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## Technical Specifications

Vevo<sup>®</sup> LAZR Photoacoustic  
Imaging System





## Vevo<sup>®</sup> LAZR Photoacoustic Imaging System

Vevo LAZR Photoacoustic Imaging technology is a ground-breaking, commercially-available photoacoustic micro-imaging system (20 to 55 MHz) for preclinical research. This technology inherently co-registers high sensitivity optical information with *in vivo* high-resolution anatomical targets providing unique, never-before-seen insight into study of the tumor microenvironment, hypoxia, metastasis and much more. In conjunction with multispectral imaging, 2D and 3D imaging, and sophisticated analysis software, the Vevo LAZR system is an ideal solution to study detailed anatomical targets by leading researchers worldwide.

Vevo LAZR Imaging System – a fully Engineered Photoacoustic dual modality system, integrating photoacoustics with high-frequency ultrasound.

- Product Name: LZ-SYSTEM-120 (120V), LZ-SYSTEM-230 (230V), LZ-SYSTEM-100 (100V)

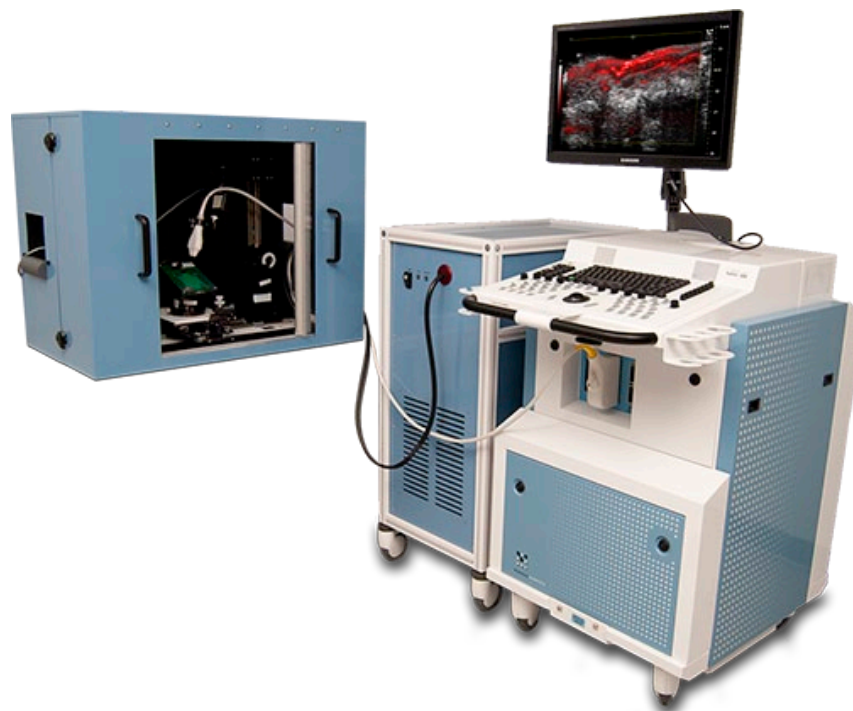


Figure 1: Vevo LAZR imaging system with PhotoTight<sup>™</sup> animal enclosure box



## **Features:**

- **Real-time *in vivo* Anatomical, Functional, Physiological and Molecular Data from a single platform with inherent co-registration**

The Vevo LAZR Photoacoustic Imaging System/Solution enables researchers to obtain Anatomical, Functional, Physiological and Molecular data simultaneously and in real-time (5-20 Hz), with resolution down to 45 microns, with one system. Unlike other imaging platforms that offer acceptable results when attempting to image static anatomical structures, the Vevo LAZR Photoacoustic Imaging System allows for acquisition of dynamic processes in real-time as well.

These unique features enable both anatomical and dynamic imaging, in a single platform and translate into increased user efficiency and improved cost effectiveness for the laboratory.

The Vevo LAZR system offers inherent co-registration of photoacoustic signal with anatomical targets in high-resolution and in real-time. Co-registration enables researchers to identify very specific regions of interest based on either or both anatomical structures and photoacoustic signals.

Co-registration functionality is particularly relevant for the early detection of orthotopic tumors and detailed study of vascular dynamics in the tumor microenvironment.

- **Applications with Endogenous Photoacoustic Signal: HemoMeaZure™ Tool and OxyZated™ Tool for analysis of hemodynamics**

HemoMeaZure enables researchers to measure the total hemoglobin content (HbT) within a particular anatomical target using the PA-Mode. The Oxygen saturation (sO<sub>2</sub>) of hemoglobin within defined anatomical targets down to the level of the microenvironment is measured with the OxyZated tool.

