Vantage™ System Release Notes

VANTAGE SYSTEM RELEASE 4.9.2

Summary

This document summarizes the changes and new features included in the Vantage™ 4.9.2 system release and provides a summary of known issues to be addressed in future releases. The Vantage 4.9.2 system release contains the entire feature set for the 4.9 release and is an all-customer release. The software builds for Vantage system releases 4.9.0, 4.9.1 were internal development builds and were not released to any customers.

For reference, the release notes from the previous Vantage system releases (4.8.4, 4.8.6, 4.8.7) are included in the documentation folder of your Vantage release.

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1. MATLAB® and Host Computer OS Compatibility

The Vantage 4.9.2 System release has been tested for compatibility and full functionality with the versions of MATLAB and host computer Operating Systems as listed in the following sections.

1.1. MATLAB

Verasonics recommends using MATLAB release 2022a, but any MATLAB release from 2020b through 2022a can be used. The 4.9.2 release will not function and will report a fault condition if a MATLAB release older than 2020b is detected. To avoid these problems, simply update your MATLAB installation to 2022a, 2021b, 2021a or 2020b.

For all Vantage software installations, the MATLAB Signal Processing Toolbox is also required. Some of the "specialty applications" included with the Vantage software require the installation of additional MATLAB toolboxes, as explained in the documentation for each of those applications.

1.2. WINDOWS OS

Windows 10 is required for use with the 4.9.2 Vantage software for all system configurations, along with version 12.9.0 of the driver for the hardware system. The driver installation instructions can be found in the "Vantage System User Manual".

NOTE: If you are using the computer in software-only mode with no hardware system connected, changing the driver will not be required when switching between different Vantage software releases.

1.3. macOS®

Verasonics does not support the use of the Vantage system release 4.9.2 with a hardware system under macOS. For a software-only installation, any macOS version from Yosemite (10.10) or newer can be used.

1.4. Linux

For all system configurations using the 4.9.2 software, Ubuntu Version 18.04 LTS is required along with a Linux kernel version in the range 3.19 to 5.18.2, and the installation of driver version 15.0.0 for use with the hardware system.

For software-only installations on a computer that will never be used with a hardware system, installation of the driver is not required.

Accessing Documentation through the Verasonics Community Web Portal

Verasonics provides a growing list of Application Notes and other documentation for our customers through our community web portal. This website is restricted to Verasonics customers and requires a one-time registration. It can be reached by browsing the following URL: https://verasonicscommunity.com/

After signing up and entering the site, please click the Vantage Resource Documents tab to access our list of Application Notes, Manuals, and other helpful documentation about the Vantage system.

2. Feature Updates in the Vantage System Release 4.9.2

For all new features, refer to the Verasonics Community web portal for specific application notes. (Not all release features have an application note in the Community portal.)

https://verasonicscommunity.com/

- Verasonics Permissive License
  - Verasonics has announced the Verasonics Permissive License, which provides customers with improved flexibility for sharing programming scripts developed with the Vantage system.
  - The Verasonics Permissive License allows Vantage customers the right to use, copy, modify, merge, distribute, sublicense, or sell copies of the software with the inclusion of copyright and permission notices.
  - This licensing change offers benefits to researchers on a global basis to:
    - Collaborate with other Vantage researchers,
    - Freely publish programming scripts,
    - Support grant funding requirements.
  - Full license terms can be found in the Vantage 4.9.2 release (see Example_Scripts/LICENSE.txt). This license does not extend to Verasonics software or documentation.

- 15 MHz Row-Column Array
  - The latest Verasonics transducer for volume imaging is a 15 MHz Row-Column Array (RCA) transducer developed in collaboration with Vermon. The RC15gV transducer features orthogonally-oriented arrays of 80 elements each, with a 0.11mm pitch and 80% bandwidth. Example scripts for imaging and simulation support for the transducer with the Vantage 256 Research Ultrasound System are provided, using the UTA 408-GE adapter. This RCA Transducer provides a cost-effective approach for high framerate capture for 3D and volume imaging applications and eliminates the high channel count or multiplexing requirement of matrix arrays.

- General Imaging Transducers
  - Verasonics is offering a new series of general imaging transducers in collaboration with HUMANSCAN to provide more options for research imaging needs. These transducers are suitable for a wide range of biomedical imaging applications using the UTA 408-GE adapter. The 408-pin connector provides improved grounding in comparison to the Canon 260-pin connectors, and Verasonics is adding transducers with this probe connector option so that our research customers have access to the best performance possible.

