

# VR9500

Vibration Testing Controller



The Innovator in Sound and Vibration Technology



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**“For every failure,  
there is a test which  
will find the failure.”**

JOHN VAN BAREN

## **WELCOME TO VIBRATION RESEARCH**

Celebrating over twenty years in business, Vibration Research Corporation® (VR) is the innovator in vibration control and data acquisition. We listen to our customers' needs and offer testing products, software, and support that deliver unrivaled value. Our best-selling VR9500 controller with easy-to-use VibrationVIEW® software and our *ObserVR1000™* Analyzer with ObserVIEW® software include patented innovations used by in-house labs and contract testing labs. Our customers include engineers and technicians in aerospace, automotive, medical, military, packaging, transportation, and more sectors around the world. VR's applications solve troublesome industry issues such as test equivalency, end use environment comparisons, and test acceleration. VR has satellite offices in China, the Czech Republic, Germany, India, Russia, and the United Kingdom.

**“I’ve been in this business a long time and have been blessed with working with some super companies, and you’re one of them. *Your team has been great as far as service, technical support, and responsiveness. These attributes, as well as an excellent product line, complete the entire package of a quality organization.*”**

## VR9500

Vibration Research’s VR9500 controllers are specially designed and engineered to provide superior value, including reliable performance, accurate testing, and user-friendly features.

### USER FRIENDLY

The VR9500 does not require any special boards or special PC drivers. Our customers are able to use any PC in their labs or simply connect to their laptops. Ready to get started? Simply plug in the Ethernet cable and begin testing.

#### DRAG AND DROP

With drag and drop capabilities, the VR9500 enables customers to quickly load any test into Microsoft® Word or Microsoft® Excel.

#### ETHERNET CONNECTION

An Ethernet connection provides important advantages over USB or PCI-based systems, including:

- Galvanic isolation eliminating ground loops
- Cable length up to 100 meters, unlimited with network infrastructure
- No drivers to install

#### PC AND WINDOWS INTEGRATION

The VR9500 integrates seamlessly with your PC and Windows operating system. Simply connect the VR9500, load VibrationVIEW® software, and you are ready to test.

#### CUSTOMIZABLE REPORTING

All VR9500 systems include our full, robust reporting package which automatically produces presentation-ready, sophisticated reports at the end of a testing sequence. Our customers have the choice of using one of our pre-packaged report templates – enabling users to enter important data such as technician, customer name, time, date, test parameters, and more – or creating their own custom, branded reports.

#### 128 AVAILABLE INPUTS

The VR9500 is scalable from 1 to 128 channels. Its modular design uses four-channel blocks that can be easily rack-mounted or stacked on a desk.

### TIME-TESTED RELIABILITY

Vibration Research guarantees your satisfaction. Our VR9500 is meticulously designed and engineered for a high degree of reliability.

- All controllers include a lifetime hardware warranty to protect your investment
- Each controller is individually tested before shipping
- Controllers utilize a common hardware platform and built-in hardware self-diagnostics, making troubleshooting a snap
- We actively solicit customer feedback – 90% of our improvements originate from customer suggestions

### RACK MOUNTABLE

The VR9500 can be easily mounted on an amplifier rack, which eliminates the need for long accelerometer and drive cables.

### ECONOMIC SOLUTION

Each four-channel module can be used independently on separate shakers or linked into a single stack for jobs requiring a higher channel count. This economic solution creates substantial cost savings for our customers. Additional outputs and software may be required to control more than one shaker. Our sales representatives can help you develop an economic solution for your company.

### WEB AND EMAIL OPTION / REMOTE INTERFACE

Test initiation, monitoring, and shut down can happen remotely with the VR9500. Our customers have the option to use their tablets, phones, or other mobile devices to monitor and control their vibration test in front of their shakers or from anywhere in the world.

### EASY INTEGRATION

Applications such as Microsoft® Excel, LabVIEW, Matlab, and more can easily interface by way of Active-X functions.



## HARDWARE FEATURES

The VR9500 control system uses state-of-the-art hardware, including:

### SPECIFICATIONS AT A GLANCE:

- < -100dB THD+N
- Control Sine, Random, or Shock vibration to 50,000Hz
- 26,000 lines of resolution - an industry maximum
- 24-bit dynamic range
- > 100dB Random dynamic range
- > 130dB Sine dynamic range

### THE FRONT END SIGNAL PROCESSING BOX

- Low-noise design with a dedicated high-speed processor for signal processing
- Front BNC connectors for four input connections
- Front panel status LEDs
- Rear panel connectors include drive signal output and COLA output
- Ethernet port
- Two high-speed interbox communication channels
- A terminal block of digital I/O lines

### INPUT CHANNELS

- 1 to 128 simultaneous channels
  - » All 128 channels can be used for control or monitor
- Analog anti-aliasing filters
- Digital anti-aliasing filters with < -92dB attenuation
- Single-ended with 100k ohm impedance
- Differential with 200k ohm impedance
- Maximum sample rate is 200kHz
- Software set-up allows for:
  - » Per channel selection of transducer sensitivity
  - » Coupling (*AC or DC*)
  - » Single-ended or fully differential input
  - » Accelerometer constant current supply (*4mA IEPE*)
  - » TEDS transducer interface
  - » A unique DC offset removal that allows measurement to true DC with constant current type accelerometers with full 10 volt range
- Custom units can be defined for other sensor types
- 200v tolerant self-resetting fuse protected inputs protect your controller from transients

### INPUT CHANNELS EXPANSION

System can be expanded from 1 to 128 total analog inputs by adding signal processing modules. Each module contains four inputs. Additional modules connect to the PC via a network switch.

## HARDWARE WARRANTY

Vibration Research warrants the controller hardware to be free of defects in materials and workmanship for the lifetime of the product. This warranty covers hardware failure under normal conditions and does not cover damage due to customer neglect or mistreatment.

### OUTPUT CHANNELS

- 1 analog output (drive) standard; COLA output is standard with the Sine testing module
- Optionally drive a differential input device
- Independent or phase controlled 2nd output optional
- Safety relay prevents shaker, amplifier, and product damage from transients
- 24-bit Digital to Analog (DAC) converter
- < -110dB THD+N
- < -130dB Digital Filter Attenuation
- Analog reconstruction filters

### OUTPUT CHANNELS EXPANSION

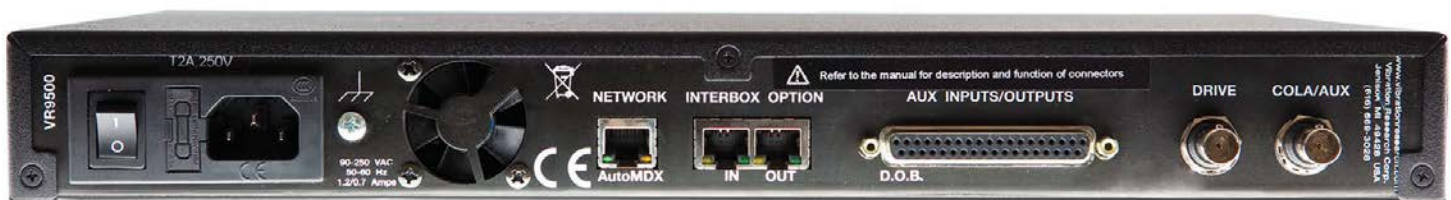
System can be expanded from one control loop with one drive output to four control loops with four drive outputs by adding signal processing modules.

