diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Papilla Mammae Diam	Papilla mammae diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode

## Cardiac Measurement Package

This section provides the measurements and calculations information for the protocols in the Cardiac measurement package.

**NOTE:** Vevo 1100 does not include AM-Mode, PW Tissue Doppler Mode, Power Doppler Mode, Linear Contrast Mode and Nonlinear Contrast Mode.

## PSLAX protocol

### Measurement definitions

Label	Description	Units	Generic type	Mode	Chain
LV Trace	PSLAX LV trace – long axis area	mm <sup>2</sup>	BLVArea	B-Mode	
A	LV trace area	mm <sup>2</sup>	BLVArea	B-Mode	
A;s	Systolic area	mm <sup>2</sup>	BLVArea	B-Mode	
A;d	Diastolic area	mm <sup>2</sup>	BLVArea	B-Mode	
V;s	Systolic volume	µL	BLVArea	B-Mode	
V;d	Diastolic volume	µL	BLVArea	B-Mode	

SV	Stroke volume	$\mu\text{L}$	BLVArea	B-Mode	
EF	Ejection fraction	%	BLVArea	B-Mode	
FS	Fractional shortening	%	BLVArea	B-Mode	
CO	Cardiac output	$\text{mL/min}$	BLVArea	B-Mode	
V	LV trace – long axis volume	$\mu\text{L}$	BLVArea	B-Mode	
HR	Heart rate	BPM	BLVArea	B-Mode	
RVID;d	Right ventricular internal diameter (diastole)	mm	Depth	M-Mode	IVS;d
IVS;d	Inter ventricular septum (diastole)	mm	Depth	M-Mode	LVID;d
IVS;d	Inter ventricular septum (diastole)	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode	LVID;d
LVAW;d	Left ventricular anterior wall (diastole)	mm	Depth	M-Mode	LVID;d
LVID;d	Left ventricular internal diameter (diastole)	mm	Depth	M-Mode	LVPW;d
LVID;d	Left ventricular internal diameter (diastole)	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode	LVPW;d
LVEnL;d	Left ventricular endocardial length (diastole)	mm	Length	B-Mode	
LVPW;d	Left ventricular posterior wall (diastole)	mm	Depth	M-Mode	
LVPW;d	Left ventricular posterior wall (diastole)	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode	
IVS;s	Inter ventricular septum (systole)	mm	Depth	M-Mode	LVID;s
IVS;s	Inter ventricular septum (systole)	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode	LVID;s
LVAW;s	Left ventricular anterior wall (systole)	mm	Depth	M-Mode	LVID;s
LVID;s	Left ventricular internal diameter (systole)	mm	Depth	M-Mode	LVPW;s

LVID;s	Left ventricular internal diameter (systole)	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode	LVPW;s
LVEEnL;s	Left ventricular endocardial length (systole)	mm	Length	B-Mode	
LVPW;s	Left ventricular posterior wall (systole)	mm	Depth	M-Mode	
LVPW;s	Left ventricular posterior wall (systole)	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode	
LVET	Left ventricular ejection time (systole)	ms	Time	M-Mode	
LA	Left atrium	mm	Depth	M-Mode	
LA	Left atrium	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode	
Ao Root	Aortic root	mm	Depth	M-Mode	
Ao Sinus	Aortic sinus	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode	
LVEEnL;d	Left Ventricular Endocardial Length (diastole)	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode	
LVEEnL;s	Left Ventricular Endocardial Length (systole)	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode	
LV Trace	Two-wall or four-wall trace of the LV systolic diameter			M-Mode; AM-Mode	
D;d	Diastolic diameter	mm	MLVArea	M-Mode; AM-Mode	

D;s	Systolic diameter	mm	MLVArea	M-Mode; AM-Mode
V;s	Systolic volume	$\mu\text{L}$	MLVArea	M-Mode; AM-Mode
V;d	Diastolic volume	$\mu\text{L}$	MLVArea	M-Mode; AM-Mode
SV	Stroke volume	$\mu\text{L}$	MLVArea	M-Mode; AM-Mode
EF	Ejection fraction	%	MLVArea	M-Mode; AM-Mode
FS	Fractional shortening	%	MLVArea	M-Mode; AM-Mode
CO	Cardiac output	$\text{mL/min}$	MLVArea	M-Mode; AM-Mode
LV Mass	LV Mass uncorrected (NOTE: available only for Four walls)	mg	MLVArea	M-Mode; AM-Mode
LV Mass Cor	LV Mass corrected (NOTE: available only for Four walls)	mg		M-Mode; AM-Mode
HR	Heart Rate	BPM	MLVArea	M-Mode; AM-Mode
ENDOmajr;d	Endocardial major in diastole	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
ENDOmajr;s	Endocardial major in systole	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
EPImajr;d	Epicardial major in diastole	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
EPImajr;s	Epicardial major in systole	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode

### Calculation definitions

Label	Description	Units	Formula
LV Vol;d	Left ventricle volume diastole (M-Mode)	$\mu\text{L}$	$7.0 / (2.4 + \text{LVID};d) * \text{LVID};d^3$

LV Vol;d	Left ventricle volume diastole (B-Mode)	$\mu\text{L}$	$7.0 / (2.4 + \text{LVID};d) * \text{LVID};d^3$
LV Vol;s	Left ventricle volume systole (M-Mode)	$\mu\text{L}$	$7.0 / (2.4 + \text{LVID};s) * \text{LVID};s^3$
LV Vol;s	Left ventricle volume systole (B-Mode)	$\mu\text{L}$	$7.0 / (2.4 + \text{LVID};s) * \text{LVID};s^3$
EF	LV ejection fraction (M-Mode)	%	$100 * ((\text{LV Vol};d - \text{LV Vol};s) / \text{LV Vol};d)$
EF	LV ejection fraction (B-Mode)	%	$100 * ((\text{LV Vol};d - \text{LV Vol};s) / \text{LV Vol};d)$
FS	LV fractional shortening (M-Mode)	%	$100 * ((\text{LVID};d - \text{LVID};s) / \text{LVID};d)$
FS; diameter	LV fractional shortening (B-Mode)	%	$100 * ((\text{LVID};d - \text{LVID};s) / \text{LVID};d)$
FS; length	LV fractional shortening length (B-Mode)	%	$100 * ((\text{LVEnL};d - \text{LVEnL};s) / \text{LVEnL};d)$
LV Mass	LV mass uncorrected (M-Mode)	mg	$1.053 * ((\text{LVID};d + \text{LVPW};d + \text{IVS};d)^3 - \text{LVID};d^3)$
LV Mass	LV mass uncorrected (B-Mode)	mg	$1.053 * ((\text{LVID};d + \text{LVPW};d + \text{IVS};d)^3 - \text{LVID};d^3)$
LV Mass (Corrected)	LV mass corrected (M-Mode)	mg	LV Mass (M-Mode) * 0.8
LV Mass (Corrected)	LV mass corrected (B-Mode)	mg	LV Mass (B-Mode) * 0.8
V;s (LV Trace)	Systolic volume parameter of PSLAX LV trace (B-Mode)	$\mu\text{L}$	The Average Systolic Volume in B-Mode (for long axis LV Trace) shall be based on the rotational volume of the LV trace at systole around the long axis line of the spline.
V;d (LV Trace)	Diastolic volume parameter of PSLAX LV trace (B-Mode)	$\mu\text{L}$	The Average Diastolic Volume in B-Mode (for long axis LV Trace) shall be based on the rotational volume of the LV trace at diastole around the long axis line of the spline.
SV (LV Trace)	Stroke volume parameter of PSLAX LV trace (B-Mode)	$\mu\text{L}$	Diastolic Volume - Systolic Volume
EF (LV Trace)	Ejection fraction volume parameter of PSLAX LV trace (B-Mode)	%	$100 * \text{Stroke Volume} / \text{Diastolic Volume}$
FS (LV Trace)	Fractional shortening volume parameter of PSLAX LV trace (B-Mode)	%	$100 * [\text{Average LVID}_{\text{diastole}} - \text{Average LVID}_{\text{systole}}] / \text{Average LVID}_{\text{diastole}}$ Where LVID is a long axis line length that extends from the base to the farthest extent of the spline
CO (LV Trace)	Cardiac output volume parameter of PSLAX LV trace (B-Mode)	$\text{mL}/\text{min}$	$\text{Stroke Volume} * \text{Heart rate (at the first frame drawn)} / 1000$
Area;d (LV Trace)	Diastolic area parameter of PSLAX LV trace (B-Mode)	$\text{mm}^2$	Average of all the Diastolic Areas
Area;s (LV Trace)	Systolic area parameter of PSLAX LV trace (B-Mode)	$\text{mm}^2$	Average of all the Systolic Areas
Endocardial FS	Fractional shortening (B-Mode)	%	$100 * ((\text{Endocardial Major}; d - \text{Endocardial Major}; s) / \text{Endocardial Major}; d)$ NOTE: Each of the above measurements are from B-Mode
V;s (LV Trace)	Systolic volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	$\mu\text{L}$	$7.0 / (2.4 + \text{Average systolic Diameter}) * (\text{Average systolic Diameter})^3$ NOTE: Each of the above input values are from the appropriate mode
V;d (LV Trace)	Diastolic volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	$\mu\text{L}$	$7.0 / (2.4 + \text{Average diastolic Diameter}) * (\text{Average diastolic Diameter})^3$ NOTE: Each of the above input values are from the appropriate mode

SV (LV Trace)	Stroke volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	$\mu\text{L}$	Diastolic Volume - Systolic Volume NOTE: Each of the above input values are from the appropriate mode
EF (LV Trace)	Ejection fraction volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	%	100 * Stroke Volume / Diastolic Volume NOTE: Each of the above input values are from the appropriate mode
FS (LV Trace)	Fractional shortening volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	%	100 * [Average Diameter_ (diastole) - Average Diameter (systole)] / Average Diameter (diastole) NOTE: Each of the above input values are from the appropriate mode
CO (LV Trace)	Cardiac output volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	$\text{mL/min}$	Stroke Volume * Heart rate (at the first point drawn)/1000 NOTE: Each of the above input values are from the appropriate mode
LV Mass (LV Trace)	LV Mass Uncorrected parameter of LV Mass LV trace  <b>NOTE:</b> available only with 4 wall trace (M-Mode and AM-Mode)	mg	$1.053 * ((\text{Average diastolic Diameter at outer wall})^3 - (\text{Average diastolic Diameter at inner wall})^3)$ NOTE: Each of the above input values are from the appropriate mode
LV Mass Corr (LV Trace)	LV Mass Corrected parameter of LV Mass LV trace  <b>NOTE:</b> available only with 4 wall trace (M-Mode and AM-Mode)	mg	$0.8 * \text{LV Mass (LV Trace)}$ That is, uncorrected LV Mass * 0.8 NOTE: Each of the above input values are from the appropriate mode
Diameter;d (LV Trace)	Diastolic Area parameter of LV Mass LV trace (M-Mode and AM-Mode)	mm	Average of all the Diastolic Diameters NOTE: Each of the above input values are from the appropriate mode
Diameter;s (LV Trace)	Systolic Area parameter of LV Mass LV trace (M-Mode and AM-Mode)	mm	Average of all the Systolic Diameters NOTE: Each of the above input values are from the appropriate mode

## SAX protocol



### Measurement definitions

Label	Description	Units	Generic type	Mode	Chain
LV Trace	SAX LV trace - short axis area	$\text{mm}^2$	BLVArea	B-Mode	
A	LV trace area	$\text{mm}^2$	BLVArea	B-Mode	
A;s	Systolic area	$\text{mm}^2$	BLVArea	B-Mode	
A;d	Diastolic area	$\text{mm}^2$	BLVArea	B-Mode	
FAC	Fractional area change	%	BLVArea	B-Mode	
HR	Heart Rate	BPM	BLVArea	B-Mode	

IVS;d	Inter ventricular septum (diastole)	mm	Depth	M-Mode	LVID;d
IVS;d	Inter ventricular septum (diastole)	mm	Length	B-Mode; Color Doppler Mode	LVID;d
				Power Doppler Mode;	
				Linear Contrast Mode;	
				Nonlinear Contrast Mode	
LVAW;d	Left ventricular anterior wall (diastole)	mm	Depth	M-Mode	
LVID;d	Left ventricular internal diameter (diastole)	mm	Depth	M-Mode	LVPW;d
LVID;d	Left ventricular internal diameter (diastole)	mm	Length	B-Mode; Color Doppler Mode	LVPW;d
				Power Doppler Mode;	
				Linear Contrast Mode;	
				Nonlinear Contrast Mode	
LVPW;d	Left ventricular posterior wall (diastole)	mm	Depth	M-Mode	
LVPW;d	Left ventricular posterior wall (diastole)	mm	Length	B-Mode; Color Doppler Mode	
				Power Doppler Mode;	
				Linear Contrast Mode;	
				Nonlinear Contrast Mode	
IVS;s	Inter ventricular septum	mm	Depth	M-Mode	LVID;s
IVS;s	Inter ventricular septum	mm	Length	B-Mode; Color Doppler Mode	LVID;s
				Power Doppler Mode;	
				Linear Contrast Mode;	
				Nonlinear Contrast Mode	
LVAW;s	Left ventricular anterior wall (systole)	mm	Depth	M-Mode	
LVID;s	Left ventricular internal diameter (systole)	mm	Depth	M-Mode	LVPW;s

LVID;s	Left ventricular internal diameter (systole)	mm	Length	B-Mode; Color Doppler Mode	LVPW;s
				Power Doppler Mode;	
				Linear Contrast Mode;	
				Nonlinear Contrast Mode	
LVPW;s	Left ventricular posterior wall (systole)	mm	Depth	M-Mode	
LVPW;s	Left ventricular posterior wall (systole)	mm	Length	B-Mode; Color Doppler Mode	
				Power Doppler Mode;	
				Linear Contrast Mode;	
				Nonlinear Contrast Mode	
LV Trace	Four wall trace of the LV systolic diameter				
D;d	Diastolic diameter	mm	MLVArea	M-Mode; AM-Mode	
D;s	Systolic diameter	mm	MLVArea	M-Mode; AM-Mode	
V;s	Systolic volume	µL	MLVArea	M-Mode; AM-Mode	
V;d	Diastolic volume	µL	MLVArea	M-Mode; AM-Mode	
SV	Stroke volume	µL	MLVArea	M-Mode; AM-Mode	
EF	Ejection fraction	%	MLVArea	M-Mode; AM-Mode	
FS	Fractional shortening	%	MLVArea	M-Mode; AM-Mode	
CO	Cardiac output	mL/min	MLVArea	M-Mode; AM-Mode	
LV Mass	LV Mass Uncorrected	mg	MLVArea	M-Mode; AM-Mode	
LV Mass Cor	LV Mass corrected	mg	MLVArea	M-Mode; AM-Mode	
ENDOarea;d	Endocardial area in diastole	mm <sup>2</sup>	Area	B-Mode; Color Doppler Mode	
				Power Doppler Mode;	
				Linear Contrast Mode;	
				Nonlinear Contrast Mode	

ENDOarea;s	Endocardial area in systole	$\text{mm}^2$	Area	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
EPlarea;d	Epicardial area in diastole	$\text{mm}^2$	Area	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
EPlarea;s	Epicardial area in systole	$\text{mm}^2$	Area	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode

## Calculation definitions

**NOTE:** Vevo 1100 does not include Legacy Calculation.

Label	Description	Units	Formula
LV Vol;d	Left ventricle volume diastole (M-Mode)	$\mu\text{L}$	$(7.0 / (2.4 + \text{LVID};d)) * \text{LVID};d3$
LV Vol;d	Left ventricle volume diastole (B-Mode)	$\mu\text{L}$	$(7.0 / (2.4 + \text{LVID};d)) * \text{LVID};d3$ NOTE: Only if legacy calculations checked
LV Vol;s	Left ventricle volume systole (M-Mode)	$\mu\text{L}$	$(7.0 / (2.4 + \text{LVID};s)) * \text{LVID};s3$
LV Vol;s	Left ventricle volume systole (B-Mode)	$\mu\text{L}$	$(7.0 / (2.4 + \text{LVID};s)) * \text{LVID};s3$ NOTE: Only if legacy calculations checked
EF	LV ejection fraction (M-Mode)	%	$100 * ((\text{LV Vol};d - \text{LV Vol};s) / \text{LV Vol};d)$