    - Available models include:
      - L11-5gH Linear Array with 128 elements
      - C5-2gH Curved Linear Array with 128 elements
      - P4-2gH Phased Array with 96 elements

o   These new transducers are compatible with all Standard Frequency and High Frequency configurations of Vantage 256, Vantage 128, and Vantage 64LE using the UTA 408-GE adapter.

3. FUS 2D and 3D Updates in the Vantage System Release 4.9.2

See section 4 - Defects Corrected in the Vantage System Release 4.9.2.

4. Defects Corrected in the Vantage System Release 4.9.2

FUS 3D 3000: Vantage 64LE and 128 now fully compatible for FUS Pairings -01, -02. -03.

FUS 3D 3000: 3D 3000 is fully compatible with the Vantage 64LE with the FUS 3D 3000 Pairings -01, -02, -03. (Issue 6355, 6208)

Errors when creating unique waveforms for each element in a matrix array transducer.

When utilizing a States or PulseCode that contains unique waveforms for each element of the Matrix1024 transducer, an error occurred while running the VSX with previous versions of software. In 4.9.2 release, per-channel waveforms can now be achieved with the UTA 1024-Mux. (Issues 6686, 6351, 6484)

Multisystem: Initial Sync no longer occasionally fails.

Previously, initial sync on multisystem would occasionally fail. With the current release, initial sync is now performing as expected. (Issue 6652, 6633)

QuickScan: GE 9L-D does not image.

In releases prior to 4.9.2, the GE 9L-D reported an error when launching from the QuickScan application. In 4.9.2 QuickScan now images with the GE 9L-D connected. (Issue 6601)

RC6gV Trans.ConnectorES mapping in computeTrans is not correct.

Trans.ConnectorES in computeTrans for the 6MHz RCA from Vermon has four elements that are out of order on the Y side of the array. In 4.9.2 software release, the element-to-channel mappings are corrected. (Issue 6382)

VSX GUI: PreSet save continues transmitting.

While using the VSX GUI, when selecting "Save" under the PreSet menu the "Save PreSet as" window pops up and the imaging window freezes, while the Vantage system is still transmitting as shown by the LEDs. In 4.9.2, selecting freeze, save under PreSets will stop the Vantage system from transmitting. (Issue 6122)

QuickScan: Measurements are editable.

In previous releases, QuickScan measurements (Ellipse, Line, etc.) were editable from within the measurement table without the corresponding lines or shapes being updated. In 4.9.2, selecting within the measurement table disallows editing measurement values.

QuickScan: Max frames is not updated when entire cine buffer is not used.

In previous releases while using QuickScan, if the user freezes the image prior to the system acquiring enough data to fill the cine buffer, the system will put static images at the beginning of the cine buffer prior to getting to the actual cine buffer data. In 4.9.2, the behavior has been updated to only show the number of frames that were acquired by the time Freeze was selected. The max frames value is updated to reflect the actual number of frames acquired if less than the specified. (Issue 6505)

QuickScan: reports no scripts found for GE 4C-D.

In previous releases, QuickScan would report an error of "no scripts were found for connected transducer" when a GE 4C-D transducer was connected. In 4.9.2, QuickScan recognizes GE 4C-D and runs the corresponding scripts. (Issue 6039)

QuickScan: Measurement table does not display units.

In previous releases, QuickScan measurement tables did not include the units. In 4.9.2, the measurement table now includes units for each of the measurement types. (Issue 5979)

QuickScan: Measurement tool labels for major and minor axes confusing.

In previous releases, QuickScan was reporting semi-major and semi-major axes whereas the label stated major and minor axis. In 4.9.2, the system now reports the major and minor axes per the labels. (Issue 5978)

QuickScan: displayed speed of sound value units do not match values.

In previous releases, QuickScan stated speed of sound units were in "m/s" but the displayed range was not in that. In 4.9.2, the displayed range is now in m/s. (Issue 5950)

QuickScan: Capture/Save clears out frame viewer without warning.

In previous releases while in QuickScan, when a user freezes imaging, then selects "Capture/Save" with "Single Frame" selected, the system would clear out all frames of the cine buffer without notifying the user. In 4.9.2, the system will notify a user if they select "Capture/Save" with a "Single Frame" selected and inform them that single frame will replace the current data in the Frame Viewer. (Issue 5939)

QuickScan: L3-12D with GE-408 UTA is not recognized.