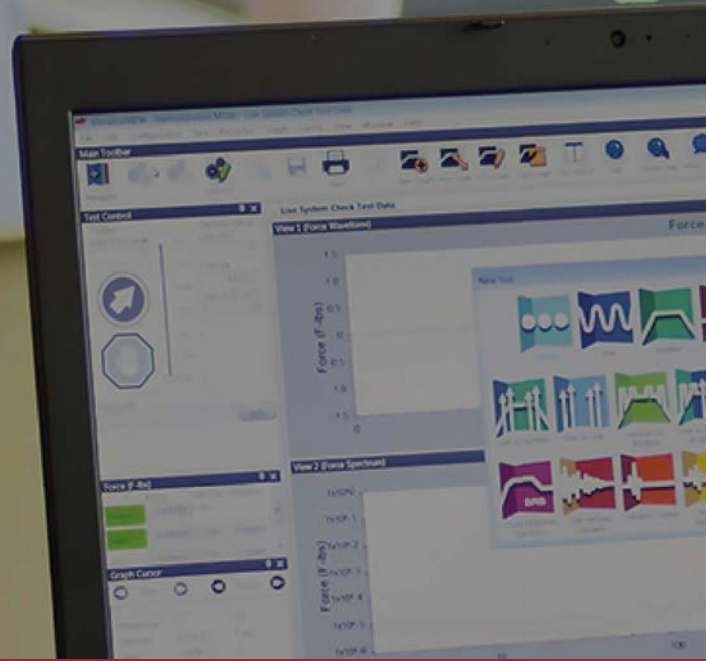
### PC CONFIGURATION

Current Windows operating system and an Ethernet port are the only PC configuration requirements. Microsoft® Word and Excel are recommended.

### DIGITAL INPUTS/OUTPUTS

- Rear, removable terminal block enables the digital level signals – eight inputs and eight outputs – to be interfaced with your product and other systems
- Used for remote start/stop/pause/continue and other functions such as:
  - » Start/stop recording
  - » Monitor unit under test for failure
  - » Multiple test selection
  - » Amplifier control and monitoring





# VibrationVIEW<sup>®</sup> SOFTWARE

Intuitive, flexible, and powerful, VibrationVIEW is Vibration Research's proprietary software that is used in conjunction with the VR9500 controller to set up and monitor vibration tests and to perform automatic as well as custom reporting. It runs on all versions of Microsoft<sup>®</sup> Windows and offers the convenience of remote monitoring and control through the web and email. Below are some of the many reasons why our customers love VibrationVIEW.

## SOFTWARE FEATURES

### SHAKER COMPATIBILITY

VibrationVIEW works with any electrodynamic, servo-hydraulic, or servo-electric shaker and includes single-axis, dual-axis, dual-phase, three-axis, multi-loop, and seismic control options.

### UNPARALLELED ANALYSIS

Optional analysis capabilities include cross spectrum, transfer functions, coherence, correlation, and the ability to apply math functions to any graph trace.

### TEST AND LEVEL SCHEDULING

Tests can be scheduled to run a user-defined length of time and the spectrum level can be scaled by a specified dB level, percentage, or a specified RMS acceleration. Tests can be programmed to run for various periods at different intensity levels. Amplitude levels can be changed while the test is running.

### GRAPHS

VibrationVIEW has an easy-to-use graphing system that includes auto-scaling and zooming capabilities. Graph images and raw data can be copied to any word processor or spreadsheet.

### DATA PLOTS

Our software allows for many graphical display options including:

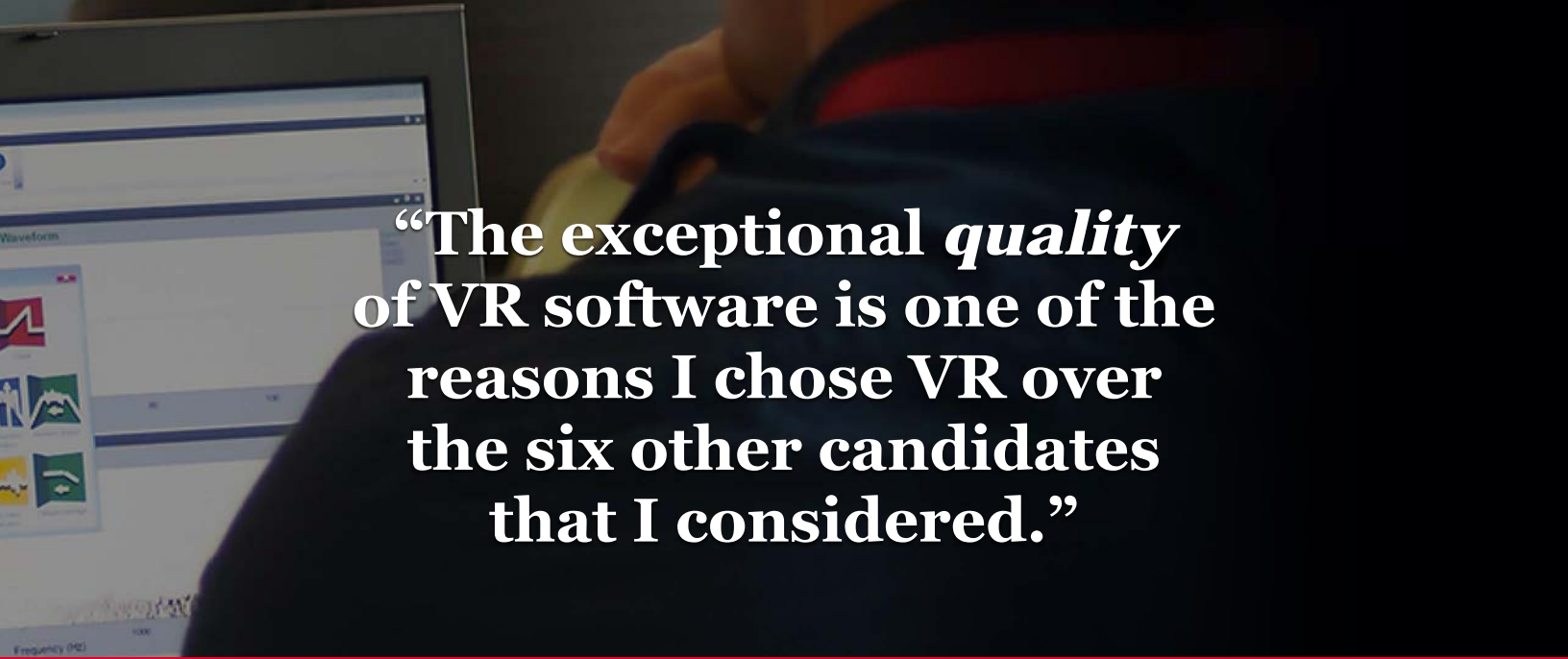
- Acceleration spectral density
- Output voltage spectral density
- Channel-to-channel transmissibility
- Phase between inputs or outputs
- Lissajous curves
- Historical data logging
- Real-time drive voltage
- Real-time channel acceleration
- Drive vs. Input, including system limits

