Verasonics®

The leader in Research Ultrasound™

The Vantage™ Systems

256™, 128™, 64 *LE*™, 64™ and 32 *LE*™

A Revolutionary Approach to Ultrasound System Architecture

Verasonics has developed a revolutionary ultrasound system architecture that provides researchers and developers a unique, flexible platform for ultrasound innovation across many applications. The Vantage Research Ultrasound Platform uses proprietary hardware and software technologies to provide direct access to raw ultrasound data, while preserving the ability to perform high quality real-time imaging with custom software, at clinically useful frame rates. The design features that make the system so capable in medical ultrasound R&D also provide significant advantages to the NDT/NDE, Geophysical and Geotechnical, and Educational disciplines as well.

Unparalleled Flexibility and Speed

The Vantage system is designed to provide the researcher/developer with broad flexibility in defining each of the system's functional components, using a familiar and powerful software interface based on the MATLAB® programming environment. In fact, a single researcher can conceive, implement, and evaluate a new approach to medical ultrasound imaging, and ultrasound therapy monitoring or delivery using the Vantage system. From integration of a custom transducer array to incorporation of a custom beamformer, or adding user-defined image processing algorithms, the researcher can develop their own ultrasound system prototype and evaluate it under laboratory or clinical conditions with unprecedented speed.

All-Software Beamforming and Sequence Control

Verasonics' system architecture provides this flexibility to the researcher by eliminating hardware beamformers, and instead uses patented algorithms to perform image reconstruction with highly optimized software, running on a desktop or laptop computer. Consequently, many new acquisition schemes using unconventional transmit beams and transmit/receive sequences can be readily examined using the Vantage system, whereas such approaches typically cannot be implemented using conventional data flow architectures that are based on hardware beamformers.

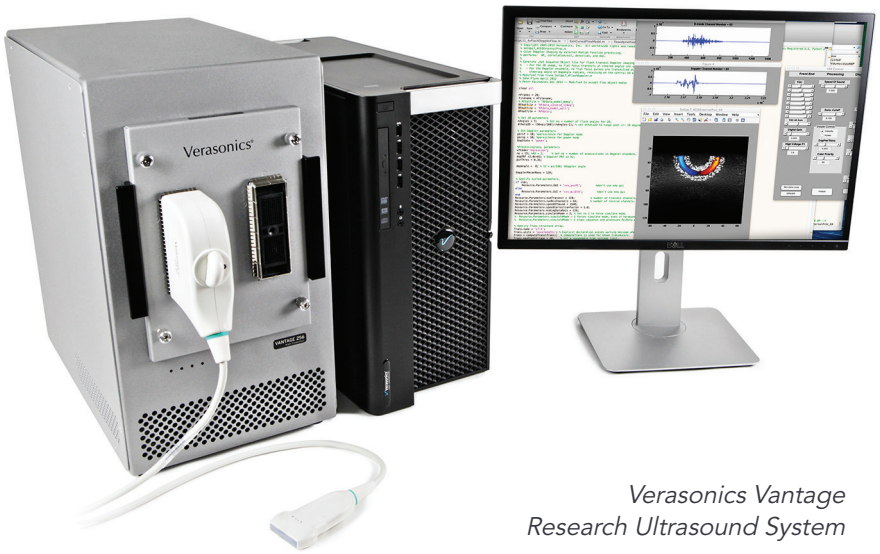
Verasonics' Unique Technology Advantages

The Vantage Systems are comprised of 3 fundamental components:

- The Vantage Data Acquisition system, with state of the art hardware and unparalleled performance, available in several different configurations and with optional features
- The Host Controller purchased through Verasonics. This powerful computer is equipped with a PCI express adapter card, the MATLAB application, custom BIOS, and other libraries and utilities pre-installed by Verasonics.
- The Verasonics Data Acquisition Software (SW) package provided by Verasonics, including application-level SW, HAL and driver-level SW, installation and self-test utilities to verify full hardware system performance. Also included is a comprehensive suite of example scripts.