- **Multispectral Photoacoustic Imaging (multiplexing) with NanoStepper™ Controller and Digital RF export**

NanoStepper™ functionality on the Vevo LAZR Photoacoustic Imaging System allows the operator to adjust the output laser wavelength in nanometer increments and export of the co-registered photoacoustic and anatomical information in digital RF, image, and video formats.

This advanced imaging method is crucial for researchers studying multiple contrast agents simultaneously as well as to increase the signal to noise ratio. Studies would include discerning blood vessels from lymphatic tissue and identifying, for example, specific cell populations in the tumor microenvironment with targeted molecular agents.



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- **Image-guided injection, fine needle aspiration biopsy, minimally invasive resection**

Real-time signal acquisition enables the assessment of fast-acting therapeutics such as vascular disrupting agents, physiological dynamics including blood flow and assessment of vascular integrity, and interventional procedures. For example, following identification of sentinel lymph nodes fine needle aspiration biopsy can be conducted with confidence and accuracy. Such a minimally invasive approach permits longitudinal study and assessment of tumor progression/regression.



### Benefits of Vevo LAZR Technology:

Feature name	Description	Benefit
HemoMeaZure™ Tool	Total Hemoglobin content and quantification	<ul style="list-style-type: none"> <li>Anemia assessment</li> <li>Other applications</li> </ul>
OxyZated™ Tool	Oxygen saturation calculation and quantification	<ul style="list-style-type: none"> <li>Assess hypoxic state of tumor to predict disease burden</li> <li>Fetal/maternal physiology</li> <li>Stroke/ischemia</li> </ul>
Contrast applications	Detection and quantification of photoacoustic imaging agents	<ul style="list-style-type: none"> <li>Sentinel lymph node detection (Methylene Blue, Evan’s Blue)</li> <li>Molecular imaging</li> <li>Cellular specificity</li> </ul>
NanoStepper™ Wavelength Controller	Allows precise adjustment of output laser wavelength	<ul style="list-style-type: none"> <li>Allows optimal wavelength to be used for various absorbing structures or contrast agents</li> </ul>
Digital RF-Mode export capability	Allows for data export from multiple wavelengths in formats that can be analyzed in MATLAB	<ul style="list-style-type: none"> <li>Allows multispectral photoacoustic analysis</li> <li>Allows for custom and sophisticated image processing</li> </ul>
Multispectral photoacoustic capabilities (multiplexing)	Imaging and consolidation of data from multiple wavelengths	<ul style="list-style-type: none"> <li>Reduction of background noise</li> <li>Improved SNR</li> <li>Imaging of multiple contrast agents</li> </ul>
Simultaneous mode, overlay	Allows anatomical imaging and photoacoustic imaging simultaneously and/or independently	<ul style="list-style-type: none"> <li>Identification of anatomical targets in high-resolution with inherently registered high-sensitivity photoacoustic data</li> <li>Positional information of signal in real-time</li> </ul>
Live 3D-Mode with real-time visualization or reconstruction	Real-time updating of 2D image for visualization and acquisition	<ul style="list-style-type: none"> <li>Control of imaging volume for precise analysis</li> <li>Volumetric acquisition</li> <li>Review, analysis, and export of 3D data sets</li> </ul>
Respiration gating capability	Acquisition gated to defined time points within the breathing cycle	<ul style="list-style-type: none"> <li>Improves or eliminates motion artifact due to breathing</li> <li>Particularly useful for abdominal imaging</li> </ul>
Presets, preferences, display maps	Optimized parameters for various imaging applications	<ul style="list-style-type: none"> <li>Ready-to-use, one-touch imaging presets</li> <li>Control and adjustment of presets</li> <li>Creation of new presets</li> <li>Customized workflow</li> </ul>

**Table 1: Benefits of Vevo LAZR technology**



## Product Specifications:

### (A) ENVIRONMENTAL SPECIFICATIONS:

Temperature: 10°–40°C (50°–104°F)

Relative Humidity: 15–80% non-condensing

Supported AC line voltages, rated at 50/60Hz frequency: 100V / 120V / 230V

### (B) SYSTEM WEIGHT AND DIMENSIONS:

- Vevo LAZR Imaging System:

Height (without monitor): 107 cm (42 in.)

Height (with monitor): 150 cm (59 in.)

Width: 119\* cm (46.8 in.)

