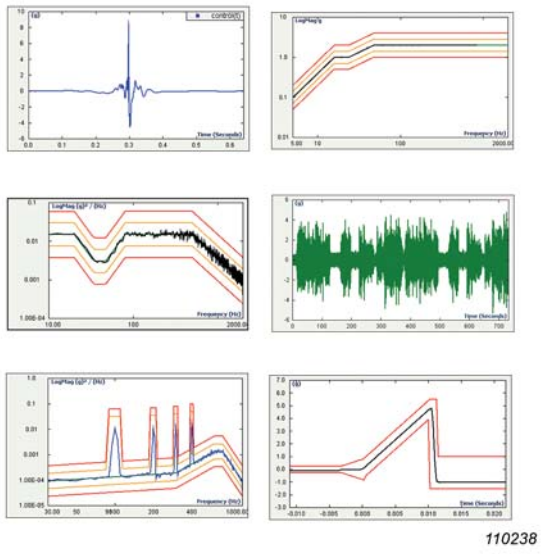
SYSTEM DATA

Vibration Control Software

for VC-LAN Vibration Controller Types 7541 and 7542

Brüel & Kjær's Vibration Control software runs with VC-LAN Vibration Controller Types 7541 and 7542. The software fully utilises the power of the controller's unique dual, parallel 24-bit A/D inputs and latest DSP technology. The hardware and software work together perfectly to give you a controller that has a wide control dynamic range, for even low-level tests, with fast loop times for accurate control during your most challenging tests.

The VC-LAN Vibration Controller hardware/software family is your solid foundation upon which to build a system that suits your present needs. It can also be extended as your requirements change. This expandability, and the continuing development of new vibration control applications and hardware, ensures the safety of your investment now and in the future.



Uses and Features

Uses

- Simulation and replication of a wide variety of vibration environments on laboratory shaker systems
- Vibration testing to MIL-STD, DIN, ISO, IEC and other standards
- Production, durability and fatigue testing of electronics and components used in automobiles, consumer electronics, military vehicles and aircraft
- Random vibration control including Sine-on-Random and Random-on-Random
- Swept Sine vibration control including tracked resonance dwell
- Shock vibration control including classical waveforms, transient replication, and SRS synthesis and control
- Time waveform replications of road test data and other field measurements

Features

- Native 64-bit software ensures compatibility with the latest Windows® software and protects your investment for the future
- Full capability for vibration control, data reduction and signal analysis
- Advanced control algorithms overcome non-linear responses and provide stable control
- Application tailored Windows®-based packages reduce learning time and make it easy to get results quickly
- Customisable user interface – from novice to expert – speeds learning and helps to ensure error-free testing
- Automated testing, including sequence of test, event controlled e-mails, control of external equipment using digital I/O or socket messages
- Keyword searches in the embedded database make it quick and easy to recall test setups and data
- Open data policy with industry standard ASAM-ODS and other export formats, makes it easy to share data and speed product development
- Simultaneous data recording for event diagnosis and test archiving
- Single-click reporting simplifies the documentation of test results and validation of tests to authorities/customers
- Password control, where an administrator can set up password security, multi-user accounts and web-based reporting tools

Easy To Use

Whether you are an experienced test operator, an occasional user, or even a new user, the Controller's software user interface provides the tools and features that you need for successful vibration testing. Vibration Control packages specifically tailored to each type of vibration test reduce learning time and make it easy to get results quickly.

The New Test Wizard allows you to define your preferences for default test parameters and displays so that you have the best configuration for each type of test you need to perform.

The current and most recent test setups are maintained in a navigational tree, which makes the basic steps to create, edit and view setups both intuitive and easy. Keyword searches in the embedded database make it quick and easy to recall saved test setups and data. Project files are searchable by keyword, date and time of day.

Related operations are grouped together in dedicated regions of the screen. Each operational window is collapsible for maximum focus and screen space. It is also possible for system administrators to customise which setup menus and dialogs are available to accommodate use by inexperienced operators or protect against unauthorised changes to the test.

Automation Simplified

Powerful automation features take the tedium out of repetitive tasks, allowing you to run complex test schedules with a single keystroke.

Ready for Any Event, Automatically

The programmable Run Schedule and flexible Event Action functions allow automatic execution of tests with even complex protocols, which is ideal when dealing with varying test conditions. These tools let you:

- Program a series of low-level steps to ensure a gentle start-up for sensitive items
- Disable and enable aborts at specified levels for reliable start-up of low-level tests with high noise levels
- Use loops and nested loops for level scheduling and cycling
- Automatically generate test reports at specified events
- Send emails or SMS messages with customisable text, in response to specific test events

Maximise Throughput

Minimise test start-up time and maximise production by using a stored drive signal. This feature allows you to bypass the initial equalisation process, starting each test immediately at full level.

Using the Test Sequencing option, the Vibration Control software also supports automatic execution of a series of project files in a predefined order – including "mission profiling", which executes sequencing for a variety of applications (for example, a random test followed by a shock test and then a sine test).

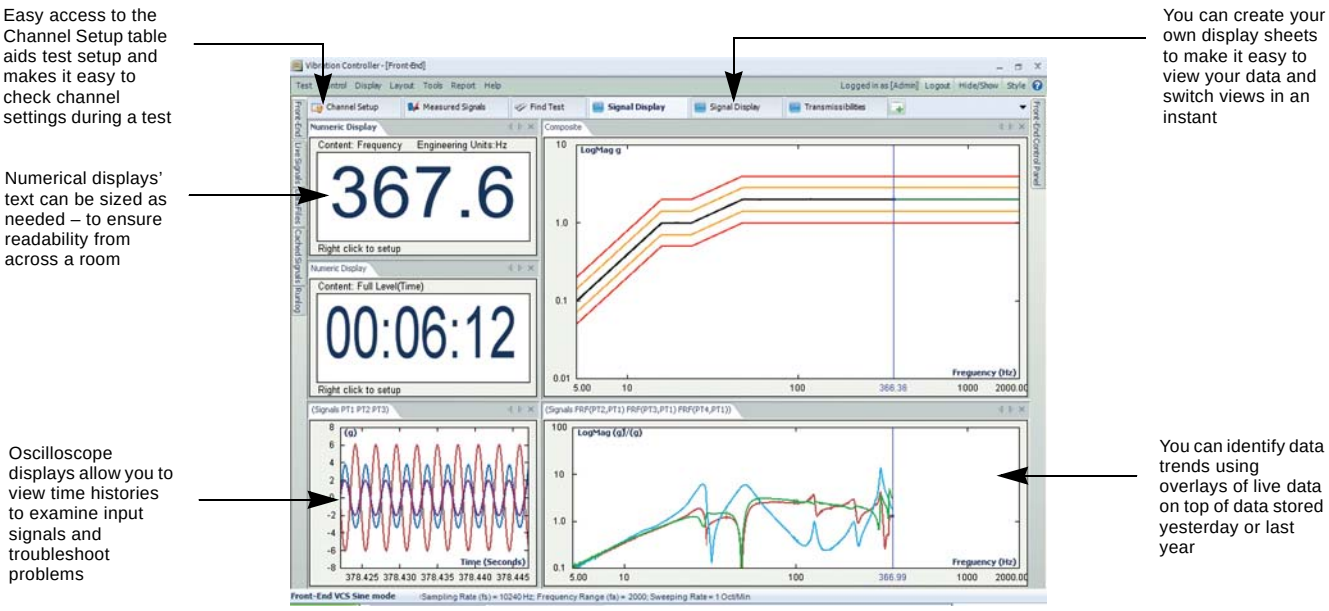
Data recording while controlling using a Data Recorder option, allows you to stream raw data for post-test event diagnosis and comprehensive test data archiving.

Integrated Environmental Testing

VC-LAN controllers can make your lab more efficient and effective by providing capabilities that tightly integrate and coordinate all of your test equipment.

- The digital I/O interface of VC-LAN controllers together with Remote Communication Interface extends automation to include synchronization of vibration testing with environmental chamber tests for temperature, humidity or pressure

Fig. 1 *Flexible display formats including numerical readout windows, overlay plotting and oscilloscope traces, make it easy to supervise and monitor tests*



Accurate, Safe Control

The robust control capabilities of VC-LAN controllers help you to run tests every day, not just when everything is perfect. To handle your most challenging tests, the controllers offer these advanced control features:

- A wide dynamic range (95 dB for random and 100 dB for sine) helps to control to tight tolerances, even if the fixture is less than ideal
- A fast loop time – typically 10 milliseconds – provides rapid test load equalisation and rapid safety checks
- Advanced control algorithms overcome non-linear behaviour and provide stable control

Multi-channel control and limiting ensure accurate and safe control of complex structures or expensive, fragile products. The Drive Notching/Limiting option prevents excessive vibration on critical components.

Control and Monitor Remotely

Since PC connectivity is via a LAN interface, it is possible to have remote, centralised control of multiple VC-LAN Controllers – away from the vibration table test stations. Using wireless network routers, the PC can connect to the controllers remotely via WLAN. WLAN connection eliminates the clutter and cost of LAN cable runs.

Fault-free Testing

VC-LAN Controllers incorporate special features to facilitate error-free measurements. Using Transducer Electronic Data Sheets (TEDS), the software's channel table automatically reads in the correct calibration values for all connected smart sensors. Transducer faults such as short conditions and broken cables are detected before the test starts.

The software protects the test article and shaker by cross-checking the profile demands against the shaker limits before sending a signal to the power amplifier. And fast safety checks performed in the controller's DSP processors detect any problems within milliseconds.

Advanced Control Methods

The special Kurtosis Parameter Control option makes it possible to reduce test time and save costs for product development. Kurtosis is a statistical parameter that provides a measure of the "peakedness" of a random signal. The capability to specify the kurtosis value provides for better simulation of real world vibration environments for automobiles, military vehicles, or general transportation vibration. Since the high kurtosis tests spend more time at higher amplitudes, tailoring kurtosis is also important as a means to accelerate fatigue tests.