### DATA CURSORS

- Automatically locate and track peaks and valleys
- Highlight particular data points
- Calculate RMS between frequencies
- Calculate slopes in log or linear plots
- Find harmonics of resonances

### SYSTEM CHECK

All VibrationVIEW software packages include a system check mode that provides manually controllable Sine wave output and oscilloscope and spectrum analysis plots of the accelerometer inputs. This test mode is used to calibrate the system and verify operation of the controller, amplifier, shaker, and accelerometers.



**“The exceptional *quality* of VR software is one of the reasons I chose VR over the six other candidates that I considered.”**



#### **TEST SEQUENCER**

A test sequence provides the capability to automatically execute a sequence of tests. All of the tests may be the same type of application or you can switch modes as part of the test sequence.

#### **DATA STORAGE**

All of the test data can be stored to any disk, including network drives, for later retrieval. Data storage can be done manually or programmed to automatically save at user-defined intervals.

#### **CONFIGURABLE SAFETY LIMITS**

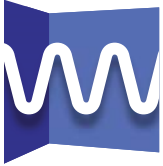
To protect your test article and shaker system, configurable acceleration limits, line limits, system gain limits, and drive limits can be set by any authorized user. The input channels are continuously monitored for fault conditions. The control input is also verified against shaker acceleration, velocity, and displacement limits.

**“Your VibrationVIEW software is *awesome!* It has been working *flawlessly* day after day over the last year. I am catching up with vibration test reports and am very appreciative of how the system is set up.”**

# TESTING OPTIONS

VibrationVIEW can be configured for one or more of the standard test modules listed on pages 6-11.

## SINE (VR9100)



Searching for resonances has never been easier than with our Sine testing module. Sine performs closed loop control of fixed and swept Sine vibration. The digital control algorithm provides time and frequency calculations using floating point math calculations, resulting in frequency changes as small as one millionth of a hertz to produce a smooth and continuous sweep. Pretest self-check is available with Analyzer Function software option VR9607.

### EASY TEST ENTRY

Enter frequency/amplitude breakpoints in an easy-to-read table form. Operator can select to control constant or ramped acceleration, velocity, or displacement. Automatically calculate and enter the frequency of intersection between any combination of constant acceleration, velocity, or displacement lines. A maximum of 1,024 separate frequency/amplitude breakpoints can be entered.

### SWEEP TYPE

Either linear (Hz/minute or minutes/sweep) or logarithmic (octave/minute, decade/minute, minutes/sweep) sweeps can be specified. Sweep rate can be changed in the test while running.

### TEST DURATION

Test duration can be entered in terms of length of time, number of Sine wave cycles, or number of sweeps.

### STONE TESTS

Sequences of fixed-frequency tones of a specified acceleration, velocity, or displacement can be run. Looping functions allow easy entry of repeating tone sequences.

### CONTROL CHANNELS

The control signal can be a single input channel, or configured from two to 128 input channels with either multi-channel averaging or multi-channel extremal control.

### FREQUENCY RANGE

Standard frequency range is DC-4,900Hz. The frequency range can be extended up to 50,000Hz with the High Frequency VR9103 option.

### CONFIGURABLE SAFETY LIMITS

The controller can be configured to abort if the controlled acceleration goes above or below the desired level by an operator-configured dB limit. Abort limits can also be enabled for individual monitoring channels as a single dB limit or profiled around the expected channel response. Notching channels allow limiting acceleration on any channel to a dB limit, or can be profiled around the expected channel response. System gain limits continuously monitor the input channels and the drive output. Drive limits can be configured to protect from overdriving your shaker in case of broken cables or failed accelerometers.

### TRACKING FILTERS

Input channels have individually selectable tracking filters to remove harmonics and out-of-band noise from the measurements. The tracking filter bandwidth is user configurable with fractional settings for low frequencies and maximum bandwidth for high frequencies. The tracking filter automatically transitions from the rapid response required at low frequencies to the tighter control allowed by higher frequencies.

### DATA STORAGE

All of the test data can be stored to any disk, including network drives, for later retrieval. Data storage can be done manually or programmed to automatically save at user-defined intervals.

### MULTI-CHANNEL EXTREMAL

Allows more than one input channel for control in a control strategy where the highest, lowest, or an average of accelerometer readings will be used for control of the test.

### MANUAL CONTROL

The frequency sweep and amplitude level can be manually controlled through the mouse.

### REFERENCE OUTPUT-COLA

The second output channel supplies a constant amplitude reference signal. The phase of this signal relative to the main output can be fixed at any phase or set to shift at a configurable rate. This signal may be used to trigger a strobe light or other measurement devices requiring triggering lock.

### DATA PLOTS

A multitude of graphical display options are available, including peak acceleration, peak velocity, peak-to-peak displacement, output drive, channel-to-channel transmissibility, and phase as a function of either frequency or time. Graphs can be easily auto-scaled or zoomed, and cursors can be displayed. Data and text annotations can be easily placed on the graphs, with data values updated live as the data changes.

### INDEPENDENT CHANNEL NOTCHING PROFILES

Assigns maximum limiting breakpoint profiles to individual channels. The drive output will be limited (or notched) if necessary to keep the input amplitude for that channel below the defined profile.



## ADDITIONAL SINE OPTIONS

### **ACCELEROMETER CALIBRATION VERIFICATION (VR9106)**

Provides an easy interface to calculate accelerometer sensitivity. This will allow the user to perform a Sine sweep, control a reference accelerometer, and produce a calibration report suitable for record keeping. Automatically calculates the accelerometer sensitivity at the chosen reference frequency.