EF	LV ejection fraction (B-Mode)	%	$100 * ((\text{LV Vol};d - \text{LV Vol};s) / \text{LV Vol};d)$ NOTE: Only if legacy calculations checked
FS	LV fractional shortening (M-Mode)	%	$100 * ((\text{LVID};d - \text{LVID};s) / \text{LVID};d)$
FS	LV fractional shortening (B-Mode)	%	$100 * ((\text{LVID};d - \text{LVID};s) / \text{LVID};d)$ NOTE: Only if legacy calculations checked
LV Mass	LV mass uncorrected (M-Mode)	mg	$1.053 * ((\text{LVID};d + \text{LVPW};d + \text{IVS};d)3 - \text{LVID};d3)$
LV Mass	LV mass uncorrected (B-Mode)	mg	$1.053 * ((\text{LVID};d + \text{LVPW};d + \text{IVS};d)3 - \text{LVID};d3)$ NOTE: Only if legacy calculations checked
LV Mass (Corrected)	LV mass corrected (M-Mode)	mg	LV Mass (M-Mode) * 0.8
LV Mass (Corrected)	LV mass corrected (B-Mode)	mg	LV Mass (M-Mode) * 0.8 NOTE: Only if legacy calculations checked
LV Mass AW	LV Mass AW Uncorrected (M-Mode)	mg	$1.053 * ((\text{LVID};d + \text{LVPW};d + \text{LVAW};d)3 - \text{LVID};d3)$
LV Mass AW (Corrected)	LV Mass AW corrected (M-Mode)	mg	LV Mass AW (M-Mode) * 0.8
Area;d (LV Trace)	Diastolic Area parameter of SAX LV trace (B-Mode)	mm <sup>2</sup>	Average of all the Diastolic Areas
Area;s (LV Trace)	Systolic Area parameter of SAX LV trace (B-Mode)	mm <sup>2</sup>	Average of all the Systolic Areas
FAC (LV Trace)	Fractional area change parameter of SAX LV trace (B-Mode)	%	$100 * [\text{Area};d (\text{LV Trace}) - \text{Area};s (\text{LV Trace})] / \text{Area};d (\text{LV Trace})$
Endocardial Volume;d	Endocardial volume in diastole (B-Mode)	µL	$5/6 * \text{End Major};d * \text{End Area};d$ NOTE: The 'End Major;d' measurement has to be made in the PSLAX protocol
Endocardial Volume;s	Endocardial volume in systole (B-Mode)	µL	$5/6 * \text{End Major};s * \text{End Area};s$ NOTE: The 'End Major;s' measurement has to be made in the PSLAX protocol
Endocardial SV	Stroke volume (B-Mode)	µL	Endocardial Volume; d - Endocardial Volume; s
Endocardial EF	Percent ejection fraction (B-Mode)	%	$(\text{Endocardial SV} / \text{Endocardial Vol}; d) * 100$
Endocardial FAC	Percent fractional area change (B-Mode)	%	$(\text{Endocardial Area}; d - \text{Endocardial Area}; s / \text{Endocardial Area}; d) * 100$
Endocardial Area Change	Area change (B-Mode)	mm <sup>2</sup>	Endocardial Area; d - Endocardial Area; s
Endocardial CO	Cardiac output (B-Mode)	mL/min	$(\text{Endocardial SV} * \text{Heart Rate})/1000$ NOTE: Heart rate is additional parameter for Endocardial Major; d measurement
Endocardial FS	Fractional shortening (B-Mode)	%	$100 * ((\text{Endocardial Major}; d - \text{Endocardial Major}; s) / \text{Endocardial Major}; d)$ NOTE: Each of the above measurements are made in PSLAX protocol in B-Mode
a;d	Average LV epicardial radius in diastole (B-Mode)	mm	$\sqrt{\frac{\text{EpicardialArea};d}{\pi}}$
b;d	Average LV endocardial radius in diastole (B-Mode)	mm	$\sqrt{\frac{\text{EndocardialArea};d}{\pi}}$
T;d	Average wall thickness (B-Mode)	mm	a - b

LV Mass;d	LV Mass (B-Mode)	mg	$1.05 * ((5/6 * \text{Epicardial Area}; d * (\text{Epicardial Major}; d+T;d)) - (5/6 * \text{Endocardial Area}; d * \text{Endocardial Major};d))$
V;s (LV Trace)	Systolic volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	$\mu\text{L}$	$7.0 / (2.4 + \text{Average systolic Diameter})^3 * (\text{Average systolic Diameter})^3$ 3] NOTE: Each of the above input values are from the appropriate mode
V;d (LV Trace)	Diastolic volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	$\mu\text{L}$	$7.0 / (2.4 + \text{Average diastolic Diameter})^3 * (\text{Average diastolic Diameter})^3$ 3] NOTE: Each of the above input values are from the appropriate mode
SV (LV Trace)	Stroke volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	$\mu\text{L}$	Diastolic Volume - Systolic Volume NOTE: Each of the above input values are from the appropriate mode
EF (LV Trace)	Ejection fraction volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	%	$100 * \text{Stroke Volume} / \text{Diastolic Volume}$ NOTE: Each of the above input values are from the appropriate mode
FS (LV Trace)	Fractional shortening volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	%	$100 * [\text{Average Diameter}_{\text{diastole}} - \text{Average Diameter}_{\text{systole}}] / \text{Average Diameter}_{\text{diastole}}$ NOTE: Each of the above input values are from the appropriate mode
CO (LV Trace)	Cardiac output volume parameter of LV Mass LV trace (M-Mode and AM-Mode)	$\text{mL/min}$	$\text{Stroke Volume} * \text{Heart rate (at the first point drawn)} / 1000$ NOTE: Each of the above input values are from the appropriate mode
LV Mass (LV Trace)	LV Mass Uncorrected parameter of LV Mass LV trace <b>NOTE:</b> available only with 4 wall trace (M-Mode and AM-Mode)	mg	$1.053 * ((\text{Average diastolic Diameter at outer wall})^3 - (\text{Average diastolic Diameter at inner wall})^3)$ NOTE: Each of the above input values are from the appropriate mode
LV Mass Corr (LV Trace)	LV Mass Corrected parameter of LV Mass LV trace <b>NOTE:</b> available only with 4 wall trace (M-Mode and AM-Mode)	mg	$0.8 * \text{LV Mass (LV Trace)}$ That is, uncorrected LV Mass * 0.8 NOTE: Each of the above input values are from the appropriate mode
Diameter;d (LV Trace)	Diastolic Area parameter of LV Mass LV trace (M-Mode and AM-Mode)	mm	Average of all the Diastolic Diameters NOTE: Each of the above input values are from the appropriate mode
Diameter;s (LV Trace)	Systolic Area parameter of LV Mass LV trace (M-Mode and AM-Mode)	mm	Average of all the Systolic Diameters NOTE: Each of the above input values are from the appropriate mode

## Anatomical M-Mode protocol



## Measurement definitions

Label	Description	Units	Generic type	Mode	Chain
IVS;d	Inter ventricular septum (diastole)	mm	Depth	AM-Mode	LVID;d
LVAW;d	Left ventricular anterior wall (diastole)	mm	Depth	AM-Mode	LVID;d
LVID;d	Left ventricular internal diameter (diastole)	mm	Depth	AM-Mode	LW;d
LW;d	Left ventricular lateral wall (diastole)	mm	Depth	AM-Mode	
IVS;s	Inter ventricular septum (systole)	mm	Depth	AM-Mode	LVID;s
LVAW;s	Left ventricular anterior wall (systole)	mm	Depth	AM-Mode	LVID;s
LVID;s	Left ventricular internal diameter (systole)	mm	Depth	AM-Mode	LW;s
LW;s	Left ventricular lateral wall (systole)	mm	Depth	AM-Mode	

## Calculation definitions

Label	Description	Units	Formula
LV Vol;d	Left ventricle volume diastole (AM-Mode)	$\mu\text{L}$	$(7.0 / (2.4 + \text{LVID};\text{d})) * \text{LVID};\text{d}^3$
LV Vol;s	Left ventricle volume systole (AM-Mode)	$\mu\text{L}$	$(7.0 / (2.4 + \text{LVID};\text{s})) * \text{LVID};\text{s}^3$
LV EF	LV ejection fraction (AM-Mode)	%	$100 * ((\text{LV Vol};\text{d} - \text{LV Vol};\text{s}) / \text{LV Vol};\text{d})$
LV FS	LV Fractional Shortening (AM-Mode)	%	$100 * ((\text{LVID};\text{d} - \text{LVID};\text{s}) / \text{LVID};\text{d})$
LV Mass	LV Mass Uncorrected (AM-Mode)	mg	$1.053 * ((\text{LVID};\text{d} + \text{LW};\text{d} + \text{IVS};\text{d})^3 - \text{LVID};\text{d}^3)$
LV Mass Corr.	LV Mass corrected (AM-Mode)	mg	$\text{LV Mass (AM-Mode)} * 0.8$
LV Mass AW	LV Mass AW Uncorrected (AM-Mode)	mg	$1.053 * ((\text{LVID};\text{d} + \text{LW};\text{d} + \text{LVAW};\text{d})^3 - \text{LVID};\text{d}^3)$
LV Mass AW Corr.	LV Mass AW corrected (AM-Mode)	mg	$\text{LV Mass AW (AM-Mode)} * 0.8$

## ARCH protocol

 Vevo 1100  Vevo 2100  Vevo LAZR

### Measurement definitions

Label	Description	Units	Generic type	Mode
Asc Ao	Ascending aorta length	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
Trans Arch	Transverse aortic arch diameter	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
Desc Ao	Descending aorta diameter	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode

## Simpson's protocol

 Vevo 1100  Vevo 2100  Vevo LAZR

### Measurement definitions

Label	Description	Units	Generic type	Mode
SimpAreaDist;d	Simpson's area distal, diastole	mm <sup>2</sup>	Area	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode

SimpAre Mid;d	Simpson's area mid, diastole	$\text{mm}^2$	Area	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
SimpAreaProx;d	Simpson's area proximal, diastole	$\text{mm}^2$	Area	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
SimpLength;d	Simpson's length, diastole	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
SimpAreaDist;s	Simpson's area distal, systole	$\text{mm}^2$	Area	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
SimpAreaMid;s	Simpson's area mid, systole	$\text{mm}^2$	Area	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
SimpAreaProx;s	Simpson's area proximal, systole	$\text{mm}^2$	Area	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
SimpLength;s	Simpson's length, systole	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode

## Calculation definitions

Label	Description	Units	Formula
Simp Volume;d	Simpson's volume calculation in diastole	µL	(Simp Area Dist;d + Simp Area Mid;d + Simp Area Prox;d) * h / 3 Where: h = Simpson Length in diastole
Simp Volume;s	Simpson's volume calculation in systole	µL	(Simp Area Dist;s + Simp Area Mid;s + Simp Area Prox;s) * h / 3 Where: h = Simpson Length in systole
Simp SV	Stroke Volume	µL	Simp Volume; d - Simp Volume; s
Simp FAC	Fraction area change	%	100 * (Simp Area Mid;d - Simp Area Mid;s)/Simp Area Mid; d
Simp EF	Ejection fraction	%	100 * Simp SV / Simp Volume; d
Simp FS	Fractional shortening	%	100*(Simp Length; d - Simp Length; s) / (Simp Length; d)
Simp CO	Cardiac output	mL/min	(Simp SV * Heart Rate)/1000

## AoV Flow protocol



## Measurement definitions

Label	Description	Units	Generic type	Mode
LVOT	Left ventricular outflow tract length	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
AoV diam	Ascending Aorta diameter	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
LVOT VTI	LVOT velocity time integral	mm	VTI	PW Doppler Mode
Mean Vel	LVOT mean velocity	mm/s	VTI	PW Doppler Mode
Mean Grad	LVOT mean pressure gradient	mmHg	VTI	PW Doppler Mode
Peak Vel	LVOT peak velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	LVOT peak pressure gradient	mmHg	VTI	PW Doppler Mode
Cycles	LVOT cycles	(none)	VTI	PW Doppler Mode

AV Peak Vel	Aortic valve peak velocity	mm/s	Vertical Velocity	PW Doppler Mode
AoV VTI	Aorta velocity time integral	mm	VTI	PW Doppler Mode
Mean Vel	Aorta mean velocity	mm/s	VTI	PW Doppler Mode
Mean Grad	Aorta mean pressure gradient	mmHg	VTI	PW Doppler Mode
Peak Vel	Aorta peak velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Aorta peak pressure gradient	mmHg	VTI	PW Doppler Mode
Cycles	Aorta cycles	(none)	VTI	PW Doppler Mode
Desc Ao Vel	Descending Aorta peak velocity	mm/s	Vertical Velocity	PW Doppler Mode
AI PHT	Aortic insufficiency deceleration	mm/s <sup>2</sup>	Acceleration	PW Doppler Mode
T	Aortic insufficiency half time	ms	Time	PW Doppler Mode
Desc Ao Vp	Descending Aorta Velocity time integral, proximal	mm	VTI	PW Doppler Mode
Mean Vel	Descending Aorta mean velocity, proximal	mm/s	VTI	PW Doppler Mode
Mean Grad	Descending Aorta mean pressure gradient, proximal	mmHg	VTI	PW Doppler Mode
Peak Vel	Descending Aorta peak velocity, proximal	mm/s	VTI	PW Doppler Mode
Peak Grad	Descending Aorta peak pressure gradient, proximal	mmHg	VTI	PW Doppler Mode
Cycles	Descending Aorta cycles, proximal	(none)	VTI	PW Doppler Mode
Desc Ao Vd	Descending Aorta Velocity time integral, distal	mm	VTI	PW Doppler Mode
Mean Vel	Descending Aorta mean velocity, distal	mm/s	VTI	PW Doppler Mode
Mean Grad	Descending Aorta mean pressure gradient, distal	mmHg	VTI	PW Doppler Mode
Peak Vel	Descending Aorta peak velocity, distal	mm/s	VTI	PW Doppler Mode
Peak Grad	Descending Aorta peak pressure gradient, distal	mmHg	VTI	PW Doppler Mode
Cycles	Descending Aorta cycles, distal	(none)	VTI	PW Doppler Mode
AAT	Aortic acceleration time	ms	Time	PW Doppler Mode
AET	Aortic ejection time	ms	Time	PW Doppler Mode

## Calculation definitions

**NOTE:** Input frame mode measurements are from B-Mode only.

Label	Description	Units	Formula
AV Peak Press	Aortic valve peak pressure gradient	mmHg	$4 * (\text{AV Peak Vel}/1000)^2$
LVOT SV	Stroke volume	µL	$0.785 * \text{LVOT}^2 * \text{LVOT VTI}$
LVOT CO	Cardiac output	mL/min	$(\text{LVOT SV} * \text{HR}(\text{from LVOT})) / 1000$
AVA	Aortic valve area	mm <sup>2</sup>	$((\text{LVOT}/2)^2 * \pi * \text{LVOT VTI, peakvel}) / \text{AV PeakV}$
AoV SV	Stroke volume	µL	$0.785 * (\text{AoV diam})^2 * \text{AoV VTI}$
AoV CO	Cardiac output	mL/min	$(\text{AoV SV} * \text{HR}(\text{from AoV diam})) / 1000$
AAT/AET	Aortic acceleration time to ejection time ratio		AAT / AET

## MV Flow protocol



### Measurement definitions

**NOTE:** PW Tissue Doppler Mode is not included on Vevo 1100.

Label	Description	Units	Generic type	Mode
MV VTI	Mitral valve velocity time integral	mm	VTI	PW Doppler Mode
Mean Vel	Mitral valve mean velocity	mm/s	VTI	PW Doppler Mode
Mean Grad	Mitral valve mean pressure gradient	mmHg	VTI	PW Doppler Mode
Peak Vel	Mitral valve peak velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Mitral valve peak pressure gradient	mmHg	VTI	PW Doppler Mode
Cycles	Mitral valve cycles	(none)	VTI	PW Doppler Mode
MV E	Mitral valve E velocity	mm/s	Vertical Velocity	PW Doppler Mode
MV A	Mitral valve A velocity	mm/s	Vertical Velocity	PW Doppler Mode
MV PHT	Mitral valve pressure half time	mm/s <sup>2</sup>	Acceleration	PW Doppler Mode
T	Mitral valve pressure half time	ms	Time	PW Doppler Mode
MV Decel	E wave deceleration time	mm/s <sup>2</sup>		PW Doppler Mode
T	E wave deceleration time	ms	Time	PW Doppler Mode
IVRT	Isovolumic relaxation time	ms	Time	PW Doppler Mode; PW Tissue Doppler Mode
IVCT	Isovolumic contraction time	ms	Time	PW Doppler Mode; PW Tissue Doppler Mode
MV ET	Mitral valve ejection time	ms	Time	PW Doppler Mode
NFT	Non-filling time	ms	Time	PW Doppler Mode
AET	Aortic ejection Time	ms	Time	PW Doppler Mode
E'	Velocity at E'	mm/s	Velocity	PW Tissue Doppler Mode
A'	Velocity at A	mm/s	Velocity	PW Tissue Doppler Mode
ET	Ejection Time	ms	Time	PW Tissue Doppler Mode
MV LW E'	Mitral Valve Velocity at E'	mm/s	Velocity	PW Tissue Doppler Mode
MV LW A'	Mitral Valve Velocity at A'	mm/s	Velocity	PW Tissue Doppler Mode
MV IVS E'	Mitral Valve IVS Velocity at E'	mm/s	Velocity	PW Tissue Doppler Mode
MV IVS A'	Mitral Valve IVS Velocity at A'	mm/s	Velocity	PW Tissue Doppler Mode