Report and Share

Proof of Test

The job is not finished until the test report arrives. Embedded tools rapidly generate professional reports, ready for distribution as electronic documents. With a click, the software automatically creates a full report in Microsoft® Word.

You have full freedom to create your own customised Word templates and use them for automatic report generation. Your Word templates can graphically define the report contents, page orientation and size, heading text, and even automatically insert your company's logo.

Data Sharing

Conveniently record test results by using automatic data saves at specified time intervals or in response to test events. Or save data manually whenever you desire. Since the Vibration Control software is an open solution, you can export data in many different formats. Raw and analysed data can be stored in the multi-user database or output in an industry standard file format like ASAM-ODS.

Random Vibration Control Type 8611

Random vibration simulates a broad range of real-world vibration environments. Since random excites all resonant frequencies simultaneously, it is also well-suited for use in vibration qualification and to characterise a structure's dynamics.

A Random test definition consists of entering a Power Spectral Density (PSD) via a simple breakpoint table or importing field data during set up of the test profile. The breakpoint table consists of PSD amplitudes and associated frequencies plus slopes. The table automatically calculates crossover frequencies or PSD amplitudes when slopes are used. As the breakpoint table is constructed, a plot shows the profile. Also automatically displayed are the overall rms value, maximum peak velocity, and maximum peak-peak displacement for the full level test. If the test's dynamic demands exceed the shaker system's limits, the software automatically warns you.

Uses

- Simulation of vibration experienced by products used in automobiles, military vehicles, and aircraft and space vehicles
- Replication of field measurements
- Production test, stress screening, prototype testing and qualification of products to military standards

Features

- Advanced control algorithms with fast processing provide accurate and safe closed-loop random control
- Up to 4 kHz control standard with the option for closed-loop control to 46 kHz
- Up to 1600 FFT lines standard with the option for up to 28800 lines
- User-selectable overlap processing to speed equalisation times for low-frequency tests
- PSD profile based on field data imported from Microsoft® Excel® CSV

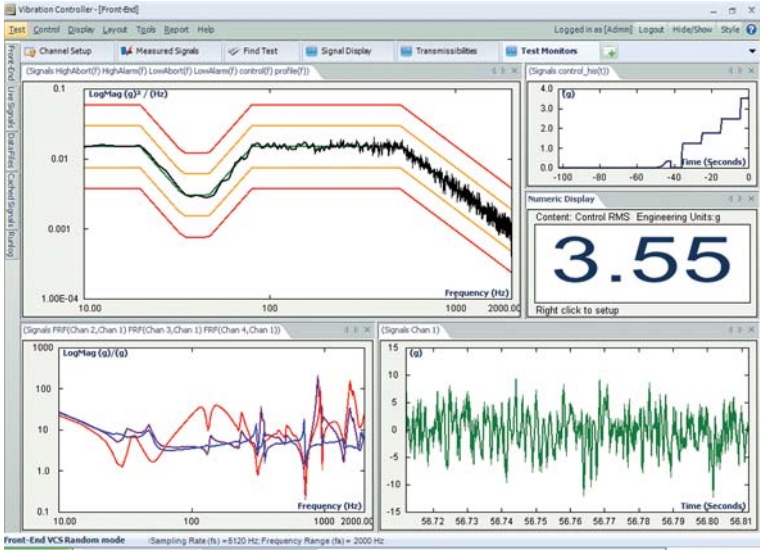


Fig. 2
Random includes all of the tools needed for testing and analysis with ultra-high resolutions up to 28800 FFT lines and on-line FRF measurements

Optional Software

- **Sine-on-Random (SoR) Vibration Control Type 8611-A:** Up to 20 pure tones, sweeping or stationary, superimposed on a random background signal
- **Random-on-Random (RoR) Vibration Control Type 8611-B:** Up to 12 narrowbands, sweeping or stationary, superimposed on a random background signal
- **Kurtosis Parameter Control Type 8611-C:** Provides a better simulation of real-world data and enhances fatigue testing. The system uses continuous feedback control to achieve a user-specified target K-value
- **High-frequency Control for Random Type 8611-E:** Extends the upper frequency range from 4 kHz to 46 kHz
- **Data Recorder Function for Random Type 8611-F:** Disk throughput while controlling
- **High Line Resolution for Random, SoR and RoR Type 8611-G:** Increases maximum FFT lines from 1800 to 28800
- **Drive Notching/Limiting for Random Type 8611-H:** To control or monitor channels
- **Displacement Optimisation Type 8611-K:** Optimising the excitation at low frequencies results in a lower displacement and allows tests to be run at higher g level

Sine Vibration Control Type 8612

Sine provides excitation and control with analog-quality drive signal and user-programmable sweep parameters. For structural dynamics, it is particularly useful to accurately measure the dynamic response of resonances. Sine is also ideal for fatigue testing as all of the excitation energy is concentrated at a single frequency.

A Sine test definition consists of entering a simple breakpoint table during the set up of the test profile. The table consists of acceleration (A), velocity (V) and displacement (D) amplitudes and their associated frequencies plus any slope segments. The software automatically calculates crossover frequencies or A, V or D amplitudes when slopes are used. As the breakpoint table is constructed, a plot shows the profile. Also automatically displayed are the maximum peak values for acceleration and velocity and the maximum peak-peak displacement for the test. If the test's dynamic demands exceed the shaker system's limits, the software automatically warns you.

Uses

- Swept sine or stepped sine testing to meet military and other standards
- Structural dynamics characterisation
- Durability and fatigue testing

Features

- True-time domain processing with analog-quality sine source (not FFT based)
- Digital tracking filters with frequency proportional or fixed bandwidth filters
- Fast 10 ms loop time for accurate control of high Q resonances
- Up to 5 kHz control standard with the option for closed-loop control to 46 kHz
- On-line measurement of FRFs (magnitude & phase) with up to 4096 frequency points
- Pre-test with broadband spectrum to identify system transfer function

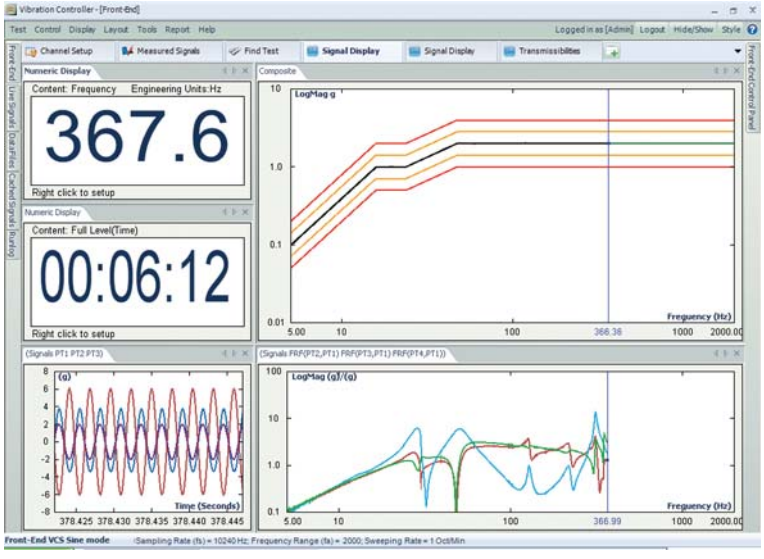


Fig. 3
Sine includes user-selectable proportional or constant bandwidth tracking filters along with on-line FRF measurements

Optional Software

- **Resonance Search Track & Dwell (RSTD) Vibration Control Type 8612-A:** Determines the resonant frequencies using a transmissibility signal, while, in real-time, each resonant frequency is tracked
- **High-frequency Control for Sine Type 8612-C:** Extends upper control range from 5 kHz to 46 kHz
- **Total Harmonic Distortion Measurement for Sine Type 8612-E:** Adds the ability of computing total harmonic distortion of the control signals
- **Data Recorder Function for Sine Type 8612-F:** Disk throughput while controlling
- **Drive Notching/Limiting for Sine Type 8612-G:** To control or monitor channels
- **Low-frequency Sine Control Type 8612-I:** 0.1 Hz minimum control frequency

Classical Shock Vibration Control Type 8613

Classical shock testing on a shaker provides better accuracy and repeatability compared to drop test methods. Special algorithms maximise the use of the full shaker stroke.

Definition of a profile waveform simply requires the selection of a pulse from a standard library of classical waveforms. You then enter the peak acceleration amplitude for the pulse and the duration of the pulse. As pulse parameters change, the setup dialog automatically updates the profile display. The software automatically calculates the peak values for velocity and displacement and displays the shaker limits. If the profile's demands exceed any of the shaker's limits then the software warns you.