### **SINE RESONANCE TRACK AND DWELL CONTROL (VR9105)**

Transmissibility peaks can be automatically detected from a Sine sweep, and then dwell tests run at the detected resonance frequencies for a specified time duration or number of Sine wave cycles. In a Sine dwell test, the controller can automatically track the resonance frequency to keep the output on resonance even when fatigue damage causes the resonance frequency to shift. With our advanced tools you can manually track a non-linear resonance.

### **HIGH FREQUENCY FOR SINE (VR9103)**

Extends upper frequency for Sine control from 4,900Hz to 50,000Hz.

### **STEP TEST MODE (VR9107)**

Frequency Stepping Test: Cycle on/off for user-specified time at discrete frequencies. Linear or logarithmic frequency step rates can be used. Stepped frequency Sine tests such as those used in MIL-STD-167 are supported.

### **SINE-ON-SINE (VR9206) \***

Run mixed-mode tests with pure Sine tones and no Random background.

- 1 to 32 true floating-point precision Sine tones can be superimposed with no background Random spectrum
- Sweep back and forth between frequencies at a user-programmable rate
- Amplitude and frequency sweep parameters are user-programmable
- Up to 50 separate frequency/amplitude breakpoints can be entered
- Tracking filters out-of-band noise from the measurements; the tracking filter automatically transitions from the rapid response required at low frequencies to the tighter control allowed by higher frequencies

*\*Offered through our Random test module*

# TESTING OPTIONS

VibrationVIEW can be configured for one or more of the standard test modules listed on pages 6-11.

## RANDOM (VR9200)



Random vibration testing provides a more closely matched vibration to your end-use environment. With our Random test module, you get the highest possible control with ease of use. Random performs real-time, closed-loop control of PSD profiles. All inputs are simultaneous, which means there is an A/D assigned to each input (not multiplexed). The inputs continuously take data, and there are no “un-sampled” periods. Highly evolved control algorithms will control electrodynamic and servo-hydraulic or servo-electric shakers. A pretest self-check with intelligent start-up is available with Analyzer Functions.

### EASY TEST ENTRY

Frequency/amplitude breakpoints are entered in an easy-to-read tabular form using either frequency and amplitude breakpoints or by entering one endpoint and the desired dB/octave slope. Over 1,000 separate frequency/amplitude breakpoints can be entered.

### LINES

The controller comes standard with 50 to 26,000 user selectable lines of control to provide the frequency resolution required for testing. You can analyze and control up to 50,000Hz with the High Frequency VR9203 option without sacrificing resolution.

### FREQUENCY RANGE

The standard frequency range is DC-4,900Hz. The frequency range can be extended up to 50,000Hz with the High Frequency VR9203 option.

### CONTROL CHANNELS

The control signal can be a single input channel, or configured from 2 to 128 input channels with multi-channel averaging, weighted averaging, extremal, or multi-channel notching.

### MULTIPLE SHAKERS

One to four control loops can be run simultaneously to independently control up to four shakers with four individually configurable and statistically independent waveforms.

### TEST AND LEVEL SCHEDULING

Tests can be scheduled to run a user-defined length of time, and the spectrum level can be scaled by a specified dB level, percentage, or a specified RMS acceleration. Level schedules can be entered to run for various durations at different acceleration levels. Levels can be changed while the test is running.

### MULTI-CHANNEL EXTREMAL

Allows more than one input channel for control in a control strategy where the highest, lowest, average, or weighted average of accelerometer readings will be used for control of the test.

### INDEPENDENT CHANNEL NOTCHING PROFILES

Assign maximum limiting breakpoint profiles to individual channels. The drive output will be limited (or ‘notched’) if necessary to keep the input spectrum for that channel below the defined profile. Up to 1,024 breakpoints can be entered for each channel, or the limit can be entered simply as a dB level relative to the demand profile. In addition, minimum limits may be defined to boost the drive output if a channel is below a defined profile. The notching profiles may also be used as spectrum abort limits, so that abort limit breakpoint profiles can be assigned to each individual channel, and, if that channel reaches the defined limit, the test will safely shut down.

### CONFIGURABLE SAFETY LIMITS

To protect your test article and shaker system, configurable acceleration limits, line limits, and drive limits can be set by the user. The control input is also verified against shaker acceleration and displacement limits.

### DATA STORAGE

All of the test data can be stored to any disk, including network drives, for later retrieval. Data storage can be done manually, or programmed to automatically save at user-defined intervals.

### DATA PLOTS

Many graphical display options are available, including acceleration spectral density, output voltage spectral density, and channel-to-channel transmissibility. Graphs can be easily auto-scaled or zoomed, and cursors can be displayed. Data and text annotations can be easily placed on the graphs, with data values updated live as the data changes.

## ADDITIONAL RANDOM OPTIONS

### **RANDOM-ON-RANDOM (VR9207)**

Run controlled, Random spectrum tests with swept random “tones” superimposed on a Random background.

- 1 to 32 narrow spectral bands can be superimposed on the background Random spectrum
- Sweep back and forth between frequencies at a user-programmable rate and amplitudes
- Amplitude, bandwidth, and frequency sweep are all user-programmable
- Up to 50 separate frequency/amplitude breakpoints per narrow band can be entered
- 50 to 26,000 lines of control frequencies



### **SINE-ON-SINE (VR9206)**

Run mixed-mode tests with pure Sine tones and no Random background.

- 1 to 32 true floating-point precision Sine tones can be superimposed with no background Random spectrum
- Sweep back and forth between frequencies at a user-programmable rate
- Amplitude and frequency sweep parameters are user-programmable
- Up to 50 separate frequency/amplitude breakpoints can be entered
- Tracking filters out-of-band noise from the measurements; the tracking filter automatically transitions from the rapid response required at low frequencies to the tighter control allowed by higher



### **SINE-ON-RANDOM (VR9206)**

Run mixed-mode tests with Sine tones superimposed on a Random background.

- 1 to 32 true floating-point precision Sine tones can be superimposed on the background Random spectrum
- Sweep back and forth between frequencies at a user-programmable rate
- Amplitude, bandwidth and frequency sweep are all user-programmable
- Up to 50 separate frequency/amplitude breakpoints per Sine tone can be entered
- 200 to 6,500 lines of control
- Tracking filters out-of-band noise from the measurements; the tracking filter automatically transitions from the rapid response required at low frequencies to the tighter control allowed by higher frequencies



### **SINE-AND-RANDOM-ON-RANDOM (VR9208)**

Runs Random sweeping “tones” and real Sine tones simultaneously on top of background Random. Included as standard when Random, Sine-on-Random, and Random-on-Random are purchased.