In previous releases, while using the GE-408 UTA with the L3-12D, QuickScan reported an error of no scripts found for the connected transducer. In 4.9.2, QuickScan recognizes the L3-12D with available scripts. (Issue 5833)

5. Known Issues in the Vantage System Release 4.9.2

FUS 3D 3000: VSX prompts to reflash the SHI FPGAs on Initial Startup after installation of new Vantage Software release version.

After installing a new Vantage system version (for example, 4.8.4 to 4.9.2), if you run FUS 3D 3000 immediately after activating it in the new installation folder and launching the GUI program by typing `startFUSElite()` at the MATLAB Command prompt, VSX prompts to reflash SHI FPGAs after pressing Start on Initial Setup window. (Issue 5703)

When a new Vantage Software release is installed, ensure that you check for FPGA updates using the steps below:

1. Launch MATLAB and navigate to the Vantage Project folder.
2. In the MATLAB Command Window, type activate, and press ENTER.
3. Type `reprogramHardware` command and press Enter. Pay attention to all the prompts and status updates displayed in the MATLAB Command Window.
4. Note that the reprogramHardware command forces revision checks and updates to all FPGA code files in the Vantage Hardware System and this process may take several minutes to complete.
   Note: Do not interrupt the system while the update process is in progress.
5. Shut down the host controller to a full power-off state—a full power cycle is required for the FPGA file updates to take effect.
6. Shut down the Vantage Hardware System.
7. First power On the Vantage Hardware System and then power ON the host controller.

FUS 3D 3000: Allow reference frame to be taken for negative values of theta

In all Vantage system releases since 4.8.4 in FUS 3D 3000, reference frames and reference scans are limited to positive position values, between 0-179.9 degrees, in the Motion Control. (Issue 5182)

FUS 3D 3000: TSI data is saved but cannot be reloaded in GUI

In all Vantage system releases since 4.8.4 in FUS 3D 3000, TSI monitoring data (located in the Monitoring file in SessionRecord/HIFU_Experiment) can be viewed by using the following commands:

```
filename = 'monitoringData_28_Oct_22 16_21_12.mat'; % example file from monitoring folder
load(filename)
TSI_frames = size(objdata.MonitoringImages,2);
figure,
for ii=1:TSI_frames
    colormap(objdata.MonitoringImages(1, ii).ColorMap )
    imagesc(objdata.MonitoringImages(1, ii).ImageData ,[0 256]),colorbar
    pause(1)
end
```

(Issue 5145)

FUS 3D 3000: Taking a reference scan with a one-degree step size using either Doppler imaging mode throws runAcq error

In all Vantage system releases since 4.8.4 in FUS 3D 3000, acquiring a reference scan while in Doppler imaging mode within a one-degree step size will produce a RunAcq error due to insufficient memory (if host controller has a RAM less than 16 GB). The user will need to use a different step size while in Doppler imaging for a reference scan. (Issue 5171)

FUS 3D 3000: Review State cannot be stopped right now

In all Vantage system releases since 4.8.4 in FUS 3D 3000, while using the Review state of HIFU Treatment the user is unable to stop the animation of the HIFU Treatment review. (Issue 4717)

FUS 3D 3000: Data Tip in XZ plots reads "[X,Y]"

In all Vantage system releases since 4.8.4 in FUS 3D 3000, the XZ plots in both Ref Data Review and HIFU Treatment read [X,Y] but are correct to be [X,Z] coordinates. (Issue 4889)

FUS 3D 3000: Calculate Burst PRF based on Image-Burst Interval and Imaging Mode TTNEB errors

In all Vantage system releases since 4.8.4 in FUS 3D 3000, while performing a HIFU Treatment a user is notified of TTNEB (time to next extended burst**)** warnings with higher Burst pulse repetition frequencies (Burst PRF). This is due to the acquisition data for imaging between bursts takes longer than the interval time between HIFU bursts. For higher Burst PRF frequencies, it may require some trial and error to dial in the settings necessary to achieve the desired result. (Issue 4940, Issue 4954)

FUS 3D 3000: HIFU Treatment mode: RunAcq error in TSI mode if pre and post scan is disabled

In all Vantage system releases since 4.8.4 in FUS 3D 3000, if pre and post scan are turned off on a reference frame or scan using TSI imaging type in HIFU treatment operating mode, a RunAcq error occurs. Workaround is to keep pre and post scan selected during TSI imaging while in HIFU treatment operating mode. (Issue 5137)