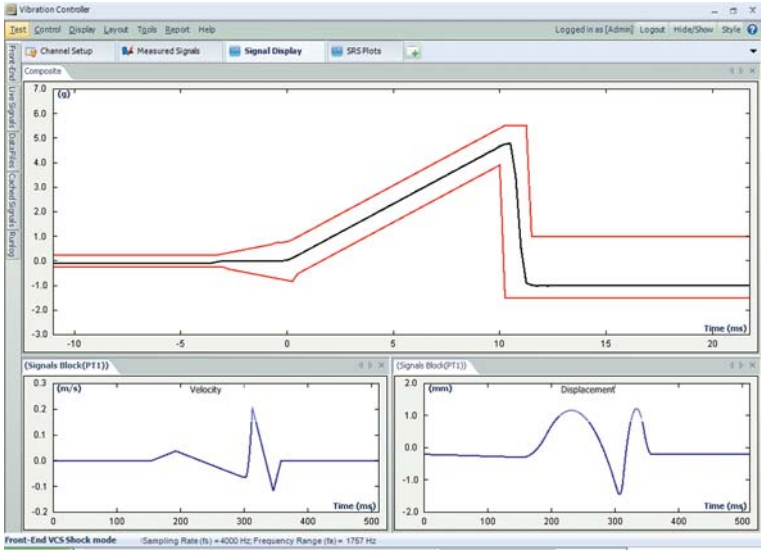
Uses

- Shock testing to meet military and other standards
- Shock Response Spectrum (SRS) computation
- Shaker test replacement for drop testing

Features

- Sampling rates up to 102 k samples per second to accurately measure the waveform peak
- Linear filter design minimises distortion and preserves the true waveform shape
- Low-pass filter with user-specified cut-off frequencies
- Convenient pulse selection from a waveform library of half-sine, haversine, initial and terminal peak sawtooth, triangle, rectangle and trapezoid pulses
- Pulse compensation including displacement optimisation
- Constant Output Level Amplitude (COLA) output pulse to synchronise external equipment

Fig. 4
Classical Shock tests, such as this MIL-STD sawtooth pulse, are easy to set up and run



Optional Software

- **Transient Replication Control (TRC) Type 8613-A:** Replicates shock transients measured in the field by importing data in a variety of formats
- **SRS Displays for Classical Shock and Transient Replication Type 8613-B:** Computes and displays Shock Response Spectra (SRS)
- **SRS Synthesis and Control Type 8613-C:** Create a special transient waveform and reproduce it on a shaker

- **Data Recorder Function for Shock Applications Type 8613-D:** Disk throughput while controlling
- **High Frame Size for Shock Control Type 8613-F*:** Increases the maximum frame size from 4096 to 65536 points

Time Waveform Replication and Control (TWRC) Type 8614

Time Waveform Replication and Control allows an exact recreation of a measured field environment on a laboratory shaker system. Measured field data, say from an automotive test track or an aircraft flight run, can be easily imported into the software, compensated to be suitable to run on your shaker system, and then ready to test.

Unlike conventional iterative equalisation techniques, TWRC updates and adapts the load transfer function on-line. This capability reduces test time and gives enhanced accuracy.

TWRC supports a wide range of data file types so the waveforms to replicate can come from practically any data acquisition system or from data created artificially (for example, from a spreadsheet program like Microsoft® Excel®).

Uses

- Replication of field environments in the lab for automobiles, military vehicles, aircraft and trains
- Test track vibration, road test vibration, aircraft landing shock, etc.
- Recreating very long events lasting from several minutes to several hours

Features

- Adaptive control for accurate adjustments over the course of long tests
- Closed-loop real-time control (not iterative control)
- Supports a wide variety of data file formats to import a reference waveform
- Flexible preprocessing of imported waveforms including DC offset removal, high- and low-pass filtering, cut and paste, and compensation for velocity and displacement to make the waveform suitable for use on a shaker system
- Looping of waveforms and schedule of multiple waveforms with cycling
- Specified aborts at a constant amplitude or point-by-point

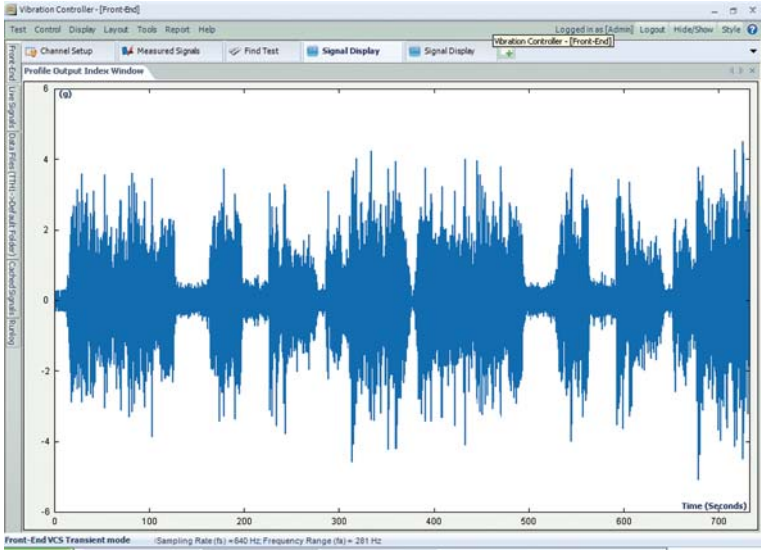


Fig. 5
Field measurements such as a vehicle's road vibration, can be replicated on a laboratory shaker system for durability testing of parts and vehicle electronics

Optional Software

- **Waveform Recording for TWR Type 8614-A:** Option for simultaneous data recording while controlling for a point-by-point record of the test

* Available only for Type 7542: 8 channels with up to 16384 points or 1 channel with 65536 points

Sine-on-Random (SoR) Vibration Control Type 8611-A

Sine-on-Random simulates complex vibration environments characterised by a combination of broadband random and sinusoids or ‘tones’. Generally both signal types are present simultaneously and the tones may appear at either fixed frequencies or they may sweep over a frequency range. One common example is the vibration from an automobile drive train as the vehicle accelerates and the gear ratio is changed. Another example is the periodic bursts of gunfire from a flying military helicopter.

In SoR, the broadband random is defined in a user-specified breakpoint table of power spectral density versus frequency – as in the Random Vibration Control software. Each sine tone has an independently set amplitude, frequency sweep range, and sweep rate. You can also define a sine sweep profile versus frequency in constant acceleration, velocity and displacement segments. Sine tone sweeps can be constrained to be harmonically related. To simulate gunfire, the software allows pre-programmed on and off periods for the sine tones.

Uses

- Simulation of vibration characterised by broadband random with one or more superimposed tones
- Gunfire from military helicopters or propeller driven aircraft
- Automobile vibration in the engine, drive train, and transmission during speed changes

Features

- General features of Random and Sine Vibration Control software included
- Time domain generated true sine tones (not created by FFT method)
- Digital tracking filter for each tone
- Up to 20 sine tones
- Tone may sweep or be fixed with harmonic or non-harmonic sweeps
- User-defined on and off durations for each tone
- Amplitude-frequency profile for each tone with constant acceleration, velocity, or displacement segments plus slopes with automatic crossover calculation
- Manual on/off control of individual tones during a test
- Sine-on-Sine test capability
- Separate sine tone track display for test validation

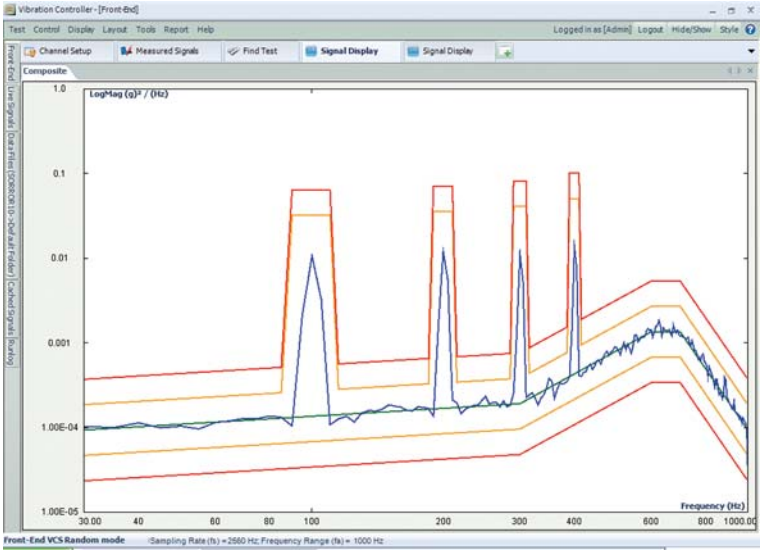


Fig. 6
Sine-on-Random simulates a broad range of vibration environments from automotive vehicles and helicopters to gunfire

Random-on-Random (RoR) Vibration Control Type 8611-B

Random-on-Random simulates the vibration environment in military tracked vehicles or any vehicle in which the overall random power spectral density is related to a variable speed device or shifts with time. The vibration stress on a truck's headlights while the truck changes speed over a rough highway would be another example of using RoR to simulate the real world on a lab shaker system.

In RoR, the broadband random is defined in a user-specified breakpoint table of power spectral density versus frequency as in the Random Vibration Control software. Each narrowband has an independently set PSD amplitude, frequency sweep range, and sweep rate. You can also define a profile of the PSD amplitude profile versus frequency. Narrowband can sweep independently or in a harmonic mode.

Uses

- Simulation of vibration characterised by broadband random with one or more superimposed narrowbands
- Military tracked vehicles or propeller-driven aircraft
- Truck vibration during speed changes

Features

- General features of Random Vibration Control software included
- Up to 12 narrowbands
- narrowbands may sweep or be fixed with harmonic or non-harmonic sweeps
- Amplitude-frequency profile for each narrowband with PSD amplitudes and frequencies plus slopes with automatic crossover calculation
- Manual on/off control of individual narrowbands during a test
- Choice of summing method for narrowbands and broadband

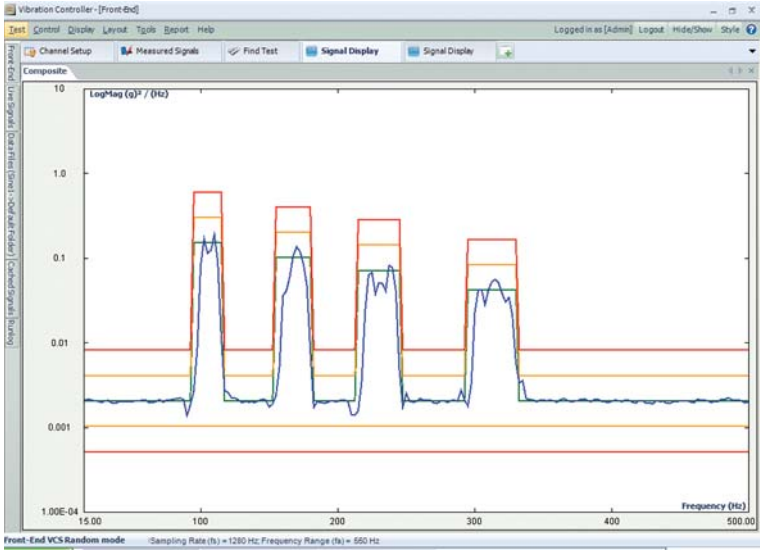


Fig. 7
Random-on-Random simulates vibration environments inside of tracked vehicles, propeller-driven aircraft, and even a truck driving on a highway

Resonance Search Track and Dwell (RSTD) Vibration Control Type 8612-A

RSTD is an invaluable tool for automated fatigue testing. A sine sweep measures the test article's transmissibility function. The setup for the sine sweep has all of the features of the Sine Vibration Control software with user settings for the start and finish frequencies, sweep rate, and spectrum frequency resolution. Once a measured transmissibility is measured, then the resonant frequencies are automatically detected based on user-defined criteria for the Q factor (or damping) and the transmissibility amplitude ratio. The dwell duration is specified in either cycles or time duration and the dwell is either a fixed dwell or a tracked dwell. A special tracking feature adjusts the drive frequency to track the resonance as its frequency changes during dwelling.