### **RANDOM IMPORT (VR9204)**

Import time history data to automatically generate a Random PSD profile or import PSD breakpoints directly from a file.



### **HIGH FREQUENCY FOR RANDOM (VR9203)**

Extends upper frequency for Random control from 4,900Hz to 50,000Hz.

# TESTING OPTIONS

VibrationVIEW can be configured for one or more of the standard test modules listed on pages 6-11.

## SHOCK (VR9300)



Classical Shock performs closed loop control of transient waveforms. The entire transient period is sampled simultaneously and gap-free. The needed drive is calculated between each pulse. All of the classical pulse types are supported. There are several methods of optimizing the displacement requirements of a given pulse.

### STANDARD PULSE SHAPES

Select from half-sine, haversine, initial-peak sawtooth, terminal-peak sawtooth, triangle, trapezoid, and square pulse shapes.

### CONTROL CHANNELS

The control signal can be a single input channel or an average of two to four different input channels.

### TEST AND LEVEL SCHEDULING

Repeat a pulse from one to more than two billion times, with a configurable repetition rate. Tests can be configured to run pulses at different amplitude levels.

### CONFIGURABLE SAFETY LIMITS

To protect your test article and shaker system, configurable acceleration and drive limits can be set by the authorized user. The control input is also verified against shaker force, velocity, and displacement ratings.

### EQUALIZATION

The controller automatically equalizes the response of the shaker/fixture/product prior to running the test. This equalization can be memorized and stored with the test to quickly start a test at a fully equalized level.

### DATA STORAGE

All of the test data can be stored to any disk, including network drives, for later retrieval. Data storage can be done manually, or programmed to automatically save at user-defined intervals.

### DATA PLOTS

Many graphical display options are available, including acceleration, velocity, displacement, output voltage, acceleration, and drive spectra. Graphs can be easily auto-scaled or zoomed, and cursors can be displayed. Data and text annotations can be easily placed on the graphs, with data values updated live as the data changes.

### FREQUENCY RANGE

Standard frequency range is DC-4,900Hz. The frequency range can be extended up to 50,000Hz with the High Frequency option.

**“Our express reason for choosing the VR9500 controller over other controllers is the *flexibility* it gave us with *SRS shock testing*. In particular, we appreciate the selection of the various synthesis types, and the ability to optimize a synthesis for acceleration, velocity, or displacement. We also find the VR9500 very *easy and intuitive* to use and we make use of the comprehensive report generation features.”**



## ADDITIONAL SHOCK OPTIONS

### SHOCK TRANSIENT CAPTURE (VR9304)

Capture a transient waveform for post processing. Use alone for data acquisition or with SRS for Shock Response Spectra analysis.

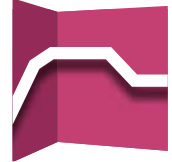


- Provides a simple interface to record transient events
- Select a trigger level, slope, channel, and duration
- Trigger the capture on the capture channel or use an independent channel as a dedicated trigger
- Use the open loop Sine chirp or Random output to drive a modal shaker
- Specify and display an SRS spectrum. Analyze SRS of each pulse as it is captured
- Many graphical display options are available, including acceleration, velocity, displacement, and acceleration spectra
- Graphs can be easily auto-scaled or zoomed, and cursors can be displayed
- Data and text annotations can be easily placed on the graphs, with data values updated live as the data changes

### SHOCK RESPONSE SPECTRA CONTROL

(VR9302)

Perform Shock Response Spectra (SRS) analysis and control. Run a Shock pulse defined to meet a SRS defined as a frequency versus acceleration peak table. A variety of waveform synthesis generation techniques are included.



- Frequency/amplitude breakpoints of the Shock Response Spectrum are entered in an easy-to-read tabular form; 200 separate frequency/amplitude breakpoints can be entered
- Adds Shock Response Spectra plots to Shock and transient capture test modes
- Supports many generation techniques including:
  - » Linear and exponential chirp
  - » WavSyn
  - » Burst Random
  - » Linear and exponential chirp on burst Random
  - » Enveloped Random
  - » Burst Sine
  - » Iterate from user waveform

Manually adjust all the parameters of the underlying wavelets, or allow VibrationVIEW to automatically adjust and run without intervention

- SRS Pseudo Velocity and SRS Acceleration plots
- Acceleration for primary (+), primary (-) or Maxi-Max. Graphs can be easily auto-scaled or zoomed, and cursors can be displayed
- Data and text annotations can be easily placed on the graphs, with data values updated live as the data changes

### HIGH FREQUENCY FOR SHOCK (VR9303)

Extends upper frequency for control and analysis to 50,000Hz.

### TRANSIENT WAVEFORMS CONTROL (EARTHQUAKE/SEISMIC) (VR9301)

Runs a user-defined time transient. Also used to run earthquake tests with the standard Bellcore earthquake time transients included.

- Used to import a time domain, user-specified transient with many file formats including txt, uff, and csv, among others
- Import up to 65,000 data points with custom support for up to 500,000 data points
- Easily create sine beat, chirp, user-defined, and random waveforms for playback and control
- Analyze with SRS package
- Run earthquake tests similar to the Bellcore standards along with any other earthquake time history
- Meets all IEEE-344 required plotting and calculation standards (VR-IEEE-344)

# TESTING INNOVATIONS

The Vibration Research team is committed to solving our customers' challenges. From rapidly measuring a product's life expectancy to preventing over-testing and under-testing, we create innovations that increase the accuracy and speed of vibration tests. Our company's proprietary testing innovations are listed on pages 12-15.

## FATIGUE DAMAGE SPECTRUM (VR9209)



Measure your product's environment, characterize the severity, and generate a test profile accelerated to represent a lifetime of fatigue in a lab run test. For years, people have used methods to calculate the lifespan of a product based on the material s/n curve. Rainflow cycle counting is applied to the actual measured vibration experienced by your product, lifetime fatigue damage is estimated, and an accelerated test is generated to reproduce a lifetime of damage in a short period of time.

### CUSTOM FREQUENCY AXIS

Typically, Random import is calculated linearly based on number of lines. Typically, FDS is calculated on a logarithmic frequency axis. You can set the frequency axis spacing and the start/end frequency on the user interface. User is in control of how many points and which points to calculate.

### TIME DOMAIN CALCULATION

Calculation through time domain – not frequency domain – to account for kurtosis you will likely see in the real world. The Fatigue Damage Spectrum is based on the response of single degree of freedom systems rather than FFTs.

### DISPLAY IMPORTED FILE STATISTICS

Displays peak acceleration, velocity, and displacement, as well as the kurtosis of the time history file. This provides a quick and easy way to determine the statistics of a waveform.