## Calculation definitions

Label	Description	Units	Formula
MV E/A	Mitral valve E to A ratio (PW Doppler Mode)		MV E / MV A
MV Area	MV area (PW Doppler Mode)	mm <sup>2</sup>	220 / (MV PHT, time)
LV MPI NFT	Left ventricle Myocardial performance index (PW Doppler Mode)		( NFT - AET ) / AET NOTE: The input values are from PW Doppler Mode
LV MPI IV	Left ventricle Myocardial performance index (PW Doppler Mode)		(IVRT + IVCT) / AET
E'/A'	Ratio of E' velocity to A' velocity (PW Tissue Doppler Mode)		E' / A'
A'/E'	Ratio of A' velocity to E' velocity (PW Tissue Doppler Mode)		A' / E'
MV E/E'	Ratio of MV E velocity to E' velocity (PW Tissue Doppler Mode)		MV E / E' NOTE: MV E is from PW Doppler Mode; E' is from PW Tissue Doppler Mode
MV LW E'/A'	Ratio of E' velocity to A' velocity (PW Tissue Doppler Mode)		MV LW E' / MV LW A'
MV LW A'/E'	Ratio of A' velocity to E' velocity (PW Tissue Doppler Mode)		MV LW A' / MV LW E'
MV IVS E'/A'	Ratio of E' velocity to A' velocity (PW Tissue Doppler Mode)		MV IVS E' / MV IVS A'
MV IVS A'/E'	Ratio of A' velocity to E' velocity (PW Tissue Doppler Mode)		MV IVS A' / MV IVS E'
MV PHT (simplified)	MV PHT (simplified) (PW Doppler Mode)	ms	0.29 * (MV Decel, time)
MV Area (simplified)	MV Area (simplified) (PW Doppler Mode)	mm <sup>2</sup>	759 / (MV Decel, time)

## RV and PV Function Protocol



## Measurement definitions

Label	Description	Units	Generic type	Mode
RVOT	Right ventricular outflow tract length	mm	Length	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode

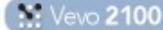
RVOT VTI				
VTI	RVOT VTI	mm	VTI	PW Doppler Mode
Mean Vel	RVOT mean velocity	mm/s	VTI	PW Doppler Mode
Mean Grad	RVOT mean pressure gradient	mmHg	VTI	PW Doppler Mode
Peak Vel	RVOT peak velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	RVOT peak pressure gradient	mmHg	VTI	PW Doppler Mode
Cycles	RVOT cycles		VTI	PW Doppler Mode
PV VTI				
VTI	Pulmonary Valve Velocity time integral	mm	VTI	PW Doppler Mode
Mean Vel	Pulmonary Valve mean velocity	mm/s	VTI	PW Doppler Mode
Mean Grad	Pulmonary Valve mean pressure gradient	mmHg	VTI	PW Doppler Mode
Peak Vel	Pulmonary Valve peak velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Pulmonary Valve peak pressure gradient	mmHg	VTI	PW Doppler Mode
Cycles	Pulmonary Valve cycles		VTI	PW Doppler Mode
PVdiam	Pulmonary Valve Diameter	mm	Length	B-Mode;  NOTE: Calculations based on PVdiam values using are only available in B-Mode.
				Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
PA VTI				
VTI	Pulmonary Artery velocity time integral	mm	VTI	PW Doppler Mode
Mean Vel	Pulmonary Artery mean velocity	mm/s	VTI	PW Doppler Mode
Mean Grad	Pulmonary Artery mean pressure gradient	mmHg	VTI	PW Doppler Mode
Peak Vel	Pulmonary Artery peak velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Pulmonary Artery peak pressure gradient	mmHg	VTI	PW Doppler Mode
Cycles	Pulmonary Artery cycles		VTI	PW Doppler Mode
PV Peak Vel	Pulmonary Valve peak velocity	mm/s	Velocity	PW Doppler Mode
PR Peak Vel	Pulmonary Regurgitation peak velocity	mm/s	Velocity	PW Doppler Mode
PAT	Pulmonary Acceleration Time	ms	Time	PW Doppler Mode
PET	Pulmonary Ejection Time	ms	Time	PW Doppler Mode
IVCT;r	Isovolumic contraction time (right ventricle)	ms	Time	PW Doppler Mode
IVRT;r	Isovolumic relaxation time (right ventricle)	ms	Time	PW Doppler Mode
NFT;r	Non-filling time (right ventricle)	ms	Time	PW Doppler Mode

## Calculation definitions

**NOTE:** Input frame mode measurements are from B-Mode only.

Label	Description	Units	Formula
PV SV	Pulmonary valve stroke volume	$\mu\text{L}$	$0.785 * (\text{PVdiam})^2 * \text{PV VTI}$
PV CO	Pulmonary valve cardiac output	$\text{mL/min}$	$[\text{PV SV} * \text{HR (from PV diam)}] / 1000$
PVA	Pulmonary Valve Area	$\text{mm}^2$	$((\text{RVOT}/2)^2 * \pi * \text{RVOT VTI, peakvel}) / \text{PV VTI, peakvel}$
RVOT SV	Right ventricle Stroke volume	$\mu\text{L}$	$0.785 * (\text{RVOT})^2 * \text{RVOT VTI}$
RVOT CO	Right ventricle Cardiac Output	$\text{mL/min}$	$[\text{RVOT SV} * \text{HR (from RVOT)}] / 1000$
PV Peak Pressure	Pulmonary valve peak gradient	$\text{mmHg}$	$4 * (\text{PV Peak V} / 1000)^2$
RV MPI NFT	Right ventricle Myocardial performance index		$(\text{NFT};r - \text{PET}) / \text{PET}$
RV MPI IV	Right ventricle Myocardial performance index		$(\text{IVRT};r + \text{IVCT};r) / \text{PET}$
PAT/PET	Pulmonary acceleration time to ejection time ratio		PAT / PET
MPAP (common)	Mean pulmonary artery pressure	$\text{mmHg}$	$79 - (0.45 * \text{PAT})$
MPAP (PAT < 120 ms)	Mean pulmonary artery pressure	$\text{mmHg}$	$90 - (0.62 * \text{PAT})$

## TV Flow protocol

### Measurement definitions

Label	Description	Units	Generic type	Mode
TV VTI	Tricuspid Velocity time integral	mm	VTI	PW Doppler Mode
Mean Vel	Tricuspid mean velocity	mm/s	VTI	PW Doppler Mode
Mean Grad	Tricuspid mean pressure gradient	$\text{mmHg}$	VTI	PW Doppler Mode
Peak Vel	Tricuspid peak velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Tricuspid peak pressure gradient	$\text{mmHg}$	VTI	PW Doppler Mode
Cycles	Tricuspid cycles	(none)	VTI	PW Doppler Mode
TV E	Tricuspid valve E wave velocity	mm/s	Vertical Velocity	PW Doppler Mode
TV A	Tricuspid valve A wave velocity	mm/s	Vertical Velocity	PW Doppler Mode
TR Peak Vel	Tricuspid regurgitation peak velocity	mm/s	Vertical Velocity	PW Doppler Mode
TV LW E'	Tricuspid Valve Velocity at E'	mm/s	Velocity	PW Tissue Doppler Mode
TV LW A'	Tricuspid Valve Velocity at A'	mm/s	Velocity	PW Tissue Doppler Mode

## Calculation definitions

Label	Description	Units	Formula
TV Peak Press	Tricuspid Valve Peak Pressure Gradient	mmHg	$4 * (TV \text{ VTI}, \text{ Tricuspid peak velocity}/1000)^2$
TV E'/A'	Ratio of tricuspid valve E' to A'	N/A	TV E'/ TV A'
TV LW E'/A'	Ratio of Velocity on Tricuspid Valve Lateral Wall	N/A	TV LW E'/TV LW A'
TV LW A'/E'	Ratio of Velocity on Tricuspid Valve Lateral Wall	N/A	TV LW A'/TV LW E'

## Embryology Measurement Package



This section provides the measurements and calculations information for the protocols in the Embryology measurement package.

### Uterine Horn protocol



## Measurement definitions

Label	Description	Units	Generic type	Mode
UA Vel	Umbilical artery velocity	mm/s	Velocity	PW Doppler
UA Diam	Umbilical artery diameter	mm	Linear	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
UA Diam	Umbilical artery diameter	mm	Depth	M-Mode, AM-Mode
UV Vel	Umbilical vein velocity	mm/s	Velocity	PW Doppler
UV Diam	Umbilical vein diameter	mm	Linear	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
UV Diam	Umbilical vein diameter	mm	Depth	M-Mode, AM-Mode
VA Vel	Vitelline artery velocity	mm/s	Velocity	PW Doppler

VA Diam	Vitelline artery diameter	mm	Linear	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
VA Diam	Vitelline artery diameter	mm	Depth	M-Mode
VV Vel	Vitelline vein velocity	mm/s	Velocity	PW Doppler, AM-Mode
VV Diam	Vitelline vein diameter	mm	Linear	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
VV Diam	Vitelline vein diameter	mm	Depth	M-Mode, AM-Mode

## Placenta protocol



### Measurement definitions

Label	Description	Units	Generic type	Mode
Placenta Sag	Sagittal length	mm	Linear	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode
Placenta Trans	Transverse length	mm	Linear	B-Mode; Color Doppler Mode Power Doppler Mode; Linear Contrast Mode; Nonlinear Contrast Mode

## Ophthalmology Measurement Package



This section provides the measurements and calculations information for the protocols in the Ophthalmology measurement package.

# Ophthalmology protocol

 Vevo 2100  Vevo LAZR

## Measurement definitions

Label	Description	Units	Generic type	Mode
Lens Length	Lens length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Lens Area	Lens area	mm <sup>2</sup>	Polygon	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Lens Curvature	Lens curvature	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Lens Radius	Lens radius	mm	Radius	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Anterior Chamber Area	Anterior chamber area	mm <sup>2</sup>	Polygon	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Cornea Length	Cornea length	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode

Choroid Thickness	Choroid thickness	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Sclera Thickness	Sclera thickness	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Retina Thickness	Retina thickness	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
Retinal Artery Velocity	Retinal artery velocity	mm/s	Velocity	PW Doppler Mode
Retinal Vein Velocity	Retinal vein velocity	mm/s	Velocity	PW Doppler Mode

## Vascular Measurement Package



This section provides the measurements and calculations information for the protocols in the Vascular measurement package.

### Abdominal Aorta and Inferior Vena Cava protocol



#### Measurement definitions

Label	Description	Units	Generic type	Mode
AA PSV	Abdominal Aorta peak systolic velocity	mm/s	Velocity	PW Doppler Mode
AA EDV	Abdominal Aorta end diastolic velocity	mm/s	Velocity	PW Doppler Mode
AA Vel	Abdominal Aorta velocity	mm/s	Velocity	PW Doppler Mode

AA Diam	Abdominal Aorta diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
AA Diam	Abdominal Aorta diameter	mm	Depth	M-Mode, AM-Mode
AA VTI	Abdominal Aorta velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Abdominal Aorta peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Abdominal Aorta mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Abdominal Aorta peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Abdominal Aorta mean gradient	mmHg	VTI	PW Doppler Mode
IVC Vel	Inferior Vena Cava peak velocity	mm/s	Velocity	PW Doppler Mode
IVC Diam	Inferior Vena Cava diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
IVC Diam	Inferior Vena Cava diameter	mm	Depth	M-Mode, AM-Mode

### Calculation definitions

Label	Description	Formula
AA RI	Abdominal Aorta Resistive Index	(AA PSV - AA EDV)/ AA PSV
AA PI	Abdominal Aorta Pulsatility Index	(AA PSV - AA EDV)/ AA VTI, Mean Velocity

## Mesenteric Arteries protocol



### Measurement definitions

Label	Description	Units	Generic type	Mode
SMA PSV	Superior mesenteric artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
SMA EDV	Superior mesenteric artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode

SMA Diam;s	Superior mesenteric artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
SMA Diam;d	Superior mesenteric artery diameter	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
SMA Diam;s	Superior mesenteric artery diameter, systole	mm	Depth	M-Mode, AM-Mode
SMA Diam;d	Superior mesenteric artery diameter, diastole	mm	Depth	M-Mode, AM-Mode
SMA VTI	Superior mesenteric artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Superior mesenteric artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Superior mesenteric artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Superior mesenteric artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Superior mesenteric artery mean gradient	mmHg	VTI	PW Doppler Mode
IMA PSV	Inferior mesenteric artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
IMA EDV	Inferior mesenteric artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
IMA Diam;s	Inferior mesenteric artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
IMA Diam;d	Inferior mesenteric artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
IMA Diam;s	Inferior mesenteric artery diameter, systole	mm	Depth	M-Mode, AM-Mode
IMA Diam;d	Inferior mesenteric artery diameter, diastole	mm	Depth	M-Mode, AM-Mode
IMA VTI	Inferior mesenteric artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Inferior mesenteric artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Inferior mesenteric artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Inferior mesenteric artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Inferior mesenteric artery mean gradient	mmHg	VTI	PW Doppler Mode

## Calculation definitions

Label	Description	Units	Formula
SMA RI	Superior mesenteric artery resistive index	none	(Superior Mesenteric Artery PSV - Superior Mesenteric Artery EDV)/ Superior Mesenteric Artery PSV
SMA PI	Superior mesenteric artery pulsatility index	none	(Superior Mesenteric Artery PSV - Superior Mesenteric Artery EDV)/ Superior Mesenteric Artery VTI,Mean Velocity
IMA RI	Inferior mesenteric artery resistive index	none	(Inferior Mesenteric Artery PSV - Inferior Mesenteric Artery EDV)/ Inferior Mesenteric Artery PSV
IMA PI	Inferior mesenteric artery pulsatility index	none	(Inferior Mesenteric Artery PSV - Inferior Mesenteric Artery EDV)/ Inferior Mesenteric Artery VTI,Mean Velocity

## Carotid Arteries protocol



### Measurement definitions

Label	Description	Units	Generic type	Mode
LCCA PSV	Left common carotid peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LCCA EDV	Left common carotid end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LCCA Diam;s	Left common carotid diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LCCA Diam;d	Left common carotid diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LCCA Diam;s	Left common carotid diameter, systole	mm	Depth	M-Mode, AM-Mode
LCCA Diam;d	Left common carotid diameter, diastole	mm	Depth	M-Mode, AM-Mode
LCCA VTI	Left common carotid velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left common carotid peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left common carotid mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left common carotid peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left common carotid mean gradient	mmHg	VTI	PW Doppler Mode
RCCA PSV	Right common carotid peak systolic velocity	mm/s	Velocity	PW Doppler Mode

RCCA EDV	Right common carotid end diastolic velocity	mm/s	Velocity	PW Doppler Mode
RCCA Diam;s	Right common carotid diameter, systole	mm	Linear	Mode
RCCA Diam;d	Right common carotid diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RCCA Diam;s	Right common carotid diameter, systole	mm	Depth	M-Mode, AM-Mode
RCCA Diam;d	Right common carotid diameter, diastole	mm	Depth	M-Mode, AM-Mode
RCCA VTI	Right common carotid velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right common carotid peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right common carotid mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right common carotid peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right common carotid mean gradient	mmHg	VTI	PW Doppler Mode
LICA PSV	Left internal carotid peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LICA EDV	Left internal carotid end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LICA Diam;s	Left internal carotid diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LICA Diam;d	Left internal carotid diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LICA Diam;s	Left internal carotid diameter, systole	mm	Depth	M-Mode, AM-Mode
LICA Diam;d	Left internal carotid diameter, diastole	mm	Depth	M-Mode, AM-Mode
LICA VTI	Left internal carotid velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left internal carotid peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left internal carotid mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left internal carotid peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left internal carotid mean gradient	mmHg	VTI	PW Doppler Mode
LECA PSV	Left external carotid peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LECA EDV	Left external carotid end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LECA Diam;s	Left external carotid diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode

LECA Diam;d	Left external carotid diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LECA Diam;s	Left external carotid diameter, systole	mm	Depth	M-Mode, AM-Mode
LECA Diam;d	Left external carotid diameter, diastole	mm	Depth	M-Mode, AM-Mode
LECA VTI	Left external carotid velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left external carotid peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left external carotid mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left external carotid peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left external carotid mean gradient	mmHg	VTI	PW Doppler Mode
RICA PSV	Right internal carotid peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RICA EDV	Right internal carotid end diastolic velocity	mm/s	Velocity	PW Doppler Mode
RICA Diam;s	Right internal carotid diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RICA Diam;d	Right internal carotid diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RICA Diam;s	Right internal carotid diameter, systole	mm	Depth	M-Mode, AM-Mode
RICA Diam;d	Right internal carotid diameter, diastole	mm	Depth	M-Mode, AM-Mode
RICA VTI	Right internal carotid velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right internal carotid peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right internal carotid mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right internal carotid peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right internal carotid mean gradient	mmHg	VTI	PW Doppler Mode
RECA PSV	Right external carotid peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RECA EDV	Right external carotid end diastolic velocity	mm/s	Velocity	PW Doppler Mode
RECA Diam;s	Right external carotid diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode

RECA Diam;d	Right external carotid diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RECA Diam;s	Right external carotid diameter, systole	mm	Depth	M-Mode, AM-Mode
RECA Diam;d	Right external carotid diameter, diastole	mm	Depth	M-Mode, AM-Mode
RECA VTI	Right external carotid velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right external carotid peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right external carotid mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right external carotid peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right external carotid mean gradient	mmHg	VTI	PW Doppler Mode

### Calculation definitions

Label	Description	Units	Formula
LCCA RI	Left common carotid resistive index	none	(Left Common Carotid PSV - Left Common Carotid EDV)/ Left Common Carotid PSV
LCCA PI	Left common carotid pulsatility index	none	(Left Common Carotid PSV - Left Common Carotid EDV)/ Left Common Carotid VTI,Mean Velocity
RCCA RI	Right common carotid resistive index	none	(Right Common Carotid PSV - Right Common Carotid EDV)/ Right Common Carotid PSV
RCCA PI	Right common carotid pulsatility index	none	(Right Common Carotid PSV - Right Common Carotid EDV)/ Right Common Carotid VTI,Mean Velocity
LICA RI	Left internal carotid resistive index	none	(Left Internal Carotid PSV - Left Internal Carotid EDV)/ Left Internal Carotid PSV
LICA PI	Left internal carotid pulsatility index	none	(Left Internal Carotid PSV - Left Internal Carotid EDV)/ Left Internal Carotid VTI,Mean Velocity
LECA RI	Left external carotid resistive index	none	(Left External Carotid PSV - Left External Carotid EDV)/ Left External Carotid PSV
LECA PI	Left external carotid pulsatility index	none	(Left External Carotid PSV - Left External Carotid EDV)/ Left External Carotid VTI,Mean Velocity
RICA RI	Right internal carotid resistive index	none	(Right Internal Carotid PSV - Right Internal Carotid EDV)/ Right Internal Carotid PSV
RICA PI	Right internal carotid pulsatility index	none	(Right Internal Carotid PSV - Right Internal Carotid EDV)/ Right Internal Carotid VTI,Mean Velocity
RECA RI	Right external carotid resistive index	none	(Right External Carotid PSV - Right External Carotid EDV)/ Right External Carotid PSV
RECA PI	Right external carotid pulsatility index	none	(Right External Carotid PSV - Right External Carotid EDV)/ Right External Carotid VTI,Mean Velocity

# Innominant and Subclavian Arteries protocol

 Vevo 2100  Vevo LAZR

## Measurement definitions

Label	Description	Units	Generic type	Mode
IA PSV	Innominant artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
IA EDV	Innominant artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
IA Diam;s	Innominant artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
IA Diam;d	Innominant artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
IA Diam;s	Innominant artery diameter, systole	mm	Depth	M-Mode, AM-Mode
IA Diam;d	Innominant artery diameter, diastole	mm	Depth	M-Mode, AM-Mode
IA VTI	Innominant artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Innominant artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Innominant artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Innominant artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Innominant artery mean gradient	mmHg	VTI	PW Doppler Mode
LSA PSV	Left Subclavian artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LSA EDV	Left Subclavian artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LSA Diam;s	Left Subclavian artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LSA Diam;d	Left Subclavian artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LSA Diam;s	Left Subclavian artery diameter, systole	mm	Depth	M-Mode, AM-Mode
LSA Diam;d	Left Subclavian artery diameter, diastole	mm	Depth	M-Mode, AM-Mode

LSA VTI	Left Subclavian artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left Subclavian artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left Subclavian artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left Subclavian artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left Subclavian artery mean gradient	mmHg	VTI	PW Doppler Mode
RSA PSV	Right Subclavian artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RSA EDV	Right Subclavian artery end diastolic velo	mm/s	Velocity	PW Doppler Mode
RSA Diam;s	Right Subclavian artery diameter, systolecity	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RSA Diam;d	Right Subclavian artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RSA Diam;s	Right Subclavian artery diameter, systole	mm	Depth	M-Mode, AM-Mode
RSA Diam;d	Right Subclavian artery diameter, diastole	mm	Depth	M-Mode, AM-Mode
RSA VTI	Right Subclavian artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right Subclavian artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right Subclavian artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right Subclavian artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Mean gradient	mmHg	VTI	PW Doppler Mode

## Calculation definitions

Label	Description	Units	Formula
IA RI	Innominant artery resistive index	none	(Innominant Artery PSV - Innominant Artery EDV)/ Innominant Artery PSV
IA PI	Innominant artery pulsatility index	none	(Innominant Artery PSV - Innominant Artery EDV)/ Innominant Artery VTI, Mean Velocity
LSA RI	Left subclavian artery resistive index	none	(Left Subclavian Artery PSV - Left Subclavian Artery EDV)/ Left Subclavian Artery PSV
LSA PI	Left subclavian artery pulsatility index	none	(Left Subclavian Artery PSV - Left Subclavian Artery EDV)/ Left Subclavian Artery VTI, Mean Velocity
RSA RI	Right subclavian artery resistive index	none	(Right Subclavian Artery PSV - Right Subclavian Artery EDV)/ Right Subclavian Artery PSV
RSA PI	Right subclavian artery pulsatility index	none	(Right Subclavian Artery PSV - Right Subclavian Artery EDV)/ Right Subclavian Artery VTI, Mean Velocity

## Iliac Arteries protocol

 Vevo 2100  Vevo LAZR

### Measurement definitions

Label	Description	Units	Generic type	Mode
CLI PSV	Common left iliac artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
CLI EDV	Common left iliac artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
CLI Diam;s	Common left iliac artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
CLI Diam;d	Common left iliac artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
CLI Diam;s	Common left iliac artery diameter, systole	mm	Depth	M-Mode, AM-Mode
CLI Diam;d	Common left iliac artery diameter, diastole	mm	Depth	M-Mode, AM-Mode
CLI VTI	Common left iliac artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Common left iliac artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Common left iliac artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Common left iliac artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Common left iliac artery mean gradient	mmHg	VTI	PW Doppler Mode
CRI PSV	Common right iliac artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
CRI EDV	Common right iliac artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
CRI Diam;s	Common right iliac artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
CRI Diam;d	Common right iliac artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
CRI Diam;s	Common right iliac artery diameter, systole	mm	Depth	M-Mode, AM-Mode
CRI Diam;d	Common right iliac artery diameter, diastole	mm	Depth	M-Mode, AM-Mode

CRI VTI	Common right iliac artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Common right iliac artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Common right iliac artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Common right iliac artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Common right iliac artery mean gradient	mmHg	VTI	PW Doppler Mode
LII PSV	Left internal iliac artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LII EDV	Left internal iliac artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LII Diam;s	Left internal iliac artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LII Diam;d	Left internal iliac artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LII Diam;s	Left internal iliac artery diameter, systole	mm	Depth	M-Mode, AM-Mode
LII Diam;d	Left internal iliac artery diameter, diastole	mm	Depth	M-Mode, AM-Mode
LII VTI	Left internal iliac artery velocity time Integral	mm	VTI	PW Doppler Mode
Peak Vel	Left internal iliac artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left internal iliac artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left internal iliac artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left internal iliac artery mean gradient	mmHg	VTI	PW Doppler Mode
LEI PSV	Left external iliac artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LEI EDV	Left external iliac artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LEI Diam;s	Left external iliac artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LEI Diam;d	Left external iliac artery Diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LEI Diam;s	Left external iliac artery Diameter, systole	mm	Depth	M-Mode, AM-Mode
LEI Diam;d	Left external iliac artery Diameter, diastole	mm	Depth	M-Mode, AM-Mode
LEI VTI	Left external iliac artery Velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left external iliac artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left external iliac artery mean velocity	mm/s	VTI	PW Doppler Mode

Peak Grad	Left external iliac artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left external iliac artery mean gradient	mmHg	VTI	PW Doppler Mode
RII PSV	Right internal iliac artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RII EDV	Right internal iliac artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
RII Diam;s	Right internal iliac artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RII Diam;d	Right internal iliac artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RII Diam;s	Right internal iliac artery diameter, systole	mm	Depth	M-Mode, AM-Mode
RII Diam;d	Right internal iliac artery diameter, diastole	mm	Depth	M-Mode, AM-Mode
RII VTI	Right internal iliac artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right internal iliac artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right internal iliac artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right internal iliac artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right internal iliac artery mean gradient	mmHg	VTI	PW Doppler Mode
REI PSV	Right external iliac artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
REI EDV	Right external iliac artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
REI Diam;s	Right external iliac artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
REI Diam;d	Right external iliac artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
REI Diam;s	Right external iliac artery diameter, systole	mm	Depth	M-Mode, AM-Mode
REI Diam;d	Right external iliac artery diameter, diastole	mm	Depth	M-Mode, AM-Mode
REI VTI	Right external iliac artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right external iliac artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right external iliac artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right external iliac artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right external iliac artery mean gradient	mmHg	VTI	PW Doppler Mode

## Calculation definitions

Label	Description	Units	Formula
CLI RI	Common left iliac artery resistive index	none	(Common Left Iliac Artery PSV - Common Left Iliac Artery EDV)/ Common Left Iliac Artery PSV
CLI PI	Common left iliac artery pulsatility index	none	(Common Left Iliac Artery PSV - Common Left Iliac Artery EDV)/ Common Left Iliac Artery VTI, Mean Velocity
CRI RI	Common right iliac artery resistive index	none	(Common Right Iliac Artery PSV - Common Right Iliac Artery EDV)/ Common Right Iliac Artery PSV
CRI PI	Common right iliac artery pulsatility index	none	(Common Right Iliac Artery PSV - Common Right Iliac Artery EDV)/ Common Right Iliac Artery VTI, Mean Velocity
LII RI	Left internal iliac artery resistive index	none	(Left Internal Iliac Artery PSV - Left Internal Iliac Artery EDV)/ Left Internal Iliac Artery PSV
LII PI	Left internal iliac artery pulsatility index	none	(Left Internal Iliac Artery PSV - Left Internal Iliac Artery EDV)/ Left Internal Iliac Artery VTI, Mean Velocity
LEI RI	Left external iliac artery resistive index	none	(Left External Iliac Artery PSV - Left External Iliac Artery EDV)/ Left External Iliac Artery PSV
LEI PI	Left external iliac artery pulsatility index	none	(Left External Iliac Artery PSV - Left External Iliac Artery EDV)/ Left External Iliac Artery VTI, Mean Velocity
RII RI	Right internal iliac artery resistive index	none	(Right Internal Iliac Artery PSV - Right Internal Iliac Artery EDV)/ Right Internal Iliac Artery PSV
RII PI	Right internal iliac artery pulsatility index	none	(Right Internal Iliac Artery PSV - Right Internal Iliac Artery EDV)/ Right Internal Iliac Artery VTI, Mean Velocity
REI RI	Right external iliac artery resistive index	none	(Right External Iliac Artery PSV - Right External Iliac Artery EDV) / Right External Iliac Artery PSV
REI PI	Right external iliac artery pulsatility index	none	(Right External Iliac Artery PSV - Right External Iliac Artery EDV) / Right External Iliac Artery VTI, Mean Velocity

## Femoral Arteries protocol



## Measurement definitions

Label	Description	Units	Generic type	Mode
LFA PSV	Left femoral artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LFA EDV	Left femoral artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode

LFA Diam;s	Left femoral artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LFA Diam;d	Left femoral artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LFA Diam;s	Left femoral artery diameter, systole	mm	Depth	M-Mode, AM-Mode
LFA Diam;d	Left femoral artery diameter, diastole	mm	Depth	M-Mode, AM-Mode
LFA VTI	Left femoral artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left femoral artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left femoral artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left femoral artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left femoral artery mean gradient	mmHg	VTI	PW Doppler Mode
RFA PSV	Right femoral artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RFA EDV	Right femoral artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
RFA Diam;s	Right femoral artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RFA Diam;d	Right femoral artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RFA Diam;s	Right femoral artery diameter, systole	mm	Depth	M-Mode, AM-Mode
RFA Diam;d	Right femoral artery diameter, diastole	mm	Depth	M-Mode, AM-Mode
RFA VTI	Right femoral artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right femoral artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right femoral artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right femoral artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right femoral artery mean gradient	mmHg	VTI	PW Doppler Mode

## Calculation definitions

Label	Description	Units	Formula
LFA RI	Left femoral artery resistive index	none	(Left Femoral Artery PSV - Left Femoral Artery EDV)/ Left Femoral Artery PSV
LFA PI	Left femoral artery pulsatility index	none	(Left Femoral Artery PSV - Left Femoral Artery EDV)/ Left Femoral Artery VTI, Mean Velocity
RFA RI	Right femoral artery resistive index	none	(Right Femoral Artery PSV - Right Femoral Artery EDV)/ Right Femoral Artery PSV
RFA PI	Right femoral artery pulsatility index	none	(Right Femoral Artery PSV - Right Femoral Artery EDV)/ Right Femoral Artery VTI, Mean Velocity

## Saphenous Arteries protocol

## Measurement definitions

Label	Description	Units	Generic type	Mode
LSaA PSV	Left saphenous artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LSaA EDV	Left saphenous artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LSaA Diam;s	Left saphenous artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LSaA Diam;d	Left saphenous artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LSaA Diam;s	Left saphenous artery diameter, systole	mm	Depth	M-Mode, AM-Mode
LSaA Diam;d	Left saphenous artery diameter, diastole	mm	Depth	M-Mode, AM-Mode
LSaA VTI	Left saphenous artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left saphenous artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left saphenous artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left saphenous artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left saphenous artery mean gradient	mmHg	VTI	PW Doppler Mode
RSaA PSV	Right saphenous artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode

RSaA EDV	Right saphenous artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
RSaA Diam;s	Right saphenous artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RSaA Diam;d	Right saphenous artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RSaA Diam;s	Right saphenous artery diameter, systole	mm	Depth	M-Mode, AM-Mode
RSaA Diam;d	Right saphenous artery diameter, diastole	mm	Depth	M-Mode, AM-Mode
RSaA VTI	Right saphenous artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right saphenous artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right saphenous artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right saphenous artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right saphenous artery mean gradient	mmHg	VTI	PW Doppler Mode

### Calculation definitions

Label	Description	Units	Formula
LSaA RI	Left saphenous artery resistive index	none	(Left Saphenous Artery PSV – Left Saphenous Artery EDV)/ Left Saphenous Artery PSV
LSaA PI	Left saphenous artery pulsatility index	none	(Left Saphenous Artery PSV - Left Saphenous Artery EDV)/ Left Saphenous Artery VTI, Mean Velocity
RSaA RI	Right saphenous artery resistive index	none	(Right Saphenous Artery PSV – Right Saphenous Artery EDV)/ Right Saphenous Artery PSV
RSaA PI	Right saphenous artery pulsatility index	none	(Right Saphenous Artery PSV - Right Saphenous Artery EDV)/ Right Saphenous Artery VTI, Mean Velocity

### Umbilical Arteries protocol



### Measurement definitions

Label	Description	Units	Generic type	Mode
UT PSV	Uterine artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode

UT EDV	Uterine artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
UT VTI	Uterine artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Uterine artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Uterine artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Uterine artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Uterine artery mean gradient	mmHg	VTI	PW Doppler Mode
UM PSV	Umbilical artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
UM EDV	Umbilical artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
UM VTI	Umbilical artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Umbilical artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Umbilical artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Umbilical artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Umbilical artery mean gradient	mmHg	VTI	PW Doppler Mode
VIT PSV	Vitelline artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
VIT EDV	Vitelline artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
VIT VTI	Vitelline artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Vitelline artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Vitelline artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Vitelline artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Vitelline artery mean gradient	mmHg	VTI	PW Doppler Mode

### Calculation definitions

Label	Description	Formula
UT RI	Uterine artery resistive index	(Uterine Artery PSV - Uterine Artery EDV)/ Uterine Artery PSV
UT PI	Uterine Artery Pulsatility index	(Uterine Artery PSV - Uterine Artery EDV)/ Uterine Artery VTI, Mean Velocity
UM RI	Umbilical artery resistive index	(Umbilical Artery PSV - Umbilical Artery EDV)/ Umbilical Artery PSV
UM PI	Umbilical Artery Pulsatility index	(Umbilical Artery PSV - Umbilical Artery EDV)/ Umbilical Artery VTI, Mean Velocity
VIT RI	Vitelline artery resistive index	(Vitelline Artery PSV - Vitelline Artery EDV)/ Vitelline Artery PSV
VIT PI	Vitelline Artery Pulsatility index	(Vitelline Artery PSV - Vitelline Artery EDV)/ Vitelline Artery VTI, mean velocity