Uses

- Fatigue and durability testing
- Compliance to military standards and other standards requiring resonance dwell testing

Features

- Transmissibility measurement with all of the Sine Vibration Control features for sweeping and control
- Automatic detection and listing of resonances including frequency, amplitude, phase and Q factor
- Tracked or fixed frequency dwells
- Amplitude profile as acceleration, velocity, or displacement
- Dwell duration based on the number of cycles or time
- Dwell termination based on resonant frequency changing by specified frequency amount (Hz), percentage of the resonant frequency, and by amount (Hz) per minute; also a change in the resonance amplitude ratio of greater than a specified dB factor

Fig. 8
Resonance Dwell provides a valuable test method for durability testing of components and assemblies

Transient Replication Control (TRC) Type 8613-A

TRC allows replication of a range of field measured shock transients, from pyrotechnic events and road bumps to earthquake transients – on a laboratory shaker system. A convenient model library allows automatic creation of special waveforms. The control and display features are the same as for the Classical Shock Vibration Control application.

TRC imports field data in a variety of formats including ASCII text, Excel CSV, Universal File Format (UFF), ASAM-ODS, and others. During importing, the software automatically digitally resamples the data, at up to 102 k samples per second, to match Type 7541 and 7542's hardware. Once imported, user-defined compensation can be applied to make the waveform suitable for use with the shaker system.

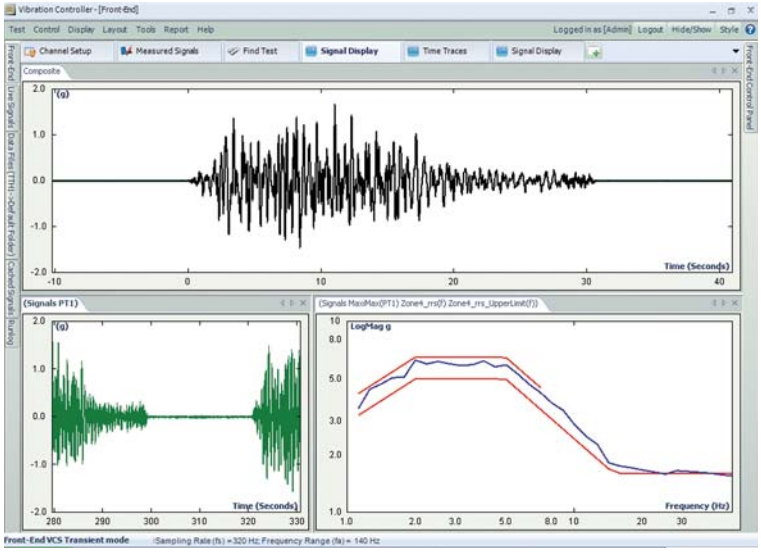
Uses

- Replicating measured field data on a laboratory shaker system
- Replication of drop shocks, pyrotechnic transients and other high frequency shocks
- Automotive applications such as door slam testing
- Testing of seismic transients including Bellcore

Features

- Import of field data in ASCII text, ASAM-ODS XML, UFF ASCII, UFF Binary, Excel CSV and National Instruments™ TDM formats
- Sampling rates up to 102 ksps with up to 65 k data points (4096 points standard)
- Compensation to give zero final velocity and displacement
- Processing tools including DC removal, high- and low-pass filters
- Model library including chirp, triangular bursts, and Bellcore seismic waveforms
- Display of time histories as acceleration, velocity and displacement
- Option for Shock Response Spectra (SRS) plots
- Constant Output Level Amplitude (COLA) output pulse to synchronise external equipment

Fig. 9
Transient Replication Control replicates real world vibration for everything – from a forklift running over a speed bump to a full-blown earthquake event as shown here



SRS Synthesis and Control Type 8613-C

SRS (Shock Response Spectrum) Synthesis and Control provides a valuable tool to evaluate the shock worthiness of equipment. By creating a synthesised waveform that matches a user-specified SRS profile, the controller tests the shock damage resistance of equipment mounted on a shaker system. The software synthesises a waveform from sinusoidal components, or wavelets, from a table of sine beats or damped sine with a wavelet at each fractional octave frequency corresponding to the SRS profile. An iterative process adjusts the amplitudes, half-cycles, and relative delays of the wavelets until the synthesised pulse's SRS matches the profile SRS to within the required accuracy.

You create an SRS profile by entering, or importing, breakpoint table of frequencies and acceleration amplitudes plus slopes if required. After specifying the Q factor (or damping) and the synthesis method as pyroshock, minimum acceleration, or a user-defined duration, SRS Synthesis and Control automatically synthesises a waveform that matches the profile SRS.

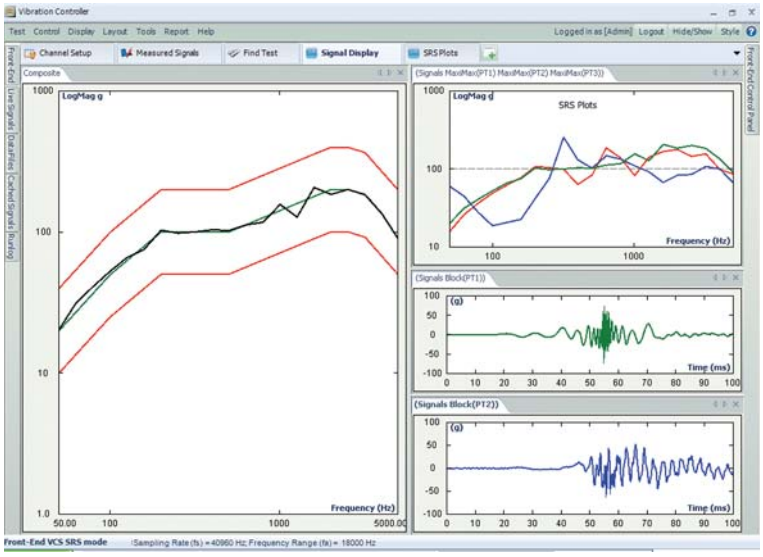
Uses

- Simulating shock transient including pyrotechnic and earthquake waveforms
- Shock damage testing by matching a specified SRS profile
- Aerospace and space applications for explosive events
- Earthquake and seismic qualification tests
- Compliance to military and commercial standards

Features

- SRS profile breakpoint table with unlimited number of entries
- Sine beats or damped sine wavelets
- Automatic iterative creation of wavelets including frequencies, half-cycles, delay and amplitude
- Manual optimisation mode to edit wavelet table
- SRS types for maxi-max, positive maximum, or negative maximum
- SRS frequencies with octave spacing from 1/1 to 1/48
- Damping ratio from 0.1 to 99% (Q = 0.5 to 500)
- SRS control up to 20 kHz
- Sampling rates up to 102 ksps with up to 65 k data points (4096 points standard)
- Display of shock response spectra and time histories as acceleration, velocity or displacement

Fig. 10
SRS Synthesis tests the damage potential for a shock vibration by matching a user-specified SRS target curve



General Options

- **Non-Acceleration Control Type 8610-L:** Allows control using a force, velocity, displacement or other transducer type
- **Calibration Software for 7541 Type 8641:** Software that allows a qualified calibration laboratory, or the system operator, to calibrate the Vibration Controller
- **Calibration Software for 7542 Type 8642:** Same as Type 8641
- **Charge Amplifier Calibration Cable and Connector Board Kit ZH-0695:** A board with the appropriate capacitors required for charge calibration

Applications

RANDOM SUITE
- Random Vibration Control Type 8611
- Sine-on-Random Vibration Control Type 8611-A
- Random-on-Random Vibration Control Type 8611-B

SINE SUITE
- Swept Sine Vibration Control Type 8612
- Resonance Search, Track and Dwell Type 8612-A

SHOCK SUITE
- Classical Shock Vibration Control Type 8613
- Transient Replication Control Type 8613-A
- SRS Synthesis and Control Type 8613-C

FIELD DATA REPRODUCTION
- Time Waveform Replication Control Type 8614

OTHER APPLICATIONS
- Shaker Response Characterisation Type 8615

Software Base

CODE BASE
Native 64-bit software; Microsoft® .NET compliant

ARCHITECTURE
Processing inside Vibration Controllers Type 7541 and 7542 removes the PC from the control loop. True multi-tasking allows the PC to deliver maximum graphics performance and responsiveness.
Software provides on-line test status and management via text displays, software toggle buttons and displays of multiple time and/or frequency signals

PC Requirements

OPERATING SYSTEM
Microsoft® Windows® 7, Windows Vista® or Windows® XP

OTHER APPLICATIONS
Microsoft® Word

PC MEMORY
To maximize PC displays, a high-end PC with at least 4 GB of RAM is recommended

PC EXPANSION
PC upgrades and peripheral additions do not delay or interrupt the control loop processing

User Interface

SETUP NAVIGATOR
Graphical setup tree provides quick and easy access to the main test setup pages.