Together these provide:

- An open, software-based research ultrasound platform
- Highly parallelized software beamforming using proprietary, Pixel-Oriented Processing
- Very high frame rate imaging using plane wave transmit beams
- Data acquisition into local memory limited by acoustic travel time, up to 100,000 frames/second
- Extremely rapid RF signal data transfer to host computer.



Verasonics Vantage Research Ultrasound System

- Well documented, flexible and easy-to-use programming API
- Familiar MATLAB scripting environment for development of custom user algorithms and graphical interfaces
- Additional software tools to facilitate control script development, analysis, and debugging
- Rapid integration of custom transducers
- A set of over 200 example control scripts (programs) for various transducers and applications, including plane wave imaging, color flow and power Doppler, spectral Doppler, conventional line mode imaging, harmonic imaging, pulse inversion, radiation force and shear wave visualization, coded excitation, and many others. These can be modified or replaced by the user to create novel algorithms.
- Real-time system simulator for offline development and reprocessing of previous acquired data.

Key System Specifications of the Vantage Platforms

Intended use

- The system is designed for ultrasound research rather than routine diagnostic use.
- It is intended to be used as a research laboratory tool to acquire, store, display and analyze data

Acquisition Module The Vantage System is available in five models with several optional configurations:

	Vantage 32 *LE*™	Vantage 64™	Vantage 64 *LE*™	Vantage 128™	Vantage 256™
Channels					
	64 Tx / 32 Rx	64 Tx / 64 Rx	128 Tx / 64 Rx	128 Tx / 128 Rx	256 Tx / 256 Rx
Configurations					
Standard Frequency (0.5 MHz – 27 MHz)*	✔	✔	✔	✔	✔
High Frequency (1 MHz – 50 MHz)	N/A	N/A	✔	✔	✔
Low Frequency (50 kHz – 1.5 MHz)	✔	✔	✔	✔	✔
HIFU (External Power Supply)	N/A	N/A	✔	✔	✔
Licensable Options					
Extended Transmit	N/A	N/A	✔	✔	✔
Arbitrary Waveform	✔	✔	✔	✔	✔
Synchronization Triggers	✔	✔	✔	Included	Included
Image Reconstruction	✔	✔	Included	Included	Included

✔ = purchasable configuration or option. All Vantage systems can be reconfigured or upgraded to additional options.

* = higher receive frequencies possible with filter adjustment

Transmit:

- Frequency Range: 0.5 MHz to 20 MHz with standard configuration*
  - 2 to 42 MHz with High Frequency configuration*
  - 50 to 1500 kHz with Low Frequency configuration*
- Time delay resolution: 4.0 ns
- Programmable pulser voltage: 2 to 190 V p-p
- Tri-state drive: + high voltage, - high voltage and ground (all at same low impedance)
- Per-channel, programmable center frequency, pulse width (burst duty cycle), burst length, polarity and delay
- Per-channel transmit apodization using pulse width modulation
- Max burst length (without Extended Transmit option): typically 5-10 microseconds (depends on transmit parameters)
- Power limit, single channel: up to 100 Watts peak, 8 Watts average (into 50 Ohms)

Transmit Options:

- Extended Transmit option: Enables long bursts for radiation force methods and for long coded excitation pulses, up to a few milliseconds.
- Arbitrary Waveform: Per-channel programming of tri-state transition timing on a 4 ns grid (includes analog waveform design tool)
- HIFU option: Enables transmit operation with up to 1200 W continuous average RF power output

Receive:

- Frequency range: 0.5 MHz to 50 MHz with standard configuration.*
  - 1 to 50 MHz with High Frequency configuration* (Also includes programmable high pass filter).
  - 50 to 1500 kHz with Low Frequency configuration*
- Programmable anti-aliasing filter cutoff: 5, 10, 15, 20, 30 MHz, (35, 50 MHz with High Frequency configuration)
- 14 bit A/D converters with programmable sample rate up to 62.5MHz
- Two independent, user-programmable, symmetrical RF data digital filters (23 tap and 41 tap)
- Transmit / receive clock jitter: less than 4ps RMS
- Noise Figure: 1.5 to 3.0 dB over programmable input impedance range of 115 to 3000 Ohms (for 100 Ohm probe impedance)
- Data acquisition into local memory limited only by acoustic travel time, up to 100,000 frames/second