Depth: 109\* cm (43 in.)

(\* ) System is offered as two rolling carts. Dimensions provided are a combination of the two.

- Vevo LAZR Imaging Solution:

Height: 76 cm (30 in.)

Width: 48 cm (18.9 in.)

Depth: 109 cm (43 in.)

Solution requires a Vevo 2100 system install in the laboratory

### (C) PHOTOACOUSTICS PERFORMANCE:

System Dynamic Range (DR): 70 dB

Signal to Noise Ratio (Photoacoustic signal) SNR: 20dB +/- 10dB

Data acquisition time:

- 2D : 0.2 seconds\*

- 3D : 74 seconds (10 mm)\*

\*full field of view (14–23 mm wide)



Photoacoustic Penetration Depth: 1 cm

Contrast Sensitivity: 521 nM of Methylene Blue

(D) ELECTRICAL SPECIFICATIONS (LASER):

- Tunable Laser
  - Type: Flashlamp pumped Q-switched Nd:YAG laser with optical parametric oscillator (OPO) and second harmonic generator
- Frequency: 20 Hz
- Wavelength: 680-970 nm
- Step size: 2 nm
- Pulse duration: 4-6 ns
- Peak Energy\*: 45 mJ +/-5 mJ (at 20Hz)
- Spot size: 24 mm<sup>2</sup> (1 mm x 24 mm)

(E) SOFTWARE

**Standard software:**

- Photoacoustic Mode: PA-mode
  - Analysis software package for PA-Mode (3D) image capture and analysis
  - PA-Mode for 2D detection and analysis
  - Cineloop image capture, display and review
  - Measurements/calculations & annotations
    - HemoMeaZure™ Tool: Hemoglobin content and quantification
    - OxyZated™ Tool: Oxygen saturation calculation and quantification
  - Integrated physiological trace, which includes:
    - Display of ECG, Respiration Waveforms and body temperature (for adult rodents) (Requires Advanced Physiological Monitoring Unit (SA- 11426))
- B-Mode:
  - Analysis software package for B-Mode (2D) image capture and analysis
  - Cine Loop image review, capture and display
  - Software analytics for advanced measurements & annotations
  - ECG on-screen trace

**Optional software:**

VS-11954	<b>ECG-Triggered</b> <ul style="list-style-type: none"> <li>- with <b>Respiration Gated Analysis</b></li> <li>- <b>ECG-Triggering</b> not available with PA-mode</li> </ul>
VS-11948	<b>M-Mode</b> <ul style="list-style-type: none"> <li>- Motion Mode, single line acquisition allowing high temporal resolution for LV functional analysis.</li> </ul>
VS-11949	<b>PW Doppler Mode</b> <ul style="list-style-type: none"> <li>- Pulsed-Wave Doppler Mode acquisition for blood flow velocity and waveform measurements using advanced digital signal Processing techniques.</li> </ul>
VS-11950	<b>PW Tissue Doppler Mode</b> <ul style="list-style-type: none"> <li>- Display lower velocity signals like LV muscle for assessment of diastolic dysfunction using advanced digital signal Processing techniques.</li> <li>- <b>Requires</b> PW Doppler Mode (VS-11949)</li> </ul>
VS-11951	<b>Color Doppler Mode Color Doppler Mode</b> <ul style="list-style-type: none"> <li>- 2D and 3D Color Flow acquisition for blood flow velocity analysis using advanced digital signal Processing techniques.</li> <li>- <b>Requires</b> PW Doppler Mode (VS-11949)</li> </ul>
VS-11995	<b>Digital RF Mode</b> <ul style="list-style-type: none"> <li>- Allowing for the capture and export of "RF Mode" data in digital formats from the Vevo LAZR system.</li> </ul>
VS-11952	<b>Power Doppler Mode</b> <ul style="list-style-type: none"> <li>- 2D and 3D Power Doppler acquisition for the visualization of slow velocity flow and relative quantification of smaller vessels using advanced digital signal Processing techniques.</li> <li>- <b>Requires</b> PW Doppler Mode (VS-11949)</li> </ul>
VS-11953	<b>Contrast Imaging Functionality</b> <ul style="list-style-type: none"> <li>- Acquisition and analysis tools using MicroMarker™ Contrast Imaging.</li> <li>- Perfusion Analysis using destruction/reperfusion quantification.</li> <li>- Biomarker quantification tools when using MicroMarker™ Target- Ready Contrast Agents.</li> </ul>
VS-11955	<b>LV Analysis</b> <ul style="list-style-type: none"> <li>- Improved and repeatable LV function analysis.</li> <li>- Integrated Blood Pressure analysis tools</li> </ul>
VS-11846	<b>VevoStrain™ Software</b> <ul style="list-style-type: none"> <li>- Analysis suite provides tools for myocardial strain, strain rate and time-to-peak analysis.</li> <li>- This feature also includes dynamic assessment of myocardial velocity and displacement.</li> </ul>
VS-12176	<b>VevoCQ™</b> Advanced Contrast Quantification Post Processing Software for perfusion and targeted signal analysis. <ul style="list-style-type: none"> <li>- Perfusion parameters (including amplitude and time) derived from a curve fitting algorithm for bolus kinetics and replenishment kinetics following destruction reperfusion.</li> <li>- Spatial rendering is available in the form of parametric maps.</li> <li>- Data can be exported in .tiff, .bmp, .wmv files and .tsv formats.</li> <li>- Requires Contrast Imaging Functionality (VS-11953).</li> </ul>