SIMPLIFIED USER INTERFACE
The user interface and user rights can be tailored for novice to expert users. The system administrator controls over 20 user interface components and sets them as either “Editable” or “Viewable”
Password Security and User Interface Customisation: This option links to all modules of the vibration control software. An administrator can create Groups, Users and Passwords.
Create groups with arbitrary names and assign privileges to access software functions. Also allows customisation of the user interface by hiding setup menus and dialogs to create a simplified user interface
Mission Profiling and Test Sequencing: Test Sequencing provides the capability to execute a sequence of project files in an automatic sequence. All of the project files may be for the same type of application, such as all random tests, or they may be for a variety of applications. The latter type of sequencing is used for “mission profiling”. For this type of project sequencing, a random test might be followed by a shock test and then a sine-on-random test.
Test Sequencing allows convenient definition, storage and recall, and execution of the test. A graphical user interface provides an easy way to create or edit a sequence of individual project files

COMMUNICATION TO/FROM VC-LAN
Remote Communication Interface (RCI): Using TTL signals connected to the digital I/O port, the vibration controller communicates and/or controls external equipment such as a thermal chamber. The software’s Test Schedule function allows programming a coordinated vibration and environmental test condition test.
Digital Inputs Actions: Start test, flash a message on screen, sound a keyboard beep, create report, save signals and the application screen, send emails, send Windows®-based message to other program, set digital output signals, start recording, stop recording, next level, increase level, decrease level, abort test, abort checks on/off, control loop closed/open
Configurable Digital Output Events: Stop test, channel overload, output maximum voltage, exceed high abort or alarm line, below low abort or alarm line, rms higher than high alarm/abort, rms lower than low alarm/abort.
Output Pulse Types: High-to-Low, Low-to-High and programmed
Send e-mails and IM as Event Actions: Provides the capability to send emails and SMS messages automatically based on pre-programmed test events
Remote Command and Control (RCC) Using Socket Messages: Enables other applications to communicate and/or control Vibration Controller Type 7541 or 7542. Socket messages easily embed into applications written in languages like Visual Basic® or Visual C++. These controls are also usable by applications such as LabVIEW™, MATLAB, and Excel®

Embedded Database

The included database manages both test data and project setups. Tests are searchable by keyword, time, and date. Test projects can be set up with or without a Type 7541 or 7542 front-end connected

Input and Output

INPUT CHANNELS
Location ID: User-specified name used for all displays of the signal and data storage
Channel Status: Bar level meter display of the level for each input channel and CCLD sensor connection status
Sensor Sensitivity: User-defined engineering unit and input sensitivity setting for each channel
Input Mode: CCLD, Charge (Type 7542 only), AC-differential, AC-single end, DC-differential and DC-single end
Digital High-Pass Filter: High-pass filter with user-specified cutoff frequency
Channel Type: Control, monitor and limiting
TEDS Detection (Type 7542 only): Detects TEDS sensor attributes
Channel Library: Saves settings of the input channel table into a library that is accessible by other projects

COLA OUTPUT (TYPE 7542 ONLY)
Random COLA: Control rms level, rms or peak value of selected input channel, no output
Sine COLA: Constant amplitude, voltage proportional to frequency, no output
Shock COLA: Pulse output, reverse polarity of pulse output, no output

Signal Displays

Unlimited number of display windows in tiled or cascade layout with click-and-drag zoom, user annotation, and cursors

PAGE LAYOUT
For Each User-defined Display Page: A choice of single, dual or quad windows and table view are available

WINDOW FORMAT
Per Window: Choice of single pane or user-defined number of multiple panes with vertical or horizontal column layout. Each pane can display single or multiple signals overlaid in either time or frequency

PLOT APPEARANCE
User-defined line colour and thickness for signals, text font size, grids, tick marks, labels, titles, etc.

SCALE FORMAT
Linear or logarithmic scales for X and Y axes with automatic or manual scaling

DIMENSION
Acceleration, velocity and displacement

FREQUENCY SIGNALS
Control; composite (control, profile, aborts and alarm limits); any input; transmissibility (amplitude and phase); drive; profile; alarms and aborts; and noise spectra

OSCILLOSCOPE PLOTS
Drive and input time histories

STRIP CHART PLOTS
Scrolling record (data point per buffer) of any input channel's rms, peak or peak-to-peak values

OTHER DISPLAYS
Numeric value (user sizable window), digital I/O view, run log, and channel status windows

COPY OPERATIONS
Direct copying of signals to clipboard for insertion of numeric tabulations and bitmaps into spreadsheets, word processors or other applications

DATA SAVES
Pre-programmed data saves in specified file format at specific time intervals or test events; on-line cache memory saves for easy data comparison during a test

CURSORS
Single cursor with X, Y, rms readouts and dual cursors with ΔX, ΔY, Δrms readouts; automatic peak/valley detection and marks; harmonic cursors

ENGINEERING UNITS
English, SI, Metric, mixed; linear or angular

Post-test Documentation

Single-click generation of data plots and test reports, including customisable notes, setup parameter listings, run log, and formatted signal plots, within Microsoft® Word

AUTOMATED REPORTS
User-defined report creation times based on Event Action definitions

USER REPORT TEMPLATE
Easily defined template with customised header/footer, layout and contents

Data Sharing

EXPORT DATA FILE FORMATS
- **ASAM-ODS XML:** ASAM Open Data Source binary format
- **UFF:** ASCII and Binary file formats
- **ASCII:** User-defined format with selectable attributes defined in customised template
- **Excel CSV:** Comma Separated Value (CSV)
- **MATLAB:** .mat binary format
- **NI TDM:** National Instruments™ structured storage format
- .**WAV:** Sound wave files can be played with a digital media player. Exported wave files do not contain file header information. Export supports time signals only

Hardware Self-check

The self-check function uses a precise signal source with an internal connection to the input channels to verify that all input channels are reading within nominal tolerances

Stand-alone Unit

Vibration Controller Type 7542 can operate as a stand-alone unit, i.e., run detached without connection to a PC. Test projects are initially downloaded from a PC and then started by the Start button on the front panel, by digital inputs, or by a wireless remote control pendant. Test data saved internally on Type 7542 is available for upload to a PC via a hardwire or wireless connection

Optional Software

NON-ACCELERATION CONTROL TYPE 8610-L
This option allows control using a force, velocity, or displacement transducer. One application of this capability is for Force Limiting. Other uses include: sine testing with transition control from a displacement sensor to an accelerometer, and control to angular acceleration

SHAKER RESPONSE CHARACTERISATION (SRC) TYPE 8615
Sine Oscillator is an application that provides open-loop sine excitation with convenient manual control of the output voltage level and frequency. The package also provides sweep capabilities and it can be used to make transmissibility and transfer function (amplitude and phase) measurements. It is a great tool for quick characterisation of a fixture or to validate the shaker's performance. It also allows for having a random pretest before the sine sweep

TRANSDUCER SENSITIVITY CHECK TYPE 8616
This tool calibrates the sensitivity of a transducer against a known reference sine signal.
User Inputs: Frequency of calibration signal; amplitude, reference amplitude of the calibration signal in rms or dBrms. After calibration the user accepts or rejects the new calibration value with automatic updating of the input channel table for accepted values

Specifications – Random Vibration Control Type 8611

Control Parameters

FREQUENCY RANGE
0 to 5 kHz
Closed-loop control extends to 46 kHz with optional software High-frequency Control for Random Type 8611-E*

CONTROL LINES
110, 225, 450, 900, or 1800 lines
Up to 28800 lines with optional software High Line Resolution for Random Type 8611-G

Δf RESOLUTION
User-selectable, including 5 Hz and its multiples

DYNAMIC RANGE
Up to 95 dB

CONTROL ACCURACY
±1 dB at 99% confidence with 200 DOF

RANDOMISATION
Frequency domain, phase-randomisation technique produces a true Gaussian distribution

LOOP TIME
Typically 12.5 ms

* For control frequencies above 5 kHz the number of channels and FFT lines are limited (e.g., Type 7542: 8 channels with 1600 lines for 14 kHz or 2 channels with 1600 lines for 46 kHz and for Type 7541: 2 channels for 46 kHz and up to 1600 lines)

SYSTEM TRANSFER FUNCTION
Measured during pre-test or recalled from disk for quick test start and equalisation

DOF
2 to 1000

OVERLAP AVERAGING
None, or from 50% to 88% overlap

CONTROL STRATEGY
Single-channel control
Multiple input channels (up to eight) combined by rms weighted average, minimum, or maximum

DRIVE CLIPPING
3 to 10 sigma or disabled

LIMITING
Any channel can be enabled as a Limit or Abort channel
Each Limit channel has its own amplitude vs. frequency profile with optional software Drive Notching/Limiting for Random Type 8611-H

Reference Profile

The profile is entered as a table of breakpoints with graphical display of the profile and graphical editing

BREAKPOINTS
Unlimited combination of PSD levels and slopes (dB/octave) at user-defined frequencies

ABORT/ALARM LIMITS
High and low profile limits defined independently at each breakpoint in dB or % with respect to reference; rms high and low limits calculated automatically from profiles or specified by user

VALIDATION TOOLS
Profile displayed and updated as it is created along with listing of rms and peak acceleration, velocity and displacement values for profile. Profile dynamic limits are automatically validated against the shaker parameters

PROFILE SCALING
Profile breakpoints rescaled based on user-defined rms value

FIELD DATA IMPORT
Field data can be imported and used as the test profile

PROFILE LIBRARY
Breakpoint table saved in library and recallable by any other Random project

Test Schedule Event Actions

SCHEDULE
A schedule can include an unlimited number of test stages and user-defined events