External Synchronization:

- Two trigger inputs and one trigger output
- Master clock input and output for phase locked operation of multiple systems
- Standard feature on the Vantage 256 and Vantage 128; Optional on the Vantage 64 *LE*, Vantage 64 and Vantage 32 *LE*

Local buffer memory for RF acquisitions:

64 MB/channel. Digital averaging, filtering, and decimation may be performed on data prior to transfer to host computer to

improve signal to noise and reduce data bandwidth
Per Channel RF signal accumulation (>1000 acquisitions)

Data transfer to host computer via 8 lanes PCIe 3.0: sustained data transfer rates up to 6.6 GB/s

Pixel-Oriented Processing image reconstruction supports high frame rate plane wave imaging for large field of view shear wave elastography and microvascular flow visualization.

Universal Transducer Adapter permits rapid transducer connector change (requires computer restart)

Adapter Options:

UTA 260 Adapters, with single and dual connectors

- Support for Verasonics probes (see below)
- Also compatible with most ATL HDI 1000, 1500, 3000 and 5000 transducers, including 192- and 256-element probes with high voltage multiplexers. (Example scripts are available for most transducers)
- A 260-MUX UTA is available for the Vantage 64 and Vantage 32 *LE* to support probes with up to 128 elements.

UTA 360 Adapter (256-ch systems, enables compatibility with selected VisualSonics MS-series transducers)

UTA 408 Adapter (128-ch and 256-ch systems, HIFU and high frequency transducers)

UTA 408-GE Adapter (enables compatibility with GE transducers that use the 408 contact connector)

UTA 156-U provides compatibility with UltraSonix transducers

1024-MUX 1024 element connectivity with MUX for high-element count arrays.

UTA 256 Direct, for custom transducers with up to 256 elements

Computer

- Host controller computer configured and provided with system purchase. GPU compatible model available.
- Windows® operating system
- MATLAB with Signal Processing Toolbox installed and configured (MATLAB *user license not included*)

System Control, Simulation and Documentation

- System software includes MATLAB scripts to control Verasonics proprietary beamforming and image processing algorithms, and an extensive collection of biomedical ultrasound imaging example scripts for Verasonics probes and commonly available (used) ATL HDI ultrasound probes
- Individual channel acquisition data and complex reconstruction data available in MATLAB workspace for storage and offline processing, or for custom inline processing in real-time
- User-provided MATLAB callable functions (m-functions or compiled 'mex' files, including GPU code) can be executed in real-time
- Built-in point scattering simulation software for evaluating and verifying acquisition and processing sequences; includes transmit beam visualization and script analysis tools. Enables simulation of experiments without acquisition hardware, and facilitates the testing and debugging of scripts.
- Documentation includes a Vantage system user guide, an extensive programming reference manual, and a programming tutorial

Available Options and Accessories

- **Extended Transmit ("extended burst" or "push") Option:** Increases the high voltage power supply's capability to support long burst sequences up to several milliseconds for shear wave elastography and acoustic radiation force applications. Not available on the Vantage 64
- **HIFU configuration**: (includes Extended Transmit option) Includes additional hardware and an external power supply for extended transmit operation up to 1200W continuous average RF power output. (Vantage 256, 128, and 64*LE* systems only.) Provides support for HIFUPlex transducers.
- **Arbitrary Waveform Generation Package**: (includes Extended Transmit option) – Permits user-defined sequences of tri-state transitions that can be programmed independently per-channel at 4 ns intervals (250 MHz clock rate) – GUI-based analog waveform design tool kit included
- **Signal Breakout Board:** Printed circuit board adapter that plugs into the 260-pin system connector and provides 0.1" headers for ribbon cable connection to custom transducers. Also includes some space for impedance matching elements. Symmetric boards for left and right connectors on dual 260-pin connector Vantage 256 system
- **Verasonics 260-pin Transducer Backshell Kit:** For up to 128 channels. Available to customers who are developing their own transducers, and/or those who want to integrate commercial transducers and have the pin-out information. Available with zero Ohm tuning or unpopulated with pads for tuning elements.
- **Verasonics 408-contact Transducer Backshell Kit:** As above, but with connections for up to 256 channels, and additional power supply and digital control signals.
- **Multi-System Synchronization Module:** provides ability to synchronize 2-8 Vantage systems (up to 2048 channels) to within 2 ns phase offset.
- **260-pin offset adapter:** provides test access to RF signals during signal transmit and receive operation.