# Renal Arteries protocol

## Measurement definitions

Label	Description	Units	Generic type	Mode
LRA PSV	Left renal artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
LRA EDV	Left renal artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
LRA Diam;s	Left renal artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LRA Diam;d	Left renal artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
LRA Diam;s	Left renal artery diameter, systole	mm	Depth	M-Mode, AM-Mode
LRA Diam;d	Left renal artery diameter, diastole	mm	Depth	M-Mode, AM-Mode
LRA VTI	Left renal artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Left renal artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Left renal artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Left renal artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Left renal artery mean gradient	mmHg	VTI	PW Doppler Mode
RRA PSV	Right renal artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
RRA EDV	Right renal artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
RRA Diam;s	Right renal artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RRA Diam;d	Right renal artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
RRA Diam;s	Right renal artery diameter, systole	mm	Depth	M-Mode, AM-Mode
RRA Diam;d	Right renal artery diameter, diastole	mm	Depth	M-Mode, AM-Mode

RRA VTI	Right renal artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Right renal artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Right renal artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Right renal artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Right renal artery mean gradient	mmHg	VTI	PW Doppler Mode

## Calculation definitions

Label	Description	Units	Formula
LRA RI	Left renal artery resistive index	none	(Left Renal Artery PSV – Left Renal Artery EDV)/ Left Renal Artery PSV
LRA PI	Left renal artery pulsatility index	none	(Left Renal Artery PSV - Left Renal Artery EDV)/ Left Renal Artery VTI, Mean Velocity
RRA RI	Right renal artery resistive index	none	(Right Renal Artery PSV – Right Renal Artery EDV)/ Right Renal Artery PSV
RRA PI	Right renal artery pulsatility index	none	(Right Renal Artery PSV - Right Renal Artery EDV)/ Right Renal Artery VTI, Mean Velocity

## Other Artery measurements



## Measurement definitions

Label	Description	Units	Generic type	Mode
OA PSV	Other artery peak systolic velocity	mm/s	Velocity	PW Doppler Mode
OA EDV	Other artery end diastolic velocity	mm/s	Velocity	PW Doppler Mode
OA Diam;s	Other artery diameter, systole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
OA Diam;d	Other artery diameter, diastole	mm	Linear	B-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode
OA Diam;s	Other artery diameter, systole	mm	Depth	M-Mode, AM-Mode
OA Diam;d	Other artery diameter, diastole	mm	Depth	M-Mode, AM-Mode

OA VTI	Other artery velocity time integral	mm	VTI	PW Doppler Mode
Peak Vel	Other artery peak velocity	mm/s	VTI	PW Doppler Mode
Mean Vel	Other artery mean velocity	mm/s	VTI	PW Doppler Mode
Peak Grad	Other artery peak gradient	mmHg	VTI	PW Doppler Mode
Mean Grad	Other artery mean gradient	mmHg	VTI	PW Doppler Mode

### Calculation definitions

Label	Description	Formula
OA RI	Other artery resistive index	(Other Artery PSV - Other Artery EDV) / Other Artery PSV
OA PI	Other artery pulsatility index	(Other Artery PSV - Other Artery EDV) / Other Artery VTI, Mean Velocity

## Appendix C

# Control panel keys and controls



This appendix lists all available controls in alphabetical order and describes the function of each control.

### In this section

Control panel controls A-M .....	693
Control panel controls N-Z.....	705

---

## Control panel controls A-M



### 2D Gain

#### 2D Gain

Adjusts the visual intensity of the signal when it returns to the face of the transducer. Turn clockwise to add gain and brighten the mode data, turn counterclockwise to reduce gain and darken the mode data.

**Active during:** B-Mode, PA-Mode, M-Mode, Contrast Mode, Color Doppler Mode and Power Doppler Mode.

**In M-Mode:** Applies to the images in both the M-Mode window as well as the B-Mode scout window.

**In PA-Mode:** Adjusts the intensity of the photoacoustic image data.

### 3D

#### 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.

## App Select

**App Select**

Opens the Application drop-down list for the active transducer. Select the application you want to work with and click **OK**.

## Back

**Back**

- Removes or cancels the last measurement point before you commit your measurement.
- Resets the parameters to the pre-defined values in the current preset.

## Backlighting Up

**o + ↑**

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.

## Backlighting Down

**o + ↓**

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

### 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

### 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 element 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 reflected in the top-left corner of the B-Mode scout image. This is the angle between the ultrasound beam and the PW angle.

In Power Doppler Mode and Color Doppler Mode, this changes the color box.

Active during Color Doppler Mode, Power Doppler Mode, PW Doppler Mode and 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

### B-Mode

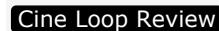
Activates B-Mode acquisition and begins displaying the acquired B-Mode data in the B-Mode window.

## 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, AM-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 PA-Mode, B-Mode, Linear Contrast Mode, Nonlinear Contrast Mode, Color Doppler Mode and Power Doppler Mode:** Stores a set of sequential frames.

**In PW Doppler Mode, PW Tissue Doppler Mode, M-Mode and AM-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**

 **Copy From**

Copies studies from an external storage location into the Study Browser.

## **Copy To**

**Copy To**

Copies studies to an external storage location.

## **Cursor**

**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, PW Tissue Doppler Mode, M-Mode or AM-Mode and the cursor is off, you can move the trackball and scroll through the cine loop.

## **Delete**

**DEL**

Deletes the selected item.

## **Depth Offset**

**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

### Display Map

Cycles through a predefined set of overlays and optimization maps that you can apply either while you acquire or review image data. Push up or pull down to cycle through the available maps for the active imaging mode.

## Doppler Angle

### Doppler Angle

Adjusts the angle correction (5-degree increments on the ultrasound cart control panel; 1-degree increments on Vevo LAB) between the vertical line of the ultrasound pulse from the face of the transducer and the direction of vascular flow in the sample volume in a PW Doppler Mode image acquisition session. The dashed yellow line indicates the direction of flow.

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

### 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

### 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.
- Pull down to decrease the range by 5dB and increase contrast.

**Active during:** B-Mode, M-Mode, PW Doppler Mode, PW Tissue Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode image acquisition sessions.

## EKV

### EKV

Opens the **EKV Acquisition Setup** dialog box so you can select the EKV scanning parameters. When you complete the parameters and click Scan, the system acquires the EKV Mode image data.

## ESC

### ESC

Click to cancel an individual measurement, or store the measurements you have made during a measurement chain.

## Export

### Export

Exports image frames, cine loops, DICOM images, reports and tables. Opens the Export window.

## Focal Zones

### 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

### 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

### Frame Rate

Adjusts the acquisition frame rate. Turn clockwise to increase the frame rate. Turn counterclockwise to lower the frame rate.

- In B-Mode, during acquisitions you can select Min, Low, Medium-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:** B-Mode, Linear Contrast Mode, PW Doppler Mode and PW Tissue Doppler Mode image acquisition sessions.

## Frame Store

### Frame Store

Stores a snapshot of all the content in the visible frame in the ultrasound image area.

In M-Mode, AM-Mode, PW Doppler Mode and PW Tissue Doppler Mode, stores the complete cine loop.

## Frequency

### 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

### Help

Opens the Help system for the Vevo Imaging System.

## Image Depth

### 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

### 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

### Image Process

When in a mode window, activates the image processing panel, which provides additional post-processing options.

## Image Sequence

### Image Sequence

In Linear 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 Modes** preferences (page 138) section of the **General** tab in the **Preferences** window.
2. The destruction burst event (page 696) runs automatically:
  - Using a) the transducer that you connect to the front panel of the Vevo Imaging System, or using b) the *external* Vevo SonoGene 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)

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 **On Scan Completion** (**Preferences** window > **General** tab > **Auto SAVE** section).

#### To configure the control for Linear Contrast Mode:

- In the **Cine Loop Size** section (page 131) of the **General** tab in the **Preferences** window configure the size of the cine loop.
- In the **Contrast Mode** preferences section (page 138) of the **General** tab in the **Preferences** window configure the parameters for the destruction sequence.

## Image Width

### 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.

## Invert

### Invert

Flips the image.

- **In PA-Mode:** Press to flip the image left/right.
- **In B-Mode:** Press to flip the image left/right.
- **In M-Mode and AM-Mode:** In the dual window view, press to flip the B-Mode scout image left/right.
- **In PW Doppler Mode and PW Tissue Doppler Mode in the dual window view:** Press to flip the spectrum window vertically.
- **In Color Doppler Mode:** Press to flip the image left/right.
- **In Power Doppler Mode:** Press to flip the image left/right.
- **In Linear Contrast Mode:** Press to flip the image left/right.

**Active during:** Image acquisition and review sessions in all imaging Modes except 3D-Mode.

## L/R Screen

**L/R Screen**

Toggles focus from left to right screen when in split screen mode.

## Line Density

 **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.

## Measure

**Measure**

When in a Mode window, activates the measurement panel.

## M-Mode

**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

**Mode Settings**

When in a Mode window, activates the mode settings panel.

## Control panel controls N-Z



### New

**New**

When you are in the Study Browser, opens the New dialog box so you can create a new study or a new series.

### Next/Prev

**Next/Prev**

Selects the next or previous image in the Study Browser. Push up to view the next item above the current item on the list. Pull down to view the next item below.

### PA



Activates PA-Mode acquisition and begins displaying the acquired data in the PA-Mode window.

### Persist

**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 Linear Contrast Mode:** Sets the process persistence filter level. Levels: None, MIP.

## Physio Settings

**Physio Settings**

When in a Mode window, activates the physiological settings panel.

## Power

 **Power**

Activates Power Doppler Mode acquisition and begins displaying the power box overlay over the B-Mode background image.

## Pre Trigger

**Pre Trigger**

In B-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 PA-Mode, B-Mode, Color Mode, Power Doppler Mode, Contrast Mode:** You define the pretrigger's cine loop size in the **Cine Loop Size** section (page 131) of the **General** tab in the **Preferences** window.

## Presets

### Presets

Active during image acquisition in every Mode other than 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 users added to the system.

All presets are both mode dependent, transducer dependent and application dependent.

## Priority

### 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

### 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

**Report**

Displays the Measurement/Analysis report page for the selected studies or series.

## RF



Activates RF Mode data acquisition.

## Save Preset

**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

**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.

## Screen Keys

**Screen Keys**

Turn the dial control to cycle through options for the current imaging mode, and then push the dial to select one.

**NOTE:** You can also cursor to a displayed option and then press **Select**.



**In PA-Mode:** Cycles through the sub-mode options: Single, NanoStepper, Oxy-Hemo, Spectro.

**In B-Mode:** Toggles the needle guide display on and off during an injection imaging session.

**In PA-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode and Nonlinear Contrast Mode:** Cycles through the image state options: Both (Overlay + B-Mode), Overlay Only, B-Mode Only, Side by Side.

 **In RF-Mode:** Cycles through the RF data display options: RF Overlay. On/Off.

## Select

### 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**.

## Sensitivity

### Sensitivity

Adjusts the level of detail at deeper distances from the transducer head. The higher you set the sensitivity level, the lower the system sets the frame rate. Push up to increase sensitivity to *High*. Pull down to decrease sensitivity to *Standard* level.

## Simul

### 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:** PW Doppler Mode and PW Tissue Doppler Mode image acquisition sessions.

## Split Screen

### 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

### 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

### Study Management

Opens the Study Browser window.

## SV/Gate

### SV/Gate

Push up to increase. Pull back to decrease.

**In M-Mode and AM-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 and PW Tissue Doppler Mode:** This control adjusts the distance in *mm* of the vertical line between the two yellow calipers of the *sample volume*. The primary gate is noticeably larger and thicker, with a larger and longer PW Angle indicator.

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, AM-Mode, PW Doppler Mode and PW Tissue Doppler Mode, the control is active in the full-screen B-Mode window after you select the Mode.

## Sweep Speed

### 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 and AM-Mode:** Set the sweep speed parameter in a range from 200 Hz to 4000 Hz (AM-Mode range can be slightly different) 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, AM-Mode, PW Doppler Mode and PW Tissue Doppler Mode image acquisition and review sessions.

## TGC sliders



Time gain compensation (TGC) 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



Tissue

Activates PW Tissue Doppler Mode image acquisition after you begin acquiring in B-Mode. Press to begin displaying the yellow PW Tissue Doppler Mode sample volume, press **Update** to display the live PW Tissue Doppler Mode spectral data in the lower window and the live B-Mode data in the scout window, then press **Simul**.

## Trackball

### Trackball

Roll the ball with your hand to:

- Move a pointer or cursor around the screen
- Move forward or backward in a cine loop
- Adjust the size and location of a Color, PA or Zoom box

## Transmit Power

### Transmit Power

Adjusts the power of the ultrasound signal transmission.

Turn the dial 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%.

## Update

### Update

#### 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

### 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 PW 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 Mode Settings preferences tab (**Prefs > Mode Settings** tab), 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

### 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

### 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

### Zoom

Activates a customizable blue zoom box overlay and magnifies the image data inside that box.

**To use this 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 and then press **Update**.
3. Trackball to position the zoom box and then 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 magnifies the data inside the box.
4. Press **Zoom** to zoom out to the original image area.

**Active during:** B-Mode, PA-Mode, Color Doppler Mode, Power Doppler Mode, Linear Contrast Mode, Nonlinear Contrast Mode and EKV-Mode image acquisition sessions. Available in M-Mode, AM-Mode, PW Doppler Mode and PW Tissue Doppler Mode only when you are displaying the B-Mode image and the sample volume or gate overlay.

#### Related information

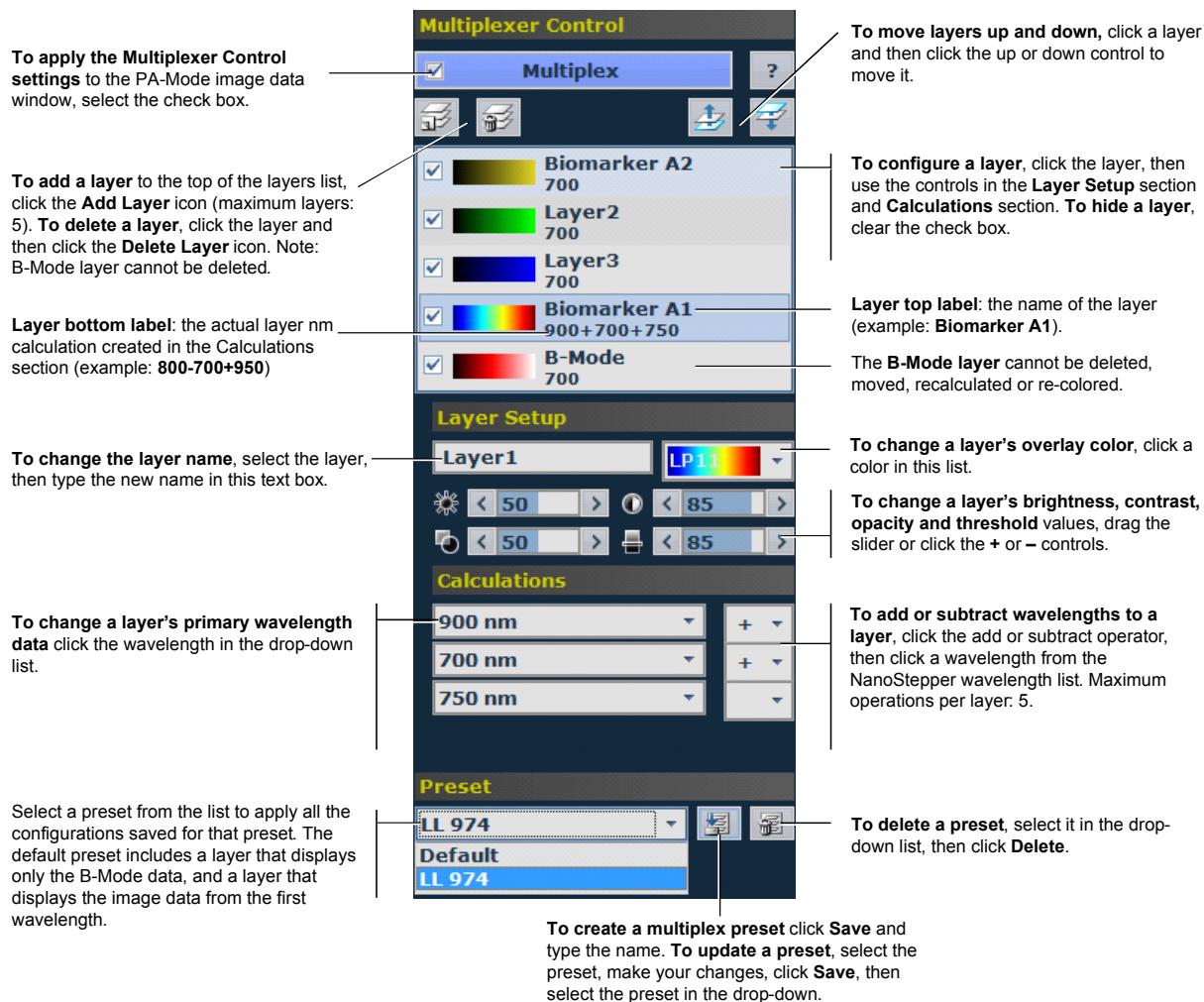
- *Zooming in to a measurement location (page 307)*

## Appendix D

# Multiplexer control panel descriptions



Multiplexer control is a set of tools you can use to assign color and other visual properties to each wavelength image series in your NanoStepper acquisition. You can then view these layers as individual or combined views of the data.