EVENT ACTIONS
Test events such as alarm conditions and digital input signals trigger actions pre-programmed by the user

EVENTS
High/low abort or alarm limits exceeded; rms high or rms low abort/alarm level exceeded; any digital input event; channel overload; output maximum; and user stop

ACTIONS
Flash message on control panel; sound keyboard beep; create report; save signals; save screen; send emails; send socket messages to another program; set digital output signals; start recording; stop recording; next level; increase level; decrease level; abort test; abort checks on/off; and control loop closed/open

Test Compliance and Safety

SHAKER PARAMETERS
Dynamic limits for shaker acceleration, velocity, displacement, and force. Maximum acceleration that will be available automatically calculated based on mass of shaker armature, fixture, and test article

CONTROL PSD LIMITS
Abort/alarm limits based on the profile breakpoint table in dB or percentage

RMS LIMITS
High and low abort/alarm rms limits for the control signal

ABORT SENSITIVITY
Slide-scale setting to set the abort sensitivity to high or low

OPEN-LOOP DETECTION
Open-loop detection for control signal and each input channel. Detection based on maximum control loss or maximum rms rate of change in the input channels

LINES OUT
Sets the allowable PSD lines out of the profile limits as a number or % relative to the Control Lines setting

MAX. DRIVE LIMIT
Maximum voltage limit for drive output

EMAIL/SMS MESSAGE
Email or SMS message automatically sent on test abort

Test Execution

The system performs pre-test checks, equalises the load, and then executes the schedule

PRE-TEST
System performs safety checks then gradually increases the drive per user-specified peak drive voltage (initial and maximum), response level goal, and ramp-up rate (slow or fast)

EQUALISATION OPTIONS
- Measure system FRF in a closed-loop test
- Run using the last measured FRF
- Use a saved FRF (pre-stored drive)

AUTOMATIC MODE
System automatically executes the events specified in the schedule

MANUAL MODE
User can override automatic mode to manage the test using manual commands

On-line Test Controls

Control panel toggle buttons provide easy access to test controls. Commonly used commands are also accessible via keyboard function keys. Text messages and numerical readouts on the control panel enhance test status monitoring

CONTROL BUTTONS
Start/stop; pause/continue; set level; reset average; increase/decrease level; enable/disable abort checks; loop closed/open; schedule clock timer on/off; next schedule item; save FRF function; show pre-test results; save signals; and start data recorder

STATUS DISPLAYS
Control and demand rms; acceleration; demand velocity and displacement; test % or dB level; peak drive volts; full level and total test time elapsed; time remaining; activity status; and a red alert message box

Optional Software

Name	Description
Sine-on-Random (SoR) Vibration Control Type 8611-A	Up to 20 pure tones, sweeping or stationary, superimposed on a random background signal
Random-on-Random (RoR) Vibration Control Type 8611-B	Up to 12 narrowbands, sweeping or stationary, superimposed on a random background signal
Kurtosis Parameter Control Type 8611-C	The Kurtosis parameter can be set to values from 3 to 10 to adjust the amplitude distribution of the vibration to match the target with minimal effect on the frequency content and dynamic range
High-frequency Control for Random Type 8611-E	Extends the upper frequency range from 4 kHz to 46 kHz. Higher frequency range selections may reduce the maximum channel count and highest allowed overlap ratio
Data Recorder Function for Random Type 8611-F	Data stream all input channels during Random, SoR, and RoR tests. Data saved internally on Vibration Controller Type 7541/7542 or on a host PC hard disk *Typical Continuous Recording Time*: 4 hours for 4 input channels with frequency range 2 kHz with 4 GB flash memory installed
High Line Resolution for Random, SoR and RoR Type 8611-G	Increases the number spectral lines from 1800 up to 28800. Higher line selections may reduce the maximum channel count and highest allowed overlap ratio *Spectral Lines*: 3600, 7200, 14400 and 28800
Drive Notching/Limiting for Random Type 8611-H	Limiting can be applied to control or monitor channels. Available limiting types are notching limit and abort limit. Limiting profiles created by using a breakpoint table of amplitudes and frequencies
Displacement Optimisation Type 8611-K	Optimising the excitation at low frequencies results in a lower displacement. This allows tests to be run at higher g level

Specifications – Sine Vibration Control Type 8612

Control Parameters

FREQUENCY RANGE
2 Hz to 5 kHz
Closed-loop control extends to 46 kHz with optional software High-frequency Control for Sine Type 8612-C* and down to 0.1 Hz with optional software Low-frequency Sine Control Type 8612-I

CONTROL RESOLUTION
256, 512, 1024, 2048 or 4096 frequency points

DYNAMIC RANGE
Up to 100 dB

CONTROL ACCURACY
±1 dB through peak-notch with a Q of 50 at 1 octave/min., 8 control channels with 25% proportional tracking filters

LOOP TIME
Typically 10 ms

TRACKING FILTERS
Proportional Bandwidth: 7 to 100% of drive frequency
Fixed Bandwidth: 1 to 500 Hz

CONTROL STRATEGY
Single-channel control
Multiple input channels (up to eight) combined by weighted average, minimum, or maximum

SWEEP RATE
Log (octave/min): 0.01 to 6000
Log (decade/min): 0.001 to 2000
Linear (Hz/s): 0.001 to 2000

LIMITING
Any channel can be enabled as a Limit or Abort channel
Each Limit channel has its own amplitude vs. frequency profile with optional software Drive Notching/Limiting for Sine Type 8612-G

* For control frequencies above 5 kHz the number of channels and FFT lines are limited (e.g., Type 7542: 8 channels for 20 kHz or 1 channel for 46 kHz and for Type 7541: 4 channels for 20 kHz or 1 channel for 46 kHz)

Reference Profile

Entered as a table of frequency-value breakpoints for constant acceleration, velocity and displacement segments plus log-log or lin-lin slopes

BREAKPOINTS
Unlimited combination of amplitudes (A, V or D) right and/or left constant A/V/D slopes at defined frequencies; automatic crossover calculations

ABORT/ALARM LIMITS
High and low profile limits defined independently at each breakpoint in dB or % with respect to reference. Peak acceleration, velocity, and displacement values calculated automatically from profile

VALIDATION TOOLS
Profile displayed and updated as it is created. Automatic listing of peak acceleration, peak velocity and peak-to-peak displacement values for profile. Profiles are validated against shaker parameter table

PROFILE LIBRARY
Breakpoint table saved in library and recallable by any other Sine project

Test Schedule Event Actions

SCHEDULE
A schedule can include an unlimited number of test stages and user-defined events

EVENT ACTIONS
Test events such as alarm conditions and digital input signals trigger actions pre-programmed by the user

EVENTS
High/low abort or alarm limits exceeded; any digital input event; channel overload; output maximum; and user stop

ACTIONS
Flash message on control panel; sound keyboard beep; create report; save signals; save screen; send emails; send socket messages to another program; set digital output signals; start recording; stop recording; next level; increase level; decrease level; abort test; abort checks on/off; and control loop closed/open

Test Compliance and Safety

SHAKER PARAMETERS
Dynamic limits for shaker acceleration, velocity, displacement, and force. Maximum acceleration that will be available automatically calculated based on mass of shaker armature, fixture, and test article

ABORT LIMITS
Abort/alarm limits based on the profile breakpoint table in dB or %

ABORT SENSITIVITY
Slide-scale setting to set the abort sensitivity to high or low

OPEN-LOOP DETECTION
Open-loop detection for control signal and each input channel. Detection based on maximum control signal dB change or peak change between successive frames

ABORT LATENCY
Total seconds that control may exceed the abort limits before initiating a test abort

MAX. DRIVE LIMIT
Maximum voltage limit for drive output

EMAIL OR SMS MESSAGE
Email or SMS message automatically sent on test abort

Test Execution

The system performs pre-test checks, then executes the sweep schedule

PRE-TEST
System performs safety checks then gradually increases the drive per the user-specified peak drive voltage (initial and maximum), response level goal, and ramp-up rate (slow or fast)

START-UP OPTIONS
- Immediately begin the test at the start frequency
- Measure the system FRF using broadband noise and then wait for operator prompt to begin

AUTOMATIC MODE
System automatically executes the events specified in the schedule

MANUAL MODE
User can override automatic mode to manage the test using manual commands

On-line Test Controls

Control panel toggle buttons provide easy access to test controls. Commonly used commands are also accessible via keyboard function keys. Text messages and numerical readouts on the control panel enhance test status monitoring

CONTROL BUTTONS
Start/stop; pause/continue; hold/resume sweep; sweep up/down; set frequency; increase/decrease sweep rate; set level; increase/decrease level; enable/disable abort checks; loop close/open; next schedule item; save signals; and start data recorder

STATUS DISPLAYS
Control and demand peak acceleration; test % or dB level; peak drive volts; full level and total test time elapsed; time remaining; activity status; and a red alert message box

Optional Software

Name	Description
Resonance Search Track & Dwell (RSTD) Vibration Control Type 8612-A	The search function determines the resonant frequencies using a transmissibility signal. In real-time control, the tracked dwell entry tracks each resonant frequency. *Resonant Frequency Search*: Uses Q or amplitude of transmissibility to automatically search the resonances within a user-specified range *Tracked Dwell Entry*: Resonant frequencies are loaded from the search table or manually entered. Dwell continues until time duration or cycle count is reached, resonant frequency changes out of limits, or amplitude changes out of limits
High-frequency Control for Sine Type 8612-C	Extends the upper frequency range from 5 kHz to 46 kHz. Higher frequency range selections may reduce the maximum channel count
Total Harmonic Distortion Measurement for Sine Type 8612-E	Adds the ability to compute total harmonics distortion of the control signals
Data Recorder Function for Sine Type 8612-F	Data stream all input channels during Sine and RSTD tests. Data saved internally on Vibration Controller Type 7541 or 7542 or on a host PC hard disk. *Typical Continuous Recording Time*: 4 hours for 4 input channels with frequency range 2 kHz with 4 GB flash memory installed
Drive Notching/Limiting for Sine Type 8612-G	Limiting can be applied to control or monitor channels. Available limiting types are notching limit and abort limit. Limiting profiles created by using a breakpoint table of amplitudes and frequencies
Low-frequency Sine Control Type 8612-I	Lowers the minimum starting frequency from 2 Hz to 0.1 Hz