#### (F) DATA MANAGEMENT AND EXPORT

The Vevo LAZR system includes the following standard outputs:

- USB 2.0 (3)
- S-Video
- DVSI
- Ethernet
- Firewire
- 3D Motor
- Physio Data
- TX Trig

The following formats are supported for data, image and video exports:

- Data formats: CSV, TXT
- Image formats: TIFF, BITMAP, DICOM compatible
- Video formats: AVI, GIFF, DICOM compatible

#### (G) SYSTEM SPECIFICATIONS

- Monitor (available with Vevo LAZR system only):
  - o 22" LCD Color Monitor with articulating arm
- Network: 100 Mb Ethernet Connection
- Storage: 250 GB HD
- DVD-Reader/Writer

#### (I) PHOTOTIGHT™ IMAGING STATION

System Weight and Dimensions:

- Height: 67 cm (27 in.)
- Width: 99 cm (39 in.)
- Depth: 56 cm (22 in.)

Detailed Description: LAZRTight™ Enclosure is a laser sealed enclosure with a special viewing window that allows the user to safely monitor the experiment, even when the laser is firing. The set-up provides encapsulation of the Imaging Station and the LZ Series Transducer, allowing for maximal system performance for image and data acquisition. The imaging station contains:

- Vevo animal handling platform
- Physiological monitoring capabilities
- LED lights with dimmer switch
- Ventilation system
- Integrated anesthesia system
- Detachable front
- Interior electrical outlet
- Webcam mount



The animal handling platform is comprised of the following components:

- Bench-mounted adjustable rail system custom designed for small animal handling and positioning..
- Fully adjustable Lazer transducer (LZt) stand and mount.
- Lazer transducer (MSt) adaptor.
- Adjustable X,Y, and Z positioning system for Vevo Ball Joint.
- Vevo Injection Mount, micro-manipulation controls and rail system extensions.
- Y-Axis stage adjustment.
- Universal Power Supply Kit (UPS 120V: SA-11208, UPS 100V: SA-11210, UPS 230V: SA-11209).
- Short Imaging Ball Joint unit (SA-11179) for easy movement and manipulation of the animal and mounting of the small animal table.
- Mouse Handling Table (SA- 11436) or Rat Handling Table (SA-11550)
- Advanced Physiological Monitoring Unit (SA-11426) to monitor animal temperature, ECG, heart rate and blood pressure (requires external pressure input).

(J) LZ SERIES TRANSDUCERS: Integrated fiberoptic linear array transducers

Unique imaging objectives require unique approaches. There are a variety of LZ Series Transducers with specific properties for use with the Vevo LAZR Photoacoustic Imaging System, each optimized for a particular imaging protocol. The LZ Series Transducers have 256 elements for detection, enabling fast, real-time acquisition. The following configurations are currently available with the Vevo LAZR system:

1. Vevo LZ550 transducer

Axial resolution: 44  $\mu\text{m}$   
Broadband frequency: 32 MHz-55 MHz

2. Vevo LZ250 transducer

Axial resolution: 75  $\mu\text{m}$   
Broadband frequency: 13 MHz-24 MHz

Transducers with alternate center frequencies are expected to be available in the future.

\*Information contained in this document is preliminary and is subject to change

**Need more information?**  
**Call us toll-free at 1-866-416-4636 (North America) or +1-416-484-5000 (other regions) or contact us via email at [photoacoustics@visualsonics.com](mailto:photoacoustics@visualsonics.com)**