Verasonics®

The leader in Research Ultrasound™

The Vantage™ Systems

256™, 128™, 64 *LE*™, 64™ and 32 *LE*™

- **Verasonics transducers:**
  - **P4-2v phased array:** 64-element phased array probe
  - **C5-2v curved linear array:** 128-element array probe
  - **L11-5v broadband linear array:** 128-element array probe
  - **L12-3v broadband linear array:** 192-element array probe with HVMux
  - **L22-14vX broadband linear array:** 128-element array probe (also available as the L22-14vXLF - Long Focus - for applications requiring a greater elevation focus depth)
  - **L35-16vX broadband linear array:** 128-element array probe
  - **L22-8v CMUT linear array:** 256-element array probe with HVMux
  - **L38-22v CMUT high frequency linear array:** 256-element array probe with HVMux

Transducers from GE:

- **GE L3-12-D:** 256-element linear array probe with HVMux
- **GE 4C-D:** 128-element curved array probe
- **GE C1-6-D**: 192-element curved array probe
- **GE IC5-9-D:** 192-element intracavitary curved array
- **GE M5Sc-D:** 80x3 elements phased array

Other available specialty transducers:

- HIFUPlex transducers from Sonic Concepts, Inc.
- 1024-element (32x32) Matrix Array Transducers at 3 & 8 MHz

Modes Provided as Examples

All modes and techniques can be performed ***in real-time*** with clinically useful frame rates. These modes can be interleaved as desired ... also in real-time.

- Conventional line mode (one focused beam transmission per scanline)
- Flash imaging (flat phase "plane-wave" imaging)
- Multi-angle flash imaging
- Overlapping beams
- Spatial compounding, frequency compounding
- Pulse inversion harmonic imaging
- Synthetic aperture, and full matrix capture imaging
- Receive-only beamforming (for photoacoustics)
- Very high frame rate acquisition using unfocused transmission
- Very high frame rate "ultrafast"color Doppler
- Conventional color flow and power Doppler
- Plane wave color flow and power Doppler
- Conventional spectral Doppler
- Vector Doppler imaging capable
- Microvascular Doppler
- Wide-area, multi-point spectral Doppler capable
- Ablative HIFU transmission with interleaved imaging
- Shear wave generation and visualization
- Real-time custom application processing on GPU
- High quality image modes
- 3D volume imaging

Additional Modes Implemented by Users on Verasonics Systems

- ARFI - radiation force and push techniques
- Elastography Imaging (e.g., Shear Wave, ARFI)
- Cardiac and vascular pulse wave imaging
- Low MI transmit for microbubble / nanoparticle imaging
- Photoacoustics / optoacoustics
- Radiation force targeting and displacement of kidney stones
- Speckle tracking: motion tracking, thermometry, HIFU monitoring

Safety Certifications

- IEC 61010-1 3rd Edition (2010) and EN 61010-1:2010 3rd Edition
- UL 61010-1: 2012 and CAN/CSA-22.2 No. 61010-1-12

Power Requirements and Physical Dimension

- 100V-240V (50-60 Hz)
- Size (Data Acquisition System) L-49cm (+10cm clearance) W-28cm x H-48cm
- Size (Host Controller) L-42cm x W-18cm x H-47cm
- Total weight of all components: approx. 35-44 Kg depending on configuration

Notes:

Maximum display frame rates may be limited by MATLAB® display software.

*Transmit and Receive performance is limited near frequency extremes

Verasonics Inc.
www.verasonics.com
11335 NE 122nd Way, Suite 100
Kirkland WA 98034
info@verasonics.com
425.998.9836