Specifications – Classical Shock Vibration Control Type 8613

Control Parameters

SAMPLING RATE
Up to 102 k samples per second automatically set based on pulse duration with selectable oversample factor. Linear filter design minimises distortion and preserves the true waveform shape

FRAME SIZE
128, 256, 1024, 2048 or 4096 points

Extended up to 65536 points with optional software High Frame Size for Shock Control Type 8613-F for 7542 only (8 channels with up to 16384 points; 1 channel with 65536 points)

SYSTEM TRANSFER FUNCTION
Measured during pre-test or recalled from disk for quick test start and equalisation

CONTROL STRATEGY
Single-channel control
Multiple input channels (up to eight) combined by weighted average

AVERAGING
User-specified coefficient from 1 to 500

FILTERING
User specifies cut-off frequency for low-pass filtering applied to the reference waveform, drive and all input channels

PULSE DELAY
User-specified delay between pulses from 0 to 1000 s

Reference Profile

Convenient pulse selection from a waveform library. User-specified duration and peak acceleration

PULSE TYPES
Half-sine, haversine, initial and terminal peak, sawtooth, triangle, rectangle and trapezoid

PULSE DURATION
0.05 ms to 5000 ms

PULSE COMPENSATION
- Pre- and post-pulse, post-pulse only, or pre-pulse only
- Choice of displacement optimum, rectangular or rounded rectangular compensation pulses
- Pre-pulse and post-pulse amplitudes definable in percentage of reference peak acceleration

ABORT LIMITS
MIL-STD-810 G, MIL-STD-202 F, ISO, IEC 6008−2−27 templates or customised by user in percentage relative to the profile waveform amplitude for the main pulse, pre-pulse and post-pulse tolerances

VALIDATION TOOLS
Waveform displayed and updated as created. Automatic display of profile acceleration, velocity and displacement waveforms together with shaker limits. Shock profile validated against shaker parameter table

Test Schedule Event Actions

SCHEDULE
A schedule can include an unlimited number of test stages and user-defined events

EVENT ACTIONS
Test events such as alarm conditions and digital input signals trigger actions pre-programmed by the user

EVENTS
High/low abort limits exceeded, any digital input event, channel overload, output maximum, and user stop

ACTIONS
Flash message on control panel; sound keyboard beep; create report; save signals; save screen; send emails; send socket messages to another program; set digital output signals; start recording; stop recording; next level; increase level; decrease level; abort test; abort checks on/off; control loop closed/open

Test Compliance and Safety

SHAKER PARAMETERS
Dynamic limits for shaker acceleration, velocity, displacement, and force; maximum acceleration that will be available automatically calculated based on mass of shaker armature, fixture, and test article

CONTROL LIMITS
Abort/alarm limits for the main pulse, pre-pulse, and post-pulse

ABORT SENSITIVITY
Slide-scale setting to set the abort sensitivity to high or low

OPEN-LOOP DETECTION
Open-loop detection for control signal and each input channel. Detection based on the rms change between successive frames

NUMBER OF POINTS
Sets the allowable total number of points out in percent of the frame size

MAX DRIVE LIMIT
Maximum voltage limit for drive output

EMAIL OR SMS MESSAGE
Email or SMS message automatically sent on test abort

Test Execution

The system performs pre-test checks, equalises the load, and then executes the schedule

PRE-TEST
System performs safety checks then gradually increases the drive per the user-specified peak drive voltage (initial and maximum), response level goal, and ramp-up rate (slow or fast)

EQUALISATION OPTIONS
- Measure system FRF in a closed-loop test
- Run using the last measured FRF
- Use a saved FRF (pre-stored drive)

AUTOMATIC MODE
System automatically executes the events specified in the schedule

MANUAL MODE
User can override automatic mode to manage the test using manual commands

On-line Test Controls

Control panel toggle buttons provide easy access to test controls. Commonly used commands are also accessible via keyboard function keys. Text messages and numerical readouts on the control panel enhance test status monitoring

CONTROL BUTTONS
Start/stop; pause/continue; inverse pulse; set level; increase/decrease level; restore level; reset average; enable/disable abort checks; loop closed/open; schedule clock timer on/off; next schedule item; save FRF function; show pre-test results; save signals; and start data recorder

STATUS DISPLAYS
Control and demand peak and rms acceleration; peak drive volts; full level and total test time elapsed; time remaining; activity status; and a red alert message box

Optional Software

Name	Description
Transient Replication Control (TRC) Type 8613-A	Replicates shock transients measured in the field by importing data and applying compensation to allow the transient to run on a shaker system
SRS Displays for Classical Shock and Transient Replication Type 8613-B	Computes and displays Shock Response Spectra with user-specified octave spacing from 1/1 to 1/24
SRS Synthesis and Control (SRS) Type 8613-C	Creates a shock pulse that meets the requirements of a user-specified SRS spectrum
Data Recorder Function for Shock Type 8613-D	Data stream all input channels during Shock, Transient Time History and SRS. Data saved internally on Vibration Controller Type 7541 or 7542 or on a host PC hard disk *Typical Continuous Recording Time*: 4 hours for 4 input channels with frequency range 2 kHz with 4 GB flash memory installed
High Frame Size for Shock Control Type 8613-F	Increases the maximum frame size from 4096 to 65536 points

Specifications – Time Waveform Replication Control (TWRC) Type 8614

TWRC provides real-time drive generation and adaptive control for replication of long duration waveforms. A waveform may be accurately replicated with minimal setup and pre-test time. The program streams the profile data from a disk file allowing simulation of events of many hours duration in one test.
TWRC is ideal for simulating automotive test track conditions or environments such as aircraft landing transients

Profile Import

Waveforms are imported through the included stand-alone program “Waveform Editor”, which allows editing (splicing, cropping, filtering, and applying compensation to acceleration, velocity, and displacement waveforms) and conversion to the atfx format supported by the VC-LAN SW. Digital resampling adjusts the data’s sample interval (time step between data points) to match standard system sampling rates

FILE FORMATS
ASAM-ODS XML; UFF ASCII; UFF Binary; Microsoft® Excel® CSV; and National Instruments TDM format

PRE-STORED PROFILES
Band-limited random, white noise, sine and chirp

Profile Editing

Select and apply editing techniques to modify the profile while viewing the acceleration, velocity and displacement waveforms

BUILD WAVEFORM
Replace, insert or append a waveform. A splice utility ensures waveform continuity between adjoining waveform segments

RESCALE
Adjust the reference waveform’s magnitude or polarity by applying a scale factor to each data point

COMPENSATION
Acceleration DC removal, velocity, DC removal, high-pass filter, low-pass filter, decimation, none

SHAPED RANDOM
Random profile with spectrum shaped specified by breakpoint table or imported PSD; user-specified kurtosis and skew

Test Schedule

SINGLE PROFILE
One profile with associated test schedule

MULTIPLE PROFILES
Unlimited profiles each with independently specified number of repetitions and level

Test Compliance and Safety

SHAKER PARAMETERS
Dynamic limits for shaker acceleration, velocity, displacement, and force; maximum acceleration that will be available automatically calculated based on mass of shaker armature, fixture, and test article

VALIDATION TOOLS
Waveform acceleration, velocity, and displacement together with the shaker limits for validation prior to running the test

AUTOMATIC OR MANUAL ABORT
Continuous point-abort checking is performed during testing. This allows aborts during a test rather than only at the end of an entire output data frame

EMAIL OR SMS MESSAGE
Email or SMS message automatically sent on test abort

Initial Equalisation

QUICK START METHOD
Browse through saved FRFs, recall a stored FRF and skip the pre-test

SHAPED RANDOM METHOD
A random noise drive signal, based on a defined PSD profile, is output and the transfer function measured using a closed loop method.
The PSD profile is entered as an unlimited combination of PSD levels and slopes (dB/octave) at user-defined frequencies. Or, the PSD of the actual waveform may be used. The PSD profile may also be defined by a measured PSD file. The user can, in addition, rescale the PSD profile to a new rms value

Drive Generation

After the initial transfer function has been determined, a test can be started immediately. The drive signal is output with constant adjustments as the test progresses. A unique overlapped convolution algorithm ensures a continuous drive signal with smooth transitions between output frames

On-line Test Controls

Control panel toggle buttons provide easy access to test controls. Commonly used commands are also accessible via keyboard function keys. Text messages and numerical readouts on the control panel enhance test status monitoring

CONTROL BUTTONS
Start/stop; pause/continue; set level; reset average; increase/decrease level; enable/disable abort checks; loop closed/open; next schedule item; save FRF function; show pre-test results; save signals; and start data recorder

STATUS DISPLAYS
Control and demand rms; acceleration; test % or dB level; peak drive volts; full level and total test time elapsed; time remaining; activity status; and a red alert message box

ON-LINE CONTROL
The transfer function is continuously updated during the test at a user-specified rate. This technique adjusts for non-linear effects and changing load dynamics to deliver high accuracy without the need for multiple pre-test iterations

Optional Software

Name	Description
Waveform recording for TWRC Type 8614-A	Data stream all input channels during TWRC tests. Data saved internally on Vibration Controller Type 7541 or 7542 or on a host PC hard disk *Typical Continuous Recording Time:* 4 hours for 4 input channels with frequency range 2 kHz with 4 GB flash memory installed