Example Script C5-2vWideBeamHISC_64LE does not work

In all Vantage system releases since 4.1, this example script would not function properly, and attempting to use it could cause the system software to crash. It has been removed in the 4.6.2 software release and will be returned in a future release after the defects have been corrected. At that time a comparable example script for the C5-2gH will also be added. (Issue 2737)

System Malfunction with Incorrect Receive Buffer rowsPerFrame

All receive acquisition events are automatically rounded up if needed by the system software, to an integer multiple of 128 samples. As a result, the rowsPerFrame value used to define the receive buffer should also be a multiple of 128, and large enough to accommodate the largest receive buffer to be used while the sequence is running (the size of the receive buffer cannot be changed after the sequence has started). However, we have found that if you mistakenly set rowsPerFrame to a value that is not a multiple of 16, the system will run with no error reported and yet a meaningless corrupted image will be

produced. To avoid this situation, simply make sure you specify Receive Buffer rowsPerFrame as a multiple of 128. Error reporting for this mistake will be added in a future release. (Issue 2630)

NDE GUI Linear Range Colormap values don't match the display

When using the Linear Display Resolution selection, if you adjust the Image Control Linear Range slider to its maximum value of 100, the actual image display will not match the identified color map. This will be corrected in a future release. (Issue 2486)

Misleading Error Condition for empty Recon LUT

To maximize processing throughput, the "Recon" receive beam-forming function operates from a look-up table ("LUT") identifying the processing to be applied to each individual pixel in the reconstructed image. This LUT is created the first time Recon is executed after starting a user script. If the number of pixels to be processed results in a LUT that exceeds the available memory space on the host computer, the system will exit with an error message "out of memory error when allocating Recon LUT". However, this same error message will be reported if the PData region definitions and TXPD processing thresholds have been set such that there are no pixels to be processed at all, resulting in an empty LUT definition. If you encounter this error condition, be aware that it may be an indication that you have no pixels to process at all, rather than that you have too many. This situation is most likely to occur in user scripts that have GUI controls to adjust the TXPD processing thresholds while the script is running. In those scripts it is easy to inadvertently set one of the thresholds such that there are no pixels to be processed, triggering the "out of memory" error condition. In a future release this condition will be reported with a more accurate error or warning message, and possibly Recon will be modified so in the empty LUT situation it simply returns an IQ buffer of all zeros and continues running normally with no error condition reported. (Issue 1743)

MATLAB Crash after Hardware System Fault

If the Vantage hardware system experiences a fault condition while a sequence is running, such as system overheating, transmit power supply over-voltage or overcurrent fault, etc., the system will automatically terminate execution and report the fault. In some cases, we have found that a MATLAB crash may occur as a side effect of the forced termination of the script. Usually, you will still be able to see the error message at the MATLAB command prompt identifying the fault that occurred, but in some cases the MATLAB crash report may cover it. If you encounter this situation, you will need to quit and restart MATLAB to recover. Note that for some hardware system faults, the system will put itself in a "locked down" state and you will have to completely shut down the system to a full power-off state and then restart it to restore normal operation. After a hardware system fault has occurred, it is a good idea to run the "VVT" system self-test to make sure the system is still fully functional. (Issues 2462, 2470)

QuickScan Anomalies

There are some known minor defects with the QuickScan feature in the 4.5.3 release: Changing probes while QuickScan is running may lead to an error condition; to avoid this, close QuickScan and restart it after changing probes (issue 2492). While running an imaging script with QuickScan, if you switch to running a color Doppler script the color region in the image display may be incorrect; to avoid this

don't switch into a color Doppler mode while running QuickScan - close and restart QuickScan to run the color Doppler mode These issues will be corrected in a future release. (Issue 2491)

Abnormal exit from user script leaves hardware system running

This bug has been identified in releases 4.1.0 up through the current release: In some situations, while a user script is running with the hardware system, it is possible for an event to occur that causes the Vantage software to close without triggering any error conditions. This situation can result in the hardware system continuing to run even though MATLAB has returned to the command prompt as if no sequence was running and with no errors or warnings reported. One way to get into this situation is by entering "control-c" at the MATLAB command prompt, while an asynchronous script is running this will cause VSX to close and return to the MATLAB prompt, but without closing the Hal or stopping the hardware system event sequence. You can tell this has occurred by observing the status indicators on the front of the Vantage system- they will remain on indicating the hardware event sequence is still running). Synchronous acquisition scripts are not affected by this problem (for example, those using a "sync" Sequence Control command or the "wait for processing" condition in Transfer To Host commands).