## Appendix E

# Product safety testing and electrical testing



### VisualSonics products tested

- Vovo 1100 Imaging System
- Vovo 2100 Imaging System
- Vovo LAZR Imaging System
- VisualSonics MicroScan transducers: LZ250, LZ550, MS200, MS201, MS250, MS250S, MS400, MS550D, MS550S, MS700

### Laser safety

The system complies with the laser safety standards listed below:

- IEC/EN 60825-1, 2nd Edition: 2007 for Laser Safety and Class I compliance

### Electrical safety testing

The system complies with the following laboratory equipment standards related to electrical safety as follows:

- This product has been tested to the requirements of CAN/CSA-C22.2 No. 61010-1, second edition, including Amendment 1
- Standard for Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements ANSI/UL 61010-1 Second Edition
- EN 61010-1:2001 / IEC 61010-1:2001 Safety requirements for electrical equipment for measurement, control, and laboratory use -- Part 1: General requirements

### Electromagnetic compatibility

The system complies with the electromagnetic compatibility (EMC) limits as per the following standards:

- IEC 61326-1:2005 / EN 61326-1:2006 Electrical equipment for measurement, control and laboratory use - electromagnetic compatibility

- EN 55011:2009/A1:2010, CISPR 11:2003/A1:2004, Class A Group 1 - Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement
- ICES-003:2004 – Digital Apparatus, Spectrum Management and Telecommunications Policy
- Interference-Causing Equipment Standard (Canada)
- FCC Part 15 Subpart B:2012

### **Test laboratories**

#### **Intertek Testing Services NA Ltd.**

6225 Kenway Drive  
Mississauga, Ontario L5T 2L3  
Canada

#### **Global EMC Inc.**

11 Gordon Collins Drive, PO Box 581  
Gormley, Ontario L0H 1G0  
Canada

### **Send any questions to**

Product Safety and Testing  
Quality Assurance and Regulatory Affairs  
FUJIFILM 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](mailto:productsafety@visualsonics.com)

### **Authorized representative**

#### **Europe**

Atlantic Bridge Limited  
Atlantic House  
PO Box 4800  
Earley, Reading, Berkshire

RG5 4GB, England

Tel :+44 (0) 118.969.7047

Fax: +44 (0) 118 901 4411

Website: [www.atlanticbridge.co.uk](http://www.atlanticbridge.co.uk)

Contact: Mr. Phillip Wicks

E-mail: [phwbusiness@btconnect.com](mailto:phwbusiness@btconnect.com)

## Appendix F

# Safety

 Vevo 1100    Vevo 2100    Vevo LAZR

This product has been tested to the requirements of CAN/CSA-C22.2 No. 61010-1, second edition, including Amendment 1, or a later version of the same standard incorporating the same level of testing requirements.

This section contains information required by regulatory agencies, including information about the ALARA (as low as reasonably achievable) principle, the output display standard, acoustic power and intensity tables, and other safety information. The information applies to the ultrasound system, transducer, accessories, and peripherals.

Please read the safety information before using the Vevo Imaging System. The following information applies to the Vevo Imaging System and supporting equipment.

This equipment is intended to be used by qualified research scientists.

Read all warnings and cautionary notes carefully before you use this equipment.

---

## Warnings

 Vevo 1100    Vevo 2100    Vevo LAZR



**WARNING: THIS EQUIPMENT IS NOT APPROVED FOR USE ON HUMANS.**

The Vevo 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 Imaging System in any way such that the acoustic power level is increased.



**WARNING:** Use ONLY VisualSonics transducers with the Vevo Imaging System. The use of other transducers may affect safety and system performance.

## Laser light hazards



This section lists laser light hazards that appear in this document. For a complete presentation of laser-related topics for the laser cart and Vevo LAZRTight see *Vevo LAZR safety* (page 58).



**WARNING:** Before you use the Vevo LAZR system be sure that you understand and observe the laser-related safety warnings presented in this manual.



**WARNING:** Only those who have been formally trained by VisualSonics to use this laser system may operate this photoacoustic imaging system.



**WARNING: Laser radiation.** Unauthorized personnel must not attempt to defeat the switches inside the fiber port in the laser cart, as well as the Vevo LAZRTight side access ports and front sliding doors.



**WARNING:** Do not use protective sheaths when operating an LZ series transducer.



**WARNING:** Ensure that you orient the position of Vevo LAZRTight such that the laser fires in a direction away from any doorways.



**WARNING:** Do not use Vevo LAZRTight if either of the front sliding doors is damaged.



**WARNING:** Only use coupling gels that are specifically approved for use with this system.

## Electric shock

Vevo 1100

Vevo 2100

Vevo LAZR



**WARNING:** Before connecting the Vevo Imaging System 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 Imaging System to the mains, always check that the mains cable is undamaged.



**WARNING:** Do not remove any panels from the Vevo 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 user-serviceable parts are located inside the system.

Any internal adjustments, replacements or modifications to the Vevo 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 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 equipment not authorized by VisualSonics to the Vevo Imaging System isolation transformer could result in an electrical hazard.



**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.



**WARNING:** Before connecting the system ensure the voltage is correct. Ensure the power cable is undamaged before plugging the system directly into the wall outlet. Do not connect the system's power supply to an MPSO or extension cord.

## Electromagnetic interference



Vevo 1100



Vevo 2100



Vevo LAZR



**WARNING:** The Vevo Imaging System should never be used where safety could be affected by the malfunction of medical devices.

The Vevo 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 Imaging System. Furthermore, the Vevo Imaging System could affect the safe operation of sensitive medical devices.



**CAUTION:** To avoid the risk of increased electromagnetic emissions or decreased immunity, use only accessories and peripherals recommended by VisualSonics. Connection of accessories and peripherals not recommended by VisualSonics could cause your ultrasound system to malfunction or cause other medical electrical devices in the area to malfunction.



**CAUTION:** The use of accessories, transducers and cables other than those specified (with the exception of transducers and cables sold by VisualSonics as replacement parts for internal components) may result in increased emissions or decreased immunity of the Vevo Imaging System.

## Chemicals

Vevo 1100 Vevo 2100 Vevo LAZR



**WARNING:** If any part of the Vevo 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 Imaging System until the device is declared completely free of harmful contamination.

## Cart movement

Vevo 1100 Vevo 2100 Vevo LAZR



**WARNING:** The Vevo 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 position the cart and its accessories in a way that makes it difficult to disconnect the plug from the socket.

## Cautionary notes

Vevo 1100 Vevo 2100 Vevo LAZR

This manual includes a broad range of cautionary notes.

## Radiation

Vevo 1100 Vevo 2100 Vevo LAZR



**CAUTION:** The use of controls or adjustments or performance of procedures in ways other than those specified in this manual may result in hazardous radiation exposure.

## Vevo Imaging System safety labels



The following table describes the safety symbols used on the ultrasound cart.

Symbol	Publication	Description
	IEC 60417 - 5031	Alternating current
	IEC 60417 - 5017	Earth (ground) terminal
	IEC 60417 - 5019	Protective earth (ground)
	IEC 60417 - 5007	On (supply)
	IEC 60417 - 5008	Off (supply)
	ISO 7000 - 0434	Attention, consult accompanying documents
	European Community directive 2002/96/EC	European Union WEEE (Waste Electrical and Electronic Equipment) Directive. Identifies the directive on waste electrical and electronic equipment.
	CAN/CSA-C22.2 No. 61010-1, second edition, including Amendment 1, or a later version of the same standard incorporating the same level of testing requirements.	Product has been tested to the requirements specified in the publication.

## 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 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 Imaging System is not being transported.

Never lift the system using the grab bars.

## Magnetic field sensitivity

Vevo 1100

Vevo 2100

Vevo LAZR



**CAUTION:** DO NOT situate the Vevo 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

Vevo 1100

Vevo 2100

Vevo LAZR

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 user will be required to correct the interference at his own expense.



**WARNING:** Changes or modifications not expressly approved by VisualSonics could void the user's authority to operate the equipment.

## Appendix G

# Specifications



This section describes the specifications – of the three major components of the system – that are most relevant to users and facility managers.

### In this appendix

Vevo Imaging System specifications .....	728
Vevo LAZR cart specifications .....	729
Vevo LAZRTight specifications.....	731

---

## Veo Imaging System specifications



### Environmental specifications

The Vevo Imaging System operating environment should be free of fumes, dirt, and electrical interference.

Specification	Value
Temperature	10° to 40° C (50° to 104° F)
Relative humidity	15% to 80% non-condensing
Altitude	Up to 2000m

### Physical dimensions

Dimension	Value
Height (without monitor)	112 cm (44 in.)
Height (with monitor)	155 cm (61 in.)
Width	71 cm (28 in.)
Depth	101 cm (39.5 in.)
Weight	170kg (375 lb.)

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 Vevo Imaging System to 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, 6A
- 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.



**CAUTION:** The ultrasound cart and the laser cart must be plugged into separate power outlets.

---

## Vevo LAZR cart specifications



### Physical dimensions

Dimension	Value
Height	76 cm (30 in.)
Width	48 cm (18.9 in.)
Depth	109 cm (43 in.)

Ensure that sufficient clearance is available around the system for adequate airflow and cooling. Do not block the air vents.

## Laser specifications

Specification	Value
Tunable laser	Type: Flashlamp pumped Q-switched Nd:YAG laser with optical parametric oscillator (OPO) and second harmonic generator
Frequency	20 Hz
Wavelength	680-970nm
Step size	1nm
Pulse duration	7-10ns
Peak energy at the transducer end	26mJ (at 20Hz)
Spot size	24mm <sup>2</sup> (1mm x 24mm)

## Electrical specifications

VisualSonics manufactures the Vevo LAZR cart to operate with AC line voltages of 120V and 230V. The electrical configuration of the system is noted on the system nameplate.

- 120V~, 50/60Hz, 15A
- 230V~, 50/60Hz, 8A

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



**CAUTION:** The ultrasound cart and the laser cart must be plugged into separate power outlets.



**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.

---

## Veo LAZRTight specifications



### Physical dimensions

Dimension	Value
Height	67 cm (27 in.)
Width	99 cm (39 in.)
Depth	56 cm (22 in.)

**IMPORTANT:** Ensure that sufficient clearance is available around the system for adequate airflow and cooling. Do not block the air vents.

## Appendix H

# Technical support and user maintenance



This appendix details the technical support and user maintenance information.

Performing maintenance procedures not described in the user manual may void the product warranty.

### In this appendix

Service provided by VisualSonics .....	732
Maintaining Vevo Imaging System.....	733
Maintaining Vevo LAZR transducers .....	735
Disposal .....	736
Cleaning the air filters .....	736

---

## Service provided by VisualSonics



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

### Contacting VisualSonics Support

#### In North America

- Phone: +1 (425) 951-1200
- Fax: (425) 951-1201; Service parts fax: 425-951-6700
- E-mail: customersupport@sonosite.com

#### In Europe

- Phone: +44 (0) 118.969.7047
- Fax: +44 (0) 118 901 4411

- E-mail: support@visualsonics.com

### Scheduled Vevo LAZR service tasks



**WARNING:** Only technicians that have been formally trained by VisualSonics to service Vevo LAZR may execute the following procedures.

The following Vevo LAZR service tasks must be completed by authorized VisualSonics personnel:

Task	Service maintenance schedule
<b>Replacing the distilled water in the cooling system.</b> The laser power supply subassembly is cooled by a circulating system of distilled water. The distilled water in the water reservoir must be replaced according to the service maintenance schedule.	Once every 6 months by authorized VisualSonics personnel only
<b>Inspecting and/or replacing the flash lamp.</b> The flash lamp is the electric glow discharge bulb that produces the source light that is manipulated through the optical system sub-components to become the laser beam that is delivered to and through the transducer. The flash lamp must be replaced according to the service maintenance schedule.	Once every 6 months by authorized VisualSonics personnel only

Contact VisualSonics to schedule a service call to complete these required tasks.

### Non-scheduled service tasks

If problems arise with the Vevo 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.

---

## Maintaining Vevo Imaging System



Vevo Imaging System requires proper care and cleaning. Use the recommendations in this document when cleaning or disinfecting the ultrasound system. Performing maintenance procedures not described in the user guide may void the product warranty.

## Moving the system

 Vevo 1100    Vevo 2100    Vevo LAZR

Move the system carefully. Be especially alert when you move the system along inclined passages.



**DANGER:** Before you complete the following step(s), ensure that the Mains power is Off and that the Vevo Imaging System is not connected to any AC outlet.

► **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

 Vevo 1100    Vevo 2100    Vevo LAZR

► **To clean the 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 Vevo LAZR transducers



The Vevo LAZR transducer is the most delicate component of Vevo LAZR. 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 system and the transducer.

### Warnings and cautions



**WARNING:** Do not disconnect the laser fiber bundle optic cable from the laser cart without turning off the power to the laser and disconnecting the laser safety fiber bundle interlock cable from the fiber interlock connector.



**WARNING:** High levels of ultrasound energy can damage tissue. Do not touch the transducer when acoustic power could be generated. Always turn off the power to the ultrasound cart before you clean or replace the transducer.

### Cleaning the transducer

After each imaging session, gently wipe down the transducer with a soft cloth and isopropyl alcohol or use Sporicidin wipes.

### Storing the transducer

- Keep the Vevo LAZR transducer inside Vevo LAZRTight between imaging sessions
- Ensure that the cables are not twisted when storing the transducer
- Use the provided case to transport the transducer from one site to another

### **Storing or transporting a transducer in the provided case**

- Make sure that the transducer is clean and dry before you place it in the case
- Place the protective cover over the end of the laser fiber bundle optic cable before you place it in the case
- Place the transducer in the case carefully to prevent kinking of the cable or the optical fiber
- Avoid storing the transducer in areas that are subject to extreme temperatures or are situated in direct sunlight
- Store the transducer separately from other instruments to avoid inadvertent damage

---

## **Disposal**



This equipment must be disposed of in accordance with current local regulations.

The following substances within the Vero Imaging System are potential health hazards:

<b>Substance</b>	<b>Location in the system</b>	<b>Indication of Quantity</b>
Lithium Ion	Back-up battery in computer	Very small quantities
Mercury	LCD monitor	Very small quantities

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, or the disposal of, the Vero Imaging System, please contact VisualSonics.

---

## **Cleaning the air filters**



VisualSonics recommends that you clean the Vero Imaging System air filters once every three months. If an air filter has been torn, it should be replaced. Contact a VisualSonics Technical Support Representative ([support@visualsonics.com](mailto:support@visualsonics.com)) for more information.

## Cleaning or replacing the frame base air filters

 Vevo 2100  Vevo LAZR

The two air filters on Config A systems are located on the base of the chassis frame, one at the front and one at the back.



**DANGER:** Before you complete the following step(s), ensure that the Mains power is Off and that the Vevo Imaging System is not connected to any AC outlet.

### ► 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.

## Cleaning or replacing the chassis rear panel center air filter

 Vevo 1100  Vevo 2100  Vevo LAZR

The air filter on Config B systems is located on the chassis rear panel. The chassis rear panel is designed in one of two configurations, as identified in the following procedure.

You will need a flathead screwdriver to complete this procedure.



**DANGER:** Before you complete the following step(s), ensure that the Mains power is Off and that the Vevo Imaging System is not connected to any AC outlet.

► **To clean or replace the chassis rear panel center air filter:**

1. With a flat-head screwdriver turn the panel latch screws counter-clockwise until you loosen the panel from the frame.

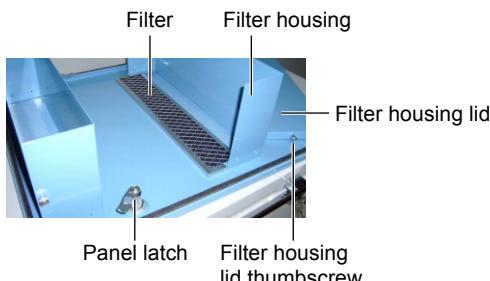


2. Firmly but carefully lift the panel until the tongues are out of the frame slots and then carefully pull the panel out.