### CONFIGURABLE PROCESS PARAMETERS

The user can define the slope of the s/n curve (beta) and quality factor (Q).

## OTHER FEATURED OPTIONS

### ObserVR1000

Measure waveforms with the ObserVR1000 and import data into a Random profile.

### Recorder

Measure waveforms with the ObserVR1000 and Recorder and import into a Random profile.

### REDUCE TEST TIME

User sets test item target life, based on product specifications, as well as test duration. The software automatically accelerates the profile to produce the same amount of fatigue damage in a shorter test time.

### ANALYSIS TO CONTROL

With one mouse click, bring your new Random breakpoints into a control profile. Go from a time waveform to a breakpoint profile and start controlling on that profile all in one program.

### INCLUDES RANDOM IMPORT

Compare multiple methods of generating a Random profile.



**Kurtosion®**

ULTIMATE KURTOSIS CONTROL

Kurtosis is a measurement of the size of a distribution's "tails," or in other words, more time spent at the extreme values from the mean (peakedness). The greatest damage potential to your product is at these peak levels. When the kurtosis of the signal is increased, the time spent at peak levels is increased, making your test better reflect what is happening in the real world. Some have called this "Shock on Random," but it is really Random with a more realistic probability distribution.



Life testing using controlled random excitation is a long accepted means of finding design and/or assembly flaws. Class-general broadband spectra, such as the NAVMAT profile, permit testing without initially knowing the specific resonances of a new package. Now kurtosis control allows such tests to be conducted in a fraction of the time required for a Gaussian drive signal to precipitate failures. However, the kurtosis control needs to be properly implemented to circumvent interference from the Central Limit Theorem. A unique feature within Vibration Research, the Kurtosion process allows resonant fatigue as well as simple static failure tests to be accelerated.

**NON-GAUSSIAN**

Traditional Random control uses a Gaussian distribution, which is highly concentrated near the mean value. This means most of the time the traditional Random test acceleration is close to zero. In most real-world environments, there is significantly more time spent at the peak levels than what is produced by the traditional Random test.

**MORE REALISTIC PROBABILITY DISTRIBUTIONS**

By controlling both the RMS and kurtosis of the Random waveform, you get more control over the probability distribution, allowing a closer match between the real world and your test lab.

**FULL RANDOM SPECTRUM**

The spectrum is defined and fully controlled just like in traditional Random tests with no change as a result of adjusting the kurtosis level.

**FULL RMS CONTROL**

With kurtosis control, acceleration is moved from the mean toward peak levels, resulting in no change of GRMS.

**FULL DYNAMIC RANGE**

The kurtosis of the acceleration is controlled without any reduction in dynamic range.

**KURTOSION DEFINED**

The action or process of controlling a signal in which the kurtosis of the signal achieves a desired result, as in "applying kurtosis."

**U.S. AND EUROPEAN PATENT**

Frequency Profile. RMS Level. Kurtosion. Our patented control now adds a third dimension to your Random vibration testing.

**INCLUDES RANDOM IMPORT**

Compare multiple methods of generating a Random profile.

**Kurtosis is a measurement of the size of a distribution's "tails," or in other words, more time spent at the extreme values from the mean (peakedness).**

# TESTING INNOVATIONS

The Vibration Research team is committed to solving our customers' challenges. From rapidly measuring a product's life expectancy to preventing over- and under-testing, we create innovations that increase the accuracy and speed of vibration tests. Our company's proprietary testing innovations are listed on pages 12-15.

## FIELD DATA REPLICATION (VR9400)



# FDR

FIELD DATA REPLICATION

Take your field acceleration measurements and reproduce them on your shaker in your test lab. There is no need to try to approximate your field environment through the approximations inherent in the standard Random, Sine, or Shock tests. FDR provides the capability to replicate your field acceleration measurements and reproduce them on the shaker in the test lab. Utilizing real-time adaptive control, FDR simulates the recorded time history measurements on your shaker.

### DATA IMPORT

Import waveforms from data recorders using an analog input, or import from txt, rpc, uff, matlab, or wav files. Waveforms can be up to 4.2 hours long at a 65,000Hz sampling rate, or up to 116 days at a 100Hz sampling rate.

### MULTIPLE SHAKERS

One to four control loops can be run simultaneously to independently control up to four shakers with four separate waveforms.

### TEST AND LEVEL SCHEDULING

The test can be set to reproduce the waveform for a specified duration. The waveform can be scaled up or down by any factor to get the test intensity you desire. Tests can be programmed to run for various periods at different intensity levels. The amplitude can be changed while the test is running.

### EQUALIZATION

The controller automatically equalizes the response of the shaker/fixture/product while running the test. This equalization can be memorized and stored with the test to quickly start a test at a fully equalized level. The frequency range of the output signal is configurable, and a frequency band can even be notched out of the signal.

### LINES

The controller comes standard with 50 to 6500 lines of control to provide you with the frequency resolution required for your test.

## OTHER FEATURED OPTIONS

### Field Data Replicator Reference (Output)

Play any uncompensated reference waveform fully synchronized with the control waveform. Useful for providing reference waveforms to a spectrum analyzer for external verification of results. Also useful for providing a pre-recorded trigger signal (e.g., tachometer, cylinder firing, etc.) synchronized to the vibration, or for synchronizing additional environmental factors (e.g., motor RPM, temperature, etc.) with the recorded vibration.

### High Frequency for Field Data Replication

Extends frequency range for FDR control up to 20,000Hz with a 65,000Hz sample rate.

### DATA STORAGE

All of the test data can be stored to any disk, including network drives, for later retrieval. Data storage can be done manually, or programmed to automatically save at user-defined intervals.

### DATA PLOTS

Many graphical display options are available, including acceleration and drive voltage versus time or frequency, and channel-to-channel transmissibility. Graphs can be easily auto-scaled or zoomed, and cursors can be displayed. Data and text annotations can be easily placed on the graphs, with data values updated live as the data changes.

### FREQUENCY RANGE

The standard frequency range is DC-4,900Hz. The frequency range can be extended up to 20,000Hz with the High Frequency VR9203 option.

### NOTCH FILTER

The notch filter can be used to isolate resonances by setting start and end notch frequencies while the test is running without stopping the test.







### TEST WITH AWARENESS WITH OUR NEW PATENTED INNOVATION FOR RANDOM VIBRATION

Introducing iDOF, Vibration Research's latest patented Random vibration test module designed to solve the problem of unknowingly over- and under-testing of high value products. When high value products fail to perform in real-life, often due to improper vibration testing, the consequences can border on catastrophic. iDOF enables companies to run highly accurate vibration tests in a condensed period while ensuring their products are tested for just the right amount of time.