If you encounter this situation while running one of the affected releases, you can force the hardware system to stop by simply closing MATLAB (within 5 to 10 seconds after that, the software watchdog feature will stop the hardware sequence and the front panel LED's will all go off). Then simply restart MATLAB, select the Vantage software folder, and run activate. This will re-initialize the system and restore normal operation; there is no need to go through a full power off cycle.

If the Vantage system is being used for clinical use with live subjects, the customer is responsible for completing a risk assessment according to their standards and regulations. Reference: Vantage Risk Analysis Revision E   July 29, 2020, Hazard ID: H.AP.4

This problem will be corrected in a future software release. (Issue 1620)

Restart MATLAB When Switching to a Different Vantage Software Version

In some situations (depending on the version of Operating System and MATLAB you are using), the system can fail to select the correct library of low-level Hal software support functions when you switch from one Vantage software installation to another. The best way to avoid this is to quit MATLAB and restart it, then navigate to the desired Vantage project folder BEFORE you run activate. The malfunction can occur if you have run activate in a different Vantage project folder and then run it again after switching to the desired Vantage project folder without restarting MATLAB. Note that if you are using a MATLAB startup.m file to automatically select a default Vantage project folder, you must remove any activate call from the startup.m file to ensure activate will not be invoked until after you have selected the desired Vantage project folder. (Issue 682)

The Microvascular Imaging example script has been removed

The Microvascular example in the Specialty_Applications folder has been removed in the 4.5.3 release, due to known bugs that prevented it from functioning properly. A new Microvascular example with improved performance is in development and will be added in a future release. (Issue 2184)

Receive Data Interleave Processing Malfunction

This bug affects the Recon pre-processing function for combining interleaved RF data acquisitions to create a higher RF data sample rate. Very intermittently and on only a few channels at a time, the interleave processing may not actually have been completed on all threads, and thus the RF data near the end of the frame will still be in the interleaved format. This effect is more likely to occur on more complex acquisition sequences with a large number of acquisitions per frame. If you encounter this problem a workaround that should eliminate it is to set Receive.startDepth to zero for all the interleaved acquisitions; a full solution will be incorporated in a future Vantage release. (Issue 638)

macOS Driver No Longer Available

macOS releases beyond 10.10 Yosemite have new driver requirements that prevent the driver from functioning properly. A new version of the driver may be provided in a future release. macOS may be used in simulation mode provided it complies with the compatible restrictions described in the Host OS Compatibility section of this document.s

Receive A/D Sample Rate Initialization

The receive A/D rate of the system is set by VSX during initialization, as redefined by the Receive structures in the event sequence. The A/D sample rate clock signal is also used to control timing within hardware acquisition events, including synchronization to an external trigger input signal. In this and all earlier Vantage releases, the actual A/D sample rate being used by the hardware system is not initialized until the first Receive event in the event sequence is executed. This means the execution time for that first Receive event will be longer than usual to complete the sample rate initialization, and any timing activity prior to that event (such as responding to a trigger input signal) may also be different than in subsequent events while the script is running.

If the timing anomalies are unacceptable for the intended use of a script, a simple workaround is to place a dummy Receive event at the start of the script prior to any actual acquisition events or timing-related sequence control commands. This workaround may be particularly important to "single-shot" scripts that only execute once and do not repeat. (Issue 117)

Receive Mode 2 (accumulate from a reference acquisition)

The receive mode 2 accumulate feature is intended to allow you to acquire and save in hardware system memory a "reference acquisition" that can subsequently be combined with real-time acquisition events. This feature is not functional in the current release; it will be restored (in a more user-friendly implementation) in a future release. (Issue 202)

Triple Mode Example Script Does Not Function Properly

The "TripleModeSimultaneous" example script from earlier Vantage releases does not function properly in the current software release. It has been removed and will be restored in a future release after it has been updated for full compatibility with the current system software. (Issue 144)

Intermittent MATLAB Crash in Simulation

In verification testing of the current release, intermittent MATLAB crashes were identified when running a very large number of scripts in simulation mode with no HW system present. This condition is very

difficult to reproduce and does not always affect the same script or even similar types of scripts but does appear to be directly tied to the use of the transmit-receive simulation function. Another situation that can lead to a MATLAB crash while running in simulation mode is when using a TX.Apod array consisting of only zeros. When one of these simulation-mode crashes occurs, it usually can be cleared by quitting the MATLAB application, restarting it, and then running the same script again. (Issue 412)