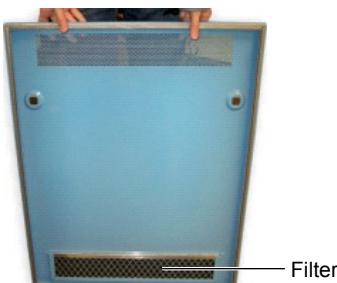


3. Slide out the filter:

- If your panel looks like this photo, twist off the filter housing lid thumbscrews, remove the filter housing lid and then slide the filter out.



- If your panel looks like this photo, slide the filter out.



4. Vacuum the filter to remove any build up of dust.

5. Slide the filter back in, and then prepare and replace the chassis rear panel.

## Appendix I

# Troubleshooting



If a problem is encountered when using the Vevo Imaging System, try the solutions described in this appendix. If none of the solutions solve the problem, contact a VisualSonics Technical Support representative ([support@visualsonics.com](mailto:support@visualsonics.com)).

### In this appendix

Vevo Imaging System troubleshooting (Configuration A) .....	740
Vevo Imaging System troubleshooting (Configuration B) .....	741
Study Browser troubleshooting.....	741
B-Mode troubleshooting.....	742
M-Mode troubleshooting .....	742
PW Doppler Mode troubleshooting .....	742
3D-Mode troubleshooting .....	743
Power Doppler Mode troubleshooting.....	743
Linear Contrast Mode troubleshooting .....	744
Physiological data troubleshooting .....	744
Measurements, annotations and calculations troubleshooting .....	745

---

## Vevo Imaging System troubleshooting (Configuration A)



Problem	Solution
System does not power up	<ul style="list-style-type: none"><li>▪ Ensure that the main power cable for the system is properly connected to the Vevo Imaging System.</li><li>▪ Ensure that the system is plugged into a grounded/earthed wall outlet. Turn the main power switch On.</li><li>▪ Turn the computer standby switch On.</li><li>▪ Check to see if the internal circuit breaker has been tripped. If the Main Power on/off bar settles to the center position between on and off, the breaker has been tripped. Contact VisualSonics to schedule a service technician.</li></ul>

Problem	Solution
No audio	<ul style="list-style-type: none"> <li>▪ Adjust the Volume dial</li> <li>▪ 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.</li> </ul>

#### Related information

- *Vevo Imaging System front view* (page 30)
- *Vevo Imaging System rear view* (page 31)

---

## Vevo Imaging System troubleshooting (Configuration B)



Problem	Solution
System does not power up	<ul style="list-style-type: none"> <li>▪ Ensure that the main power cable for the system is properly connected to the Vevo Imaging System.</li> <li>▪ Ensure that the system is plugged into a grounded/earthed wall outlet. Turn the main power switch On.</li> <li>▪ Turn the computer standby switch On.</li> <li>▪ If you still cannot power on the system, the fuses will need to be replaced. Contact VisualSonics to schedule a service technician.</li> </ul>
No audio	<ul style="list-style-type: none"> <li>▪ Adjust the Volume dial</li> <li>▪ 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.</li> </ul>

#### Related information

- *Vevo Imaging System front view* (page 30)
- *Vevo Imaging System rear view* (page 31)

---

## Study Browser troubleshooting



Problem	Solution
Unable to create new studies	Ensure that a transducer is connected to the front panel of the Vevo Imaging System, and ensure that it has been initialized.

Problem	Solution
Unable to commit a study session	Ensure that a user has been specified.

---

## B-Mode troubleshooting



Problem	Solution
Lack of penetration or sensitivity	<ul style="list-style-type: none"> <li>▪ Ensure that there is adequate coupling medium (for example, ultrasound gel) between the transducer and the animal.</li> <li>▪ Adjust the position of the TGC sliders.</li> <li>▪ Increase the Transmit Power.</li> <li>▪ Ensure the appropriate transducer is being used.</li> </ul>

---

## M-Mode troubleshooting



Problem	Solution
Lack of penetration or sensitivity	<ul style="list-style-type: none"> <li>▪ Ensure that there is adequate coupling medium (for example, ultrasound gel) between the transducer and the animal.</li> <li>▪ Adjust the position of the TGC sliders.</li> <li>▪ Increase the Transmit Power.</li> <li>▪ Ensure the appropriate transducer is being used.</li> </ul>

---

## PW Doppler Mode troubleshooting



Problem	Solution
Aliasing in the PW Doppler Mode acquisition	<ul style="list-style-type: none"> <li>▪ Increase the Frequency.</li> <li>▪ Decrease the Doppler Angle.</li> <li>▪ Adjust the Baseline setting.</li> </ul>
The PW Doppler signal is very small when the viewed flow is slow	<ul style="list-style-type: none"> <li>▪ Decrease the Frequency setting.</li> </ul>
Signal appears to be low intensity	<ul style="list-style-type: none"> <li>▪ Adjust the Doppler Gain setting.</li> </ul>

Problem	Solution
Signal exhibits saturation	<ul style="list-style-type: none"> <li>▪ Lower the Doppler Gain setting.</li> </ul>
Low frequency noise level in PW Doppler acquisition is high	<ul style="list-style-type: none"> <li>▪ Increase the Wall Filter setting.</li> </ul>
Noise appears in the image	<ul style="list-style-type: none"> <li>▪ Adjust the Sample Volume size and position such that it includes tissue only.</li> </ul>

---

## 3D-Mode troubleshooting



Problem	Solution
Can't initialize the motor	<ul style="list-style-type: none"> <li>▪ Ensure that the cable for the 3D motor stage is connected to the rear panel.</li> <li>▪ Ensure that the motor is positioned such that there are no objects obstructing the path of the transducer during initialization.</li> </ul>
Expected data is not acquired	<ul style="list-style-type: none"> <li>▪ 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.</li> <li>▪ Ensure that the Range and Step Size settings are adequate for acquiring the desired amount of data.</li> <li>▪ If two transducers are connected, ensure that the active transducer is the one connected to the 3D motor stage.</li> <li>▪ Ensure that the transducer is tightly connected to the port on the front of the cart.</li> </ul>

---

## Power Doppler Mode troubleshooting



Problem	Solution
Color bands in the image	<ul style="list-style-type: none"> <li>▪ Enable Respiration Gating.</li> <li>▪ Adjust Wall Filter setting.</li> <li>▪ Adjust Scan Speed setting.</li> <li>▪ Adjust the Priority settings.</li> </ul>
Respiration artifacts in the image	<ul style="list-style-type: none"> <li>▪ Enable Respiration Gating.</li> <li>▪ Adjust Wall Filter setting.</li> <li>▪ Adjust Sweep Speed setting.</li> </ul>

Problem	Solution
Lack of sensitivity	<ul style="list-style-type: none"> <li>▪ Ensure the anatomy being studied is in the focal zone for the transducer.</li> </ul>
Lack of penetration or sensitivity	<ul style="list-style-type: none"> <li>▪ Increase the Transmit Power.</li> <li>▪ Ensure that there is adequate coupling medium (for example, ultrasound gel) between the transducer and the animal.</li> <li>▪ Adjust the position of the TGC sliders.</li> <li>▪ Ensure the appropriate transducer is being used.</li> </ul>

## Linear Contrast Mode troubleshooting



Problem	Solution
Linear Contrast Mode functions are not available	<ul style="list-style-type: none"> <li>▪ Ensure that Linear Contrast Mode is the active mode.</li> </ul>
The agent color in the contrast overlay is not displayed where expected	<ul style="list-style-type: none"> <li>▪ 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.)</li> </ul>
The amount of agent color in the contrast overlay is too much or too little	<ul style="list-style-type: none"> <li>▪ 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.</li> </ul>

## Physiological data troubleshooting

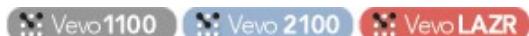


Problem	Solution
No ECG signal is displayed	<ul style="list-style-type: none"> <li>▪ Ensure the ECG cable is connected to the physiological monitoring and control system, and the keyed end of the cable is connected to the front panel of the Vevo cart.</li> </ul>
ECG signal appears flatlined	<ul style="list-style-type: none"> <li>▪ Ensure that the ECG monitor is producing a strong, consistent signal.</li> </ul>

Problem	Solution
ECG signal is poor	<ul style="list-style-type: none"> <li>▪ Ensure that all of the animal's limbs are secured to the ECG pads on animal platform.</li> <li>▪ Ensure that no gel has leaked onto any of the contacts on the animal platform.</li> <li>▪ Ensure that there is no 50/60 Hz noise source near the animal platform (for example a lamp or a power cable).</li> </ul>
Blood pressure signal is not accurate	<ul style="list-style-type: none"> <li>▪ Calibrate the blood pressure signal.</li> <li>▪ Check hardware gain and blood pressure check box in User Preferences.</li> <li>▪ Check positioning and operation of blood pressure catheter.</li> </ul>

---

## Measurements, annotations and calculations troubleshooting



Problem	Solution
Measurement tools are not available	<ul style="list-style-type: none"> <li>▪ Ensure that the system is not acquiring data or playing a cine loop.</li> <li>▪ Ensure that data is displayed in the mode window.</li> </ul>
A calculated value is not displayed in the Value column for calculations	<ul style="list-style-type: none"> <li>▪ 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.</li> </ul>
PV Loop calculations are not available	<ul style="list-style-type: none"> <li>▪ The system might not have recorded a blood pressure signal. Ensure that a blood pressure source is connected to the animal.</li> </ul>

# Glossary of Terms

 Vevo 1100    Vevo 2100    Vevo LAZR

## 3D-Mode

 3D-Mode provides a three-dimensional view of an area of interest from frame-based imaging modes, excluding PA-Mode (Spectro) and EKV Mode. The system acquires the 3D data by a) creating a rapid series of B-Mode slices, and then b) combining these slices into a whole image. You can then view the structures you are interested in by using the analysis and measurement tools.

## Anatomical M-Mode (AM-Mode)

 Anatomical M-Mode, or *AM-Mode*, is a modification to standard M-mode typically used in echocardiography; anatomical M-mode is a tool you can use to steer the sample volume to any angle, rather than positioning the sample volume in a strict vertical position.

## Annotation

A text label 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 the imaging mode you will work with most often because it is the most effective mode for locating anatomical structures. If you have seen a conventional ultrasound image then you are already familiar with B-Mode.

You also:

- Use B-Mode in other imaging modes as the background orientation image over which the active mode data is applied.
- Use B-Mode as a real-time orientation window in other imaging mode windows so you can visually guide the transducer to the right location to acquire the most useful data in your active imaging mode.

## BMP

BMP is a Bitmap file extension of a static image file format. Each bit of the saved BMP file represents a piece or pixel of the image.

## Bolus

 A defined volume to be perfused into the animal during one injection.

## Caliper

An user-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.

This mode is useful for blood flow applications such as:

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

## **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.

## **ECG trigger**

 A feature you can use when you want to add measurements at a specific time during the heart cycle. ECG triggering acquires one single frame of image data during each cardiac cycle, at precisely the same time point after the R wave peak. To use this feature, your subject must be connected to the Advanced Physiological Monitoring Unit.

## **EKV Mode**

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

By acquiring data over multiple heart cycles and extracting data at specific time points, EKV-mode produces a cine loop that is representative of a typical heart cycle.

EKV Mode is not a source image acquisition mode. Rather, EKV Mode takes the cine loop data that you acquire in a source imaging mode and then processes it into the representative one-heart-cycle cine loop.

To analyze an EKV Mode image, you use the same analysis tools that you would use to analyze an image in the source image acquisition mode.

## **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.

## **HemoMeaZure**

 A measuring tool that measures and quantifies hemoglobin content and quantification in PA-Mode images. Available only in Oxy-Hemo sub-mode.

## **Linear Contrast Mode**

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

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

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

## **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.

## **M-Mode**

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

M-Mode works fundamentally differently than B-Mode. Where B-Mode is a frame-based image that uses multiple scanning beams to create its image, M-Mode is a time-based image that uses just one beam.

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.

## **Multiplexer Control**

 Multiplexer

control is a set of tools you can use to assign color and other visual properties to each wavelength image series in your NanoStepper acquisition. You can then view these layers as individual or combined views of the data.

## **NanoStepper**

 One of four available sub-modes in PA-Mode (Single, Oxy-Hemo, NanoStepper, Spectro). NanoStepper is a multi-wavelength PA-Mode image acquisition sub-mode that acquires photoacoustic images at up to five custom wavelengths.

## **Nonlinear Contrast Mode**

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

During acquisition the system modulates the amplitude of the ultrasound pulses, enabling a nonlinear response to microbubbles.

To acquire images in this mode you must use one of the following transducers: MS-200, MS-201, MS-250, MS-250S or LZ250.

### Oxy-Hemo



One of four available sub-modes in PA-Mode (Single, Oxy-Hemo, NanoStepper, Spectro). Oxy-Hemo sub-mode acquires PA-Mode image data at two wavelengths. In the Mode Settings preferences tab (**Prefs > Mode Settings** tab) you can select one of two default wavelength values (734 nm or 750 nm) for Wavelength 1. Wavelength 2 is always 850 nm. The blue overlay displays deoxygenated blood. The red overlay displays oxygenated blood.

### OxyZated



A measuring tool that calculates and quantifies oxygen saturation in PA-Mode images. Available only in Oxy-Hemo sub-mode.

### PA-Mode



A method for obtaining optical contrast from biological tissues and detecting it with ultrasound. By illuminating tissue, a thermoelastic expansion occurs and this expansion creates an ultrasound wave which can be detected with an ultrasound transducer.

### Perfusion



The delivery and circulation of contrast agent through the blood vessels.

### Power Doppler Mode



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

### Pressure-volume loop

A graphical method of identifying and evaluating LV pressure-volume relationship changes related to dynamic levels of cardiac stress.

### PW Angle / AM-Mode

Adjusts the angle correction (5-degree increments on the ultrasound cart control panel; 1-degree increments on Vevo LAB) between the vertical line of the ultrasound pulse from the face of the transducer and the direction of vascular flow in the sample volume in a PW Doppler Mode image acquisition session. The dashed yellow line indicates the direction of flow.

### PW Doppler Mode

PW Doppler Mode (Pulsed Wave Doppler) is an ultrasound mode you can use to measure the velocity and direction of flow. The Vevo software presents the detected PW Doppler signal as both a spectral image in the display window as well as an audio output through the system speakers.

## **RF-Mode**

 Digital RF-Mode provides data in RF, Raw and IQ format for further analysis. Digital RF-Mode allows users to acquire, digitize and view the raw RF data from the high-frequency ultrasound signal.

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

## **Rocker switch**

A rocker switch is a spring-return key that provides the user 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 and AM-mode acquisition. Sample volume size is defined by the length of the pulse and the width of the ultrasound beam.

## **Scout window**

A small B-Mode window that renders the region of interest for acquisition in M-Mode, AM-Mode PW Doppler Mode, PW Tissue Doppler Mode.

## **Session**

A period of time that a user spends adding information (acquiring data or making measurements and/or annotations on acquired data) to a study.

## **Single**

 One of four available sub-modes in PA-Mode (Single, Oxy-Hemo, NanoStepper, Spectro). PA-Mode (Single) is a single-wavelength PA-Mode image acquisition sub-mode that acquires photoacoustic data at one wavelength.

## **Spectro**

 One of four available sub-modes in PA-Mode (Single, Oxy-Hemo, NanoStepper, Spectro). Spectro is a multiple-wavelength PA-mode image acquisition sub-mode that acquires a flexible range of two-dimensional images at defined steps between a range of wavelengths.

## **Standard Mode**

When the Vevo Imaging System is installed, Standard Mode is the default user access mode. Each user maintains full administrator rights until someone assigns administrator rights either to themselves or to someone else.

## **Study sharing level**

 When User Management Mode is enabled, a user can apply one of the three sharing levels to their own study to control who accesses it:

- **Keep Private** provides study access to you and administrators
- **Share with Group** provides study access to you, to all users in your group and to administrators
- **Share with Everyone** provides study access to all users and administrators

### **Targeted quantification**

 The calculations that determine the presence of a biomarker.

### **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.

### **Usage log**

 Usage Log is a user management mode feature that tracks users who access the system, when they used it and how long they spent scanning images with a transducer.

The log consists of individual session entries and is available on the Vevo Imaging System as well as the Vevo LAB software.

### **User**

A specified user of the system with whom study sessions may be associated.

### **User group**

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

### **User Management Mode**

 User Management Mode is an administration option (not an image acquisition mode) that activates advanced user account controls, user groups, user-assignable study sharing levels and Usage Log availability.

### **Vevo LAB**

VisualSonics offers optional Vevo LAB software which includes all the software tools and features that you will find on the Vevo Imaging System, excluding the image acquisition tools features.

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

### **VevoColor**

VevoColor is a tool that applies color to add visual definition to an area of interest on an image.