### BRIDGING THE GAP BETWEEN LAB AND REALITY

Test Technicians, Engineers, and Lab Managers appreciate the "perfect world scenario" that iDOF offers. It's the innovation that the vibration control industry has needed for some time. As innovators in vibration control, Vibration Research listened to your needs and has responded!

### USING IDOF, YOUR PSD PLOTS WILL:

- Provide a precise estimated PSD with as few as five frames of data
- Display smooth curves early in a test
- Analyze using only measurements made at full level

Test engineers can now see details which were previously obscured through averaging. It's dangerous to pretend a test run at low level was actually run at a higher level. Yet this is a popular estimation used to make it appear in a test report that short duration Random test run to completion in tolerance. Issues perilously hidden when test levels change are abundantly clear with iDOF. Technicians can respond to changing responses, such as shifting resonances quickly without long averaging times associated with high degree of freedom. When real-life resonances shift with changing test conditions, you are able to make a decision to abort the test before your products are damaged then placed in real world environments where failure is catastrophic.

Too often, vibration tests show a trace smooth and in tolerance by running a test for an extended period of time at a low level (a small percentage of the demand level), taking that averaged PSD, and simply scaling it by a factor to project to full level. This method is invalid. It's based on the false assumption that the behaviors of a product at high vibration levels always exactly mimic that of it at low vibration levels. This vibration testing protocol is unfortunately very common and is exactly why high value products are so often over- and under-tested.

**Harness the exactness, efficiencies, and peace of mind that iDOF® now offers to vibration control practitioners.**

# SOFTWARE SPECIFICATIONS

## SINE (Page 6)

**Frequency Range:** DC to 50,000Hz. Up to 4,900Hz standard; High frequency option extends to 50,000Hz. Sample frequency 10,000 to 200,000Hz.

**Sweep Rate:** Linear from zero to 100,000Hz/min or logarithmic from zero to 100,000octaves/min

**Control Methods:** Single channel, average, weighted average, minimum, or maximum Control Dynamic Range:  $\geq 130\text{dB}$

**Level Types:** Sweep from frequency A to frequency B, sweep back and forth through profile, constant frequency, wait for operator intervention, wait for timed interval, resonance table generation and dwell frequency selection (optional), level looping (with nesting up to 10 levels), phase tracking to hold resonance frequency

**Breakpoints:** Acceleration, Velocity, or Displacement can be defined for up to 1,024 different frequencies, as well as the transitions between each defined breakpoint.

**Resolution:** As fine as 0.000001Hz; Loop Time: 5msec typical

**Manual Control:** Limits both the drive output and the control signal on start-up to a user-controlled level; normal test operation will commence only after the limited start-up is verified by the user

## RANDOM (Page 8)

**Frequency Range:** Near DC to 50,000Hz, user-selectable. Sample Rate from 100Hz to 200,000Hz. Up to 4,900Hz standard; high frequency option extends to 50,000Hz.

**Spectrum Lines:** 50 to 26,000 lines

**Measurement Strategies:** Input channels may be run individually, or combined by minimum, maximum, weighted average, or average

**Control Dynamic Range:** 100dB typical; Breakpoints: Up to 1,024 frequency/amplitude breakpoints with slope (dB/octave) automatic calculations or manually set slope values between frequencies

**Profile View:** The desired profile is graphed and updated as you build it. The test maximum peak acceleration, peak velocity, and peak-to-peak displacement values are displayed. Values are highlighted in red if they exceed the shaker parameter values selected.

**Drive Clipping:** Clipping modes include digital, analog, and silent clipping; can be set at any level between 1 sigma up

**Manual Control:** Limits both the drive output and the control signal on start-up to a user-controlled level; normal test operation will commence only after the limited start-up is verified by the user

**Test Documentation:** Extensive reporting capabilities

**Level Types:** Scale entered profile by % level, by dB level or to an RMS acceleration level. Wait for operator intervention, wait for a timed interval, level loop (with nested looping up to 10 levels), auto-reporting and more.

**Number of Levels:** 2,000 levels

**Degrees of Freedom:** 2 to 10,000 degrees of freedom; up to 4x Update Rate (75% overlap)

**Oversampling:** Sample beyond the defined test frequencies to monitor responses at frequencies that otherwise would require a separate analyzer

# SOFTWARE SPECIFICATIONS

## SHOCK (Page 10)

**Frequency Range:** Up to 4,900Hz standard; up to 50,000Hz optional

**Classical Pulse Types:** Half-sine, haversine, initial and terminal peak sawtooth, triangle, square, and trapezoid

**Pulse Duration:** From 0.02mS to 600+ seconds

**Sample Rate:** 100Hz to 200,000Hz

**Frame Size:** 128 to 524,000 points or automatically optimized

**Loop Transfer Function:** Automatic calculation during pretest or, for no pretest start-up, recall a drive from disk

**Pulse Compensation:** Both pre-pulse and post-pulse compensation is performed. Double-sided for minimum displacement and full use of shaker stroke. Choice of smoothed or rectangular compensation pulses to minimize high frequency content or shaker stroke. Pre-pulse and post-pulse amplitudes settings are a percentage of the demand peak acceleration. Optionally share the pre- and post-pulse compensation to meet Mil-810 requirements.

**Engineering Units:** English, SI, Metric, mixed, user-defined

**Filtering:** User specifies desired frequency for low pass filtering applied to the demand waveform, output drive signal, and input channels

**Delay Between Pulses:** User set from 0 to 1,000 seconds; all specifications are subject to change without notice

## ADDITIONAL OPTIONS

### Shaker Monitor and Analog DC Inputs (VR9602)

The eight inputs on the rear of the VR9500 controller can be set up as analog DC inputs. This allows the user to monitor, log, and graph data from up to eight analog signals such as armature and field current and voltage. The inputs have a +/- 10 volts range which can be scaled to any user-defined units such as RMS amps or RMS volts. Other features include user-defined high and low trip points to automatically abort tests on a fault condition. This is a good way to monitor and log the shaker's armature voltage, armature current, field voltage, and field current for all of your tests.

### Math Traces Option (VR9606):

This option provides the ability to define math functions based on graph traces, test parameters and/or test results, and plot the result of the calculations as additional graph traces. In addition, calculators may also be defined to evaluate a function continuously during the test, and plot time history of the result. Each calculator can also have upper and lower limits assigned to stop the test based on the calculation result.

### Analyzer Functions Option (VR9607):

Provides Coherence, Cross-Spectrum, and Transfer Function plots in both Random and FDR test modes, FFT Spectrum plots in Sine test mode, and scatter plots (channel-vs-channel) in all test modes. In addition, this option provides a configurable function generator for outputting user-defined voltage waveforms.

# GENERAL SPECIFICATIONS

## INPUTS

**Voltage Range:** +/-1v, +/-10v, +/-20v

**Filtering:** Analog multiple pole filter plus a digital filter

**Sample Rate:** 100 to 200,000Hz

**Resolution:** 24-bit

**Dynamic Range:** >110dB Dynamic Range (*>130dB with tracking filters*)

**Total Harmonic Distortion:** <-100dB THD+N

**Protected:** 200v peak tolerant inputs

**Noise Floor:** <70nV/ $\sqrt{\text{Hz}}$  spurious free

## OUTPUTS

**Output Channels:** 2 Output channels

**Voltage Range:** +/-1v, +/-10v

**Drive Channel:** 24-bit digital to analog converted (*DAC*), digital and analog anti-imaging filter, emergency stop shutdown circuit and power failure transient prevention shutdown circuitry

**Filtering:** Analog multiple pole filter plus a digital filter

**Frequency Range:** Capability of up to 50,000Hz output frequency (*200,000 samples per second*)

**Resolution:** 24-bit

**Total Harmonic Distortion:** <-105dB THD+N

## OTHER

**Dimensions:** 15 $\frac{1}{8}$ " L (*384mm*), 10 $\frac{1}{2}$ " W" (*267mm*), 1 $\frac{3}{4}$ " H (*45mm*)

**Weight:** 7.5lbs (*3.4kg*)

**Power:** 90 to 250VAC, 50/60Hz, 1.2/.7Amps

**Operating Temperature Range:** 35° to 122° Fahrenheit (*2° to 50° Celsius*)



**“This is my first direct experience with VR and I would characterize your company as ‘first class’ based on your amazing customer service. There aren’t many companies who have the agility to accept an international project with less than 3 weeks’ notice!”**

## Customer Support

At Vibration Research, we believe ongoing support is just as important as the initial installation. We include a lifetime hardware warranty with the VR9500. In addition, we include one year of unlimited factory support to be sure you get everything you want and need from your vibration control system. VibrationVIEW provides context-sensitive help, a great place to explore the many features of our software. We have also incorporated a very helpful tool into our software to assist with any support issues related to difficulty completing tests. In the help menu of VibrationVIEW is a selection titled “help with recent tests.” The last 50 tests run with VibrationVIEW are listed and, with a simple selection, you can email to us or upload through our secure website all the test settings and test results required by our customer support to quickly resolve any issues you have with your shaker and controller.

### ONGOING SUPPORT

#### Additional Training and Support

Vibration Research provides year-round live and on-demand support and training options, including:

- Topic-specific monthly web seminars
- One-on-one web training
- On-site training and support
- Two-day training seminars

#### Upgrades and Support Agreements (U&SA)

Our team of dedicated software engineers is driven to advance the vibration testing community. We offer Upgrades and Support Agreements that include:

- All VibrationVIEW software updates
- Providing innovative solutions to your testing requirements
- Creating new software features and functionality to solve real-world testing opportunities
- 50% discount on factory calibration (A2LA)
- Lifetime hardware warranty
- Unlimited technical support for your VR9500 controllers

As we work together to provide you with the very best products and service, we encourage you to renew your U&SA.



# LOCATIONS

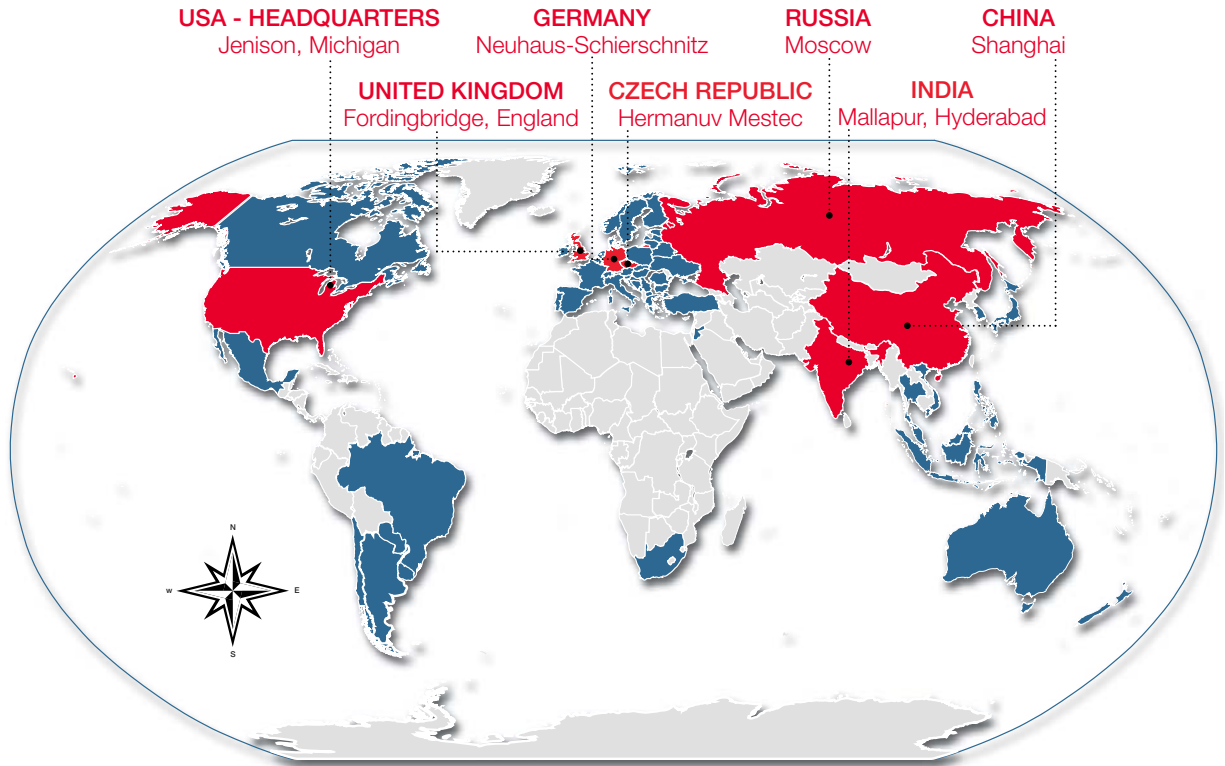
We have offices and sales representatives strategically located around the world. Specific contact details can be found at [www.vibrationresearch.com/contact](http://www.vibrationresearch.com/contact). We invite you to contact a representative in your local area to request more information. Be sure to ask about a demo-version of our VibrationVIEW software.

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Israel  
Italy  
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**At Vibration Research, we believe  
*ongoing support* is just as important  
as the initial installation.**





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