### **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.

# Index

## 3

- 3D motor stage • 261, 262, 263
- 3D-Mode
  - acquiring Color Doppler Mode images in • 499
  - acquiring PA-Mode images in • 390
  - acquisition setup • 262, 263, 465, 467
  - adding generic measurements • 485
  - control panel controls • 464
  - for NanoStepper images • 379, 400
  - for PA-Mode images • 390
  - overview • 115, 454
  - recording • 469
  - rotating images • 473
  - sculpting • 476
  - thresholding color-mapped images in • 484
  - troubleshooting • 743
  - typical acquisition session • 457
  - visualization tools • 470
  - volume measurements • 478, 479, 480, 483
  - workspace • 457

## A

- abdominal package annotations • 311
- acceleration measurement • 600
- acquiring • 281, 335, 413, 443, 457, 498, 515, 517, 531, 534
- adding focal zones • 338
- air filters • 736, 737
- AM-Mode • 114, 424, 426, 429
  - reconstructing from other modes • 426
- analysis
  - of image data • 286
  - reports • 319, 321
- analysis browser
  - creating reports in • 319, 321
  - workspace • 100
- Anatomical M-Mode (AM-Mode)
  - analyzing images • 429
  - typical acquisition session • 424
- angle measurement • 600
- annotations

- adding • 315
  - displaying • 159, 160
  - modifying • 315
  - predefined
    - abdominal package • 311
    - cardiac package • 312
    - embryology package • 313
    - ophthalmology package • 314
    - vascular package • 314
  - preferences • 159
  - troubleshooting • 745
  - working with • 309
  - workspace • 309
- application packages • 118
- applications • 164
  - importing • 166

## B

- backing up preferences • 176
- blood pressure • 270
- B-Mode
  - acquisition settings • 334
  - adding focal zones • 338
  - adding generic measurements • 341
  - control panel controls • 329
  - optimizing for imaging tissue • 337
  - overview • 113
  - pressure-volume measurement loops • 344
  - troubleshooting • 742
  - typical acquisition session • 335
  - visualizing injections • 338
  - workspace • 326
- B-Mode LV Area measurement • 615, 617, 618
- burst parameters • 138

## C

- calibrating • 273, 274, 275
- cardiac region measurement • 601, 603
- cine loops • 288
  - annotations • 309
  - creating • 291
  - extending size of • 131, 284
  - reviewing • 289, 290
  - saving • 133
  - setting preferences • 131
  - workspace • 288
- color
  - adding to an image to define an area • 317

- adding to NanoStepper layers • 398  
**C**  
 Color Doppler Mode  
     acquisition settings • 496  
     adding generic measurements • 501  
     control panel controls • 493  
     overview • 115  
     typical acquisition session • 498  
     workspace • 489  
 connectors • 32  
 contact support • 2, 732  
 contour measurements  
     modifying • 304  
 contrast agents  
     displaying as overlay • 536, 537  
     non-targeted • 535  
     targeted • 535  
 Contrast Mode  
     acquisition settings • 529  
     adding generic measurements • 540  
     burst parameters • 138  
     contrast agents  
         displaying as overlay • 536, 537  
         non-targeted • 535  
         targeted • 535  
         technology of • 535  
     control panel controls • 527  
     overview • 116  
     troubleshooting • 744  
     typical acquisition session • 531  
     workspace • 524  
 control panel • 36  
 control panel controls  
     3D-Mode • 464  
     backlighting control • 36, 694  
     B-Mode • 329  
     Color Doppler Mode • 493  
     Contrast Mode • 527  
     descriptions • 693  
     M-Mode • 409  
     PA-Mode • 365  
     Power Doppler Mode • 510  
     PW Doppler Mode • 436  
 custom measurement packages • 149  
     custom applications • 164, 170  
**D**  
 date and time stamp • 134  
 depth interval measurement • 612  
 Doppler Angle control • 698  
**E**  
 ECG trigger • 278  
 EKV AM-Mode • 426  
 EKV Mode • 26, 47, 117, 133, 138, 424, 426, 581, 584, 585, 586, 588  
 embryo measurements • 304  
 embryology measurement package  
     annotations • 313  
 exporting  
     applications • 165  
     cine loops • 240, 242  
     contrast data • 612  
     contrast region graphs • 604  
     custom measurement packages • 150  
     description of • 240  
     Export and Copy To windows  
         workspace • 103  
     image analysis report • 321  
     image frames • 243, 246  
     images • 134, 240, 242, 243, 246, 247, 249, 445, 593  
     images from the Mode window • 246  
     images to DICOM • 247, 249  
     Linear Contrast Mode images • 612  
     log files • 175  
     physiological • 246  
     physiological data • 246  
     PW Doppler Mode cine loop audio • 445  
     RF-Mode data • 593  
     Study Brower list view • 249  
     system log files • 175  
     user preferences • 146  
**F**  
 focal zones  
     adding • 338  
 front view • 39  
**H**  
 heart rate measurement • 613  
     HemoMeaZure • 748  
**I**  
 image acquisition modes • 112, 113, 114, 115, 116, 117, 118  
 images • 119, 218, 235  
     acquiring • 281, 335, 413, 443, 457, 498, 515, 517, 531, 534  
     adding measurements • 298, 341, 416, 449, 478, 485, 501, 519, 540  
     analyzing • 286, 319

exporting • 134  
labeling • 235  
managing • 217  
modifying qualities when stored • 236  
opening • 235, 321  
saving • 237, 282, 284  
importing  
    custom measurement packages • 149  
    studies • 255  
    transducer applications • 166  
    user preferences • 146  
injections  
    visualizing with needle guide overlay • 338  
institution name • 130  
interlocks • 49, 52, 60, 370, 374, 380

**L**

laser  
    cart • 49, 61, 66, 67, 123  
    changing the wavelength of • 390, 392  
    optimizing the energy of for image output • 391  
    positioning the transducer • 393  
    safety • 58, 59, 721  
    system components • 49, 52  
LAZRTight • 52, 64, 66  
    specifications • 729  
legacy calculations • 158  
lens radius measurement • 343  
Linear Contrast Mode  
    acquisition settings • 529  
    control panel controls for • 527  
    linear contrast region measurement • 603, 604, 606  
    copying and pasting • 606  
    creating analysis chart for • 604  
    placing • 603  
    working with chart data • 606  
typical 3D-Mode image acquisition session • 534  
typical acquisition session • 531  
workspaces • 524  
linear distance measurement • 614  
locking • 222, 308  
    measurements • 308  
    studies • 135, 222, 223  
log • 175  
logging in • 76, 125, 126

LV wall measurements • 347, 350, 352, 354, 355, 357, 601, 603, 615, 617, 619

## M

mean and standard deviations • 598  
measurement packages • 20, 148, 154, 155  
    abdominal • 631  
    activating • 152  
    batch changing • 152  
    cardiac • 650  
    creating custom • 149  
    custom • 149, 150  
    embryology • 670  
    exporting • 150  
    modifying • 149  
    ophthalmology • 671  
    showing/hiding • 153  
    vascular • 673

## measurements

2D area measurement  
    mean and standard deviations • 598  
    placing • 597  
acceleration measurement • 600  
angle measurement • 600  
B-Mode LV Area measurement • 615, 617, 618  
cardiac region measurement • 601, 603  
copying and pasting • 306  
deleting • 308  
depth interval measurement • 612  
displaying • 154, 155  
embryo • 304  
exporting • 612  
heart rate measurement • 613  
lens radius measurement • 343  
linear contrast region measurement • 603, 604, 606  
linear distance measurement • 614  
locking • 308  
LV wall measurements • 347, 350, 352, 354, 355, 357, 601, 603, 615, 617, 619  
M-Mode chain measurements • 305, 418  
modifying contours • 304  
modifying points on • 303  
modifying properties of • 300  
packages preferences • 148

photoacoustics region measurement • 620  
 preferences • 148  
 pressure-volume measurement loops • 345, 419  
 protocol measurements adding • 298  
 description of • 297  
 single point measurement • 622  
 strain rate measurements • 347, 350, 352, 354, 355, 357  
 time interval measurement • 623, 625  
 traced distance measurement • 625  
 troubleshooting • 745  
 units • 299  
 velocity measurement • 626  
 VTI measurements • 628, 629  
 workspace • 293  
 zooming into • 307

**M-Mode**  
 acquisition settings • 412  
 adding generic measurements • 416  
 adding measurement chains • 418  
 control panel controls • 409  
 measurement chains • 305  
 overview • 114  
 pressure-volume measurement loops • 345, 419  
 setting the region of interest • 415  
 troubleshooting • 742  
 typical acquisition session • 413  
 workspace • 405

**Mode settings** presets • 167  
 creating • 266  
 modifying • 267  
 selecting • 267

**monitor** • 42, 175

**Multiplexer Control** • 84, 379, 385, 398

**N**

**NanoStepper** sub-mode (in PA-Mode) • 374  
 generating in 3D • 400  
**Oxy-Hemo** sub-mode (in PA-Mode) • 380  
 viewing wavelength images as color layers • 84, 398

**network drive mapping** • 181, 184

**Nonlinear Contrast Mode**  
 typical acquisition session • 544

**O**

on/off, powering the system • 123  
**operators**  
 adding • 194, 195  
 deleting • 197  
 modifying • 196  
 passwords • 197  
 profiles • 194

**ophthalmology measurement package**  
 annotations • 314  
 lens radius measurement • 343  
 optimizing for imaging tissue • 337

**OxyZated** • 396, 750

**P**

**packages** • 20, 631, 650, 670, 671, 673

**PA-Mode**  
 acquiring 3D images in • 390  
 acquiring images in • 359  
 acquisition settings • 367  
 changing display layout for • 389  
 control panel controls for • 365  
 overview • 113  
 preferences • 139  
**sub-modes**  
 changing laser wavelength in • 392  
 typical acquisition session - **NanoStepper** • 374, 398  
 typical acquisition session - **Oxy-Hemo** • 380, 396  
 typical acquisition session - Single • 370  
 typical acquisition session - **Spectro** • 385  
 workspaces • 84, 360

passwords • 197, 223

physiological alarm levels • 144  
 physiological settings • 269, 271  
 connecting blood pressure equipment • 270  
 display • 141, 143, 144, 271, 272, 273, 276, 278, 291  
 sources • 269  
 troubleshooting • 744

**Power 3D-Mode** • 517

**Power Doppler Mode**  
 acquisition settings • 513  
 adding generic measurements • 519  
 control panel controls • 510  
 overview • 116

- Power 3D-Mode • 517
- troubleshooting • 743
- typical acquisition session • 515
- workspace • 505
- preferences
  - Annotation tab • 159
  - applications • 164
  - cine loop size • 131
  - Contrast Mode • 138
  - General tab • 130
  - image export • 134
  - institution name • 130
  - Maintenance tab • 172
  - measurement packages • 20, 148, 154, 155
  - Measurement tab • 148
  - mode settings • 167
  - mode window/scout window sizes • 136
  - Network tab • 181
  - Operator tab • 146
  - PA-Mode tab • 139
  - physiological alarm levels • 144
  - physiological display • 141, 143, 144
  - physiological live display • 143
  - Presets tab • 162
  - PW Doppler Mode scale • 137
  - System tab • 179
  - presets • 162
  - pressure-volume measurement loops • 345, 419
  - protocols
    - abdominal aorta and inferior vena cava • 673
    - adrenal glands • 639
    - AoV flow • 664
    - ARCH • 662
    - carotid arteries • 676
    - female reproductive • 641
    - femoral arteries • 685
    - gallbladder • 636
    - iliac arteries • 682
    - innominate and subclavian arteries • 680
    - kidney • 637
    - liver • 631
    - male reproductive • 645
    - mammary gland • 649
    - mesenteric arteries • 674
    - MV flow • 666
    - ophthalmology • 672
- other artery measurements • 691
- pancreas • 641
- placenta • 671
- PSLAX • 650
- renal arteries • 690
- RV diastolic • 667
- saphenous arteries • 687
- SAX • 655
- Simpson's • 662
- spleen • 635
- TV flow • 669
- umbilical arteries • 688
- uterine horn • 670
- PW Doppler Mode
  - acquisition settings • 441
  - adding generic measurements • 449
  - automatic waveform tracing • 450
  - blockout zone • 445
  - control panel controls • 436
  - overview • 115
  - PW Tissue Doppler Mode • 447, 448
  - scale preferences • 137
  - setting the sample volume • 444, 445
  - troubleshooting • 742
  - typical acquisition session • 443
  - workspace • 432
- PW Tissue Doppler Mode • 447, 448
- Q**
  - quick-start tutorial • 72
- R**
  - reconstructing AM-Mode • 426
  - reports • 319
  - resolution tool • 622
  - respiration gating • 276
  - RF-Mode
    - typical acquisition session • 590
- S**
  - saving • 133, 282, 284
    - safety eyewear • 61
  - segmentation • 517
  - series • 119, 218, 230
    - closing • 233
    - creating • 230
    - deleting • 233
    - managing • 217
    - modifying • 231
  - single point measurement • 622
  - Single sub-mode (in PA-Mode) • 370

Spectro sub-mode (in PA-Mode) • 385, 401  
measuring region changes in • 401  
Standard Mode  
fundamentals • 187  
managing users in • 194, 195, 196, 197  
starting a session in • 126  
switching to, from User Management Mode • 192  
status bar • 92, 190, 291  
strain rate measurements • 347, 350, 352, 354, 355, 357  
studies • 119, 218, 219  
copying • 252  
creating • 219, 220  
deleting • 254  
finding • 221  
importing • 255  
locking • 222  
modifying • 222  
passwords • 223  
sharing levels • 92, 96, 119, 189, 190, 222, 224, 225, 751, 752  
study browser  
exporting from • 240, 243, 246, 247, 249  
working with images in • 235, 236, 237, 238  
working with series in • 230, 231, 232, 233  
working with studies in • 219, 220, 221, 222, 223, 224, 225, 227, 228  
workspace • 92  
study sharing levels • 92, 96, 119, 189, 190, 222, 224, 225, 751, 752  
sub-modes in PA-Mode • 370, 374, 380  
support, contact information for • 732

## T

technical support • 732  
TGC sliders settings - saving and applying • 108  
Threshold • 484  
time interval measurement • 623, 625  
traced distance measurement • 625  
transducer arrays  
applications • 164  
available models - Vevo LAZR • 56  
connecting • 260, 263  
front ports • 32, 260

orienting for 3D-Mode • 467  
remotely positioning • 393  
storing • 259  
troubleshooting • 740

## U

ultrasound system  
air filters • 736, 737  
cart • 25, 36, 39, 40, 41, 42, 43  
cautions • 725  
disposing • 736  
front view • 39  
logging on • 120, 125, 126  
moving and cleaning • 733  
quick start tutorial • 72  
rear view • 32, 262  
servicing • 732  
technical support • 732  
turning on/off • 120  
Vevo Imaging Station • 69  
Vevo LAB • 45, 290  
warnings • 28, 58, 59, 61, 64, 720

upgrading software

preferences • 172  
usage log • 208, 210, 212, 214  
backing up • 212  
enabling • 210  
exporting • 212  
purging • 214

user groups • 204, 205, 752

User Management Mode

fundamentals • 92, 187, 188, 189, 190, 751, 752  
logging in to and out of • 126, 127  
login window workspace • 76  
managing users in • 199, 201, 202, 204, 205, 206  
switching to, from Standard Mode • 191

users • 119

adding • 195, 201  
exporting and importing • 146  
managing, in Standard Mode • 194  
managing, in User Management Mode • 199

## V

vascular measurement package  
annotations • 314  
velocity measurement • 626  
Vevo 1100 • 20

Vevo 2100 • 22, 26, 41, 66, 131, 717  
Vevo Imaging System  
    component descriptions • 25, 26, 28,  
        30, 31, 32, 36, 37, 39, 40, 41, 42,  
        43, 45  
    configurations A and B • 30, 31, 42,  
        740  
    connections • 32, 66  
    control panel keys and controls • 693  
    maintenance and tech support • 732,  
        733  
    overview • 20  
    transducers • 37, 259, 260, 263  
Vevo LAB • 45, 290  
Vevo LAZR  
    cable connections • 66, 67  
    cart • 49, 61, 66, 67, 123  
    component descriptions • 46, 47, 49,  
        52, 56, 58  
    LAZRTight • 52  
    safety • 58, 59, 61, 64  
    transducers • 56, 260, 393  
    turning on and off • 123  
VevoColor • 317  
VevoStrain • 347, 350, 352, 354, 355,  
        357  
VTI measurements • 628, 629

## **W**

warnings • 28, 58, 59, 61, 64, 720  
workspace descriptions • 78, 84, 92, 96,  
        103, 288, 293, 309, 326, 360, 398,  
        405, 432, 461, 489, 505, 524

**VISUALSONICS**

a subsidiary of SonoSite

**3080 yonge street suite 6100  
box 66 toronto canada M4N 3N1  
T > +1.416.484.5000  
F > +1.416.484.5001  
E > [info@visualsonics.com](mailto:info@visualsonics.com)  
W> [www.visualsonics.com](http://www.visualsonics.com)**