Specifications – Sine-on-Random (SoR) Type 8611-A

This add-on module for Random Vibration Control Type 8611 combines fixed or sweeping sine tones with broadband random vibration. SoR simulates the effect of variable speed rotating equipment in moving vehicles (for example, automotive power trains, helicopters, gunfire, etc.). SoR is very easy to set up and run, and it uses an advanced phase-locked tracking filter technique simultaneously on 20 independent tones. On-line tone sweep tracks allow easy verification of the compliance of all tones to their acceleration versus frequency profiles

Test Setup and Control

SoR is an option for Random Vibration Control Type 8611 and includes all of the features of the Random Vibration Control package.
Set up of a SoR broadband Power Spectral Density (PSD) profile is the same as in the Random package. The user then adds up to 20 stationary or sweeping tones.
Automatic on/off switching (at arbitrary intervals) of each of the sine tones, or even the broadband random, can be set in the schedule

Broadband Control Technique

The broadband control process is the same as that used in the Random package. The controller calculates the PSDs for the drive and control channels for every data frame and continuously updates the control loop transfer function. The broadband random drive signal has a true Gaussian distribution

Sine Tone Control Technique

Up to 20 tones can be controlled simultaneously. The SoR software applies an individual tracking filter to each sine tone for accurate extraction of each tone's amplitude from the control signal. Digital generation of each sine tone in the drive signal, with updates to amplitude and frequency made on a per point basis or at zero crossings, produces analog quality sine outputs

SINE TONE CHARACTERISTICS
Number or Tones: Up to 20 tones; up to 12 independently sweeping tones and up to 20 harmonic tones
Target Amplitude: Constant acceleration or amplitude versus frequency profile table with constant acceleration, velocity, and displacement segments plus slopes
High Abort/Alarm Limits: Specified in dB or % with respect to the target amplitude
Sweep Range: High, low, and initial frequency in Hz (all with a resolution as fine as 0.000001 Hz); tones sweep non-harmonically or harmonically
Sweep Direction: Increasing or decreasing from the initial frequency
Sweep Mode: Linear or logarithmic specified as rate or time
Sweep Rate: Linear at 0 to 1000 Hz/min, or logarithmic at 0 to 20 octave/min
Sweep Time: User-defined in minutes/sweep
Ramping Rate: 0 to 200 dB/s (the amplitude changes between 0 and the target at this rate after the tone is switched on/off)
Burst On and Off: Independent time on time off with resolution of 0.001 s
Harmonic Mode: Sets tones no. 2, 3, 4,... to be integer multiples of sine tone number 1's frequency parameters

SINE-ON-SINE
The broadband random may be totally suppressed allowing multi-sine excitation with up to 20 sine tones simultaneously

The high precision waveform generator creates pure sine tones with extremely low amplitude distortion. The Total Harmonic Distortion (THD) of each sine tone is less than –90 dB. The tone sweep characteristics are not linked to the broadband random spectral resolution or the frame acquisition time

Test Compliance and Safety

VALIDATION TOOLS
Automatic listing of acceleration, velocity and displacement values for the broadband, individual tones, and overall profile. The sum of the rms values of all active components (sine tones and broadband random) is used to calculate the overall expected peak vibration levels. The peak A/V/D levels are automatically validated against the shaker limits prior to starting a test and before implementing any manual mode changes during testing

RMS LIMITS
Software automatically calculates high/low rms alarm/abort limits based on the profile or manually entered by the user

Special On-line Test Controls

CONTROL BUTTONS
SoR includes all of the automatic and manual test controls included in the Random package, with these additions:
- **On/Off Panel:** This panel allows the user to switch on/off individual sine tones or the broadband random
- **Sweep Panel:** This panel allows the user to hold/resume the sweeps of individual tones

Special Displays

SoR provides the following special data displays:
- **Tone Tracks:** Acceleration versus frequency online displays for all sweeping tones
- **Sweep Envelope:** Amplitude versus frequency sweep envelope for tones, provides pre-test validation of the setup

Specifications – Random-on-Random (RoR) Type 8611-B

This add-on module for Random Vibration Control Type 8611 allows the user to create a vibration environment by combining fixed or sweeping narrowbands of random vibration with a broadband random vibration profile.
RoR is very easy to set up and run, and is unique in that it maintains accurate control of the broadband profile plus up to 12 narrowbands even if they all cross over each other simultaneously. User-defined ramping rates manage changes in level, when turning the narrowbands on and off

Test Setup and Control

RoR is an option for Random Vibration Control Type 8611 and includes all of the features of the Random Vibration Control package.
Set up of a RoR broadband Power Spectral Density (PSD) profile is the same as in the Random package. The user then adds up to 12 stationary or sweeping narrowbands

Broadband Control Technique

The broadband control process is the same as that used in the Random package. The PSDs for the drive and control channels are calculated on a per frame basis and used to continuously update the control loop transfer function

Narrowband Control Technique

The reference profile is updated on a per frame basis. The total drive signal, made up of the broadband random plus the random narrowbands, has a true Gaussian distribution

NARROWBAND CHARACTERISTICS
Number of Narrowbands: Up to 12
Target Amplitude: Acceleration PSD (for example, g^2/Hz, or $(m/s^2)^2$/Hz, etc.)
Profile Breakpoints: Unlimited combination of PSD levels plus slopes (dB/octave) at user-defined frequencies
Bandwidth: Narrowband frequency bandwidth specified in Hz
High Abort/Alarm Limits: Specified in dB with respect to the target amplitude
Frequency Range: High, low, and initial frequency in Hz (specified for the centre frequency of the narrowband); tones sweep non-harmonically or harmonically
Sweep Direction: Increasing or decreasing from the initial frequency
Sweep Mode: Linear or logarithmic specified as rate or time
Sweep Rate: Linear at 0 to 500 Hz/min, or logarithmic at 0 to 10 octave/min
Sweep Time: User-defined in hours:minutes:seconds
Ramping Rate: 0 to 60 dB/s (the amplitude changes between 0 and the target at this rate after the narrowband is switched on/off)
Harmonic Mode: Sets tones no. 2, 3, 4,... to be integer multiples of sine tone number 1's frequency parameters
Profile Composition: Sum of narrowbands and broadband or maximum between narrowbands and broadband

Test Compliance and Safety

VALIDATION TOOLS
Automatic listing of acceleration, velocity and displacement values for the broadband, tones and overall profile. The sum of the rms values of all active components (narrowbands and broadband random) is used to calculate the overall expected peak vibration levels. The peak A/V/D levels are automatically validated against the shaker limits prior to starting a test and before implementing any manual mode changes during testing

RMS LIMITS
Software automatically calculates high/low rms alarm/abort limits based on the profile or manually entered by the user

Test Management

RoR includes all of the automatic and manual test controls that are included in the Random package, with the addition of a control panel that allows the user to switch on/off individual narrowbands or the broadband random

AUTOMATIC MODE
While creating the test schedule, the user arranges events using looping and nested looping logic similar to creating a schedule in Random. In RoR, the control panel can be repeatedly inserted as an event to switch on/off individual narrowbands or the broadband random at any time. One typical application of this feature is to delay the start time of the narrowbands until after the random has reached full level

MANUAL MODE
During testing, the user can use the on-line controls to activate or deactivate any of the narrowbands at any time

Special Displays

RoR provides the following special data displays:
Sweep Envelope: Amplitude versus frequency sweep envelope for tones, provides pre-test validation of the setup

Specifications – Resonance Search Track and Dwell (RSTD) Type 8612-A

This add-on module for Swept Sine Vibration Control Type 8612 provides the capability to perform a sine sweep to locate resonances and dwell at user-specified resonances.
RSTD simplifies testing by automatically searching for and identifying resonances, and by dwelling for the specified time or number of sine cycles. RSTD provides a complete test report, including resonant frequencies, transmissibility amplitude ratios, Q values, and dwell durations

Test Setup and Management

RSTD includes all of the features of Swept Sine Vibration Control Type 8612 software package. Users can follow familiar procedures for quick test setup. In the Schedule profile, the user defines a Search Event by frequency range, sweep rate, and minimum Q and amplitude for resonance detection. Schedule also allows easy definition of a Dwell Event by selecting a frequency locked dwell or tracked dwell at the resonances in the Dwell List generated during the Search Event.
During the resonance search, all of the control buttons, icons and status displays are available as in the Swept Sine package

RESONANCE SEARCH
Resonance search creates a resonance table from a measured transmissibility function using specified detection criteria
Transmissibility: Measurement between any pair of inputs or an input and the control signal (amplitude and phase)
Search Range: User-selected start and end frequencies within the frequency range defined by the reference profile
Sweep Rate: Default to the sweep rate for the reference profile
Detection Criteria: Identification of resonances based on Q and transmissibility amplitude thresholds

RESONANCE DWELL AND TRACKED DWELL
Dwell Modes: Fixed frequency or tracked resonance dwell. Tracked dwell adjusts the drive frequency to track the resonance as its frequency changes during dwelling
Dwell Duration: Time or cycles using true cycle counting
Drift Criteria: Programmed end to resonance track on a frequency drift exceeding a specified percentage of the initial resonant frequency, a specified shift in frequency over a specified time interval, or a specified change in amplitude ratio

Displays

SIGNAL DISPLAYS
RSTD offers all of the flexible window displays and plot attribute selections available in the Swept Sine Control package
Search Log: Provides a time-stamped list of all activities including search start/end, resonance frequencies found, and resonance tracking status
Resonance List: Shows the frequency, amplitude, phase, and Q of each resonance found. User has the choice to interactively edit the resonance frequencies, tracking range (% relative to the resonance frequency), and amplitude level (% relative to the sweep profile)
Amplitude Plot: Plot of transmissibility magnitude versus frequency
Phase Plot: Plot of transmissibility phase angle versus frequency

SPECIAL DISPLAYS
Special displays for monitoring resonance dwells include:
- **Dwell Histories:** Control acceleration versus time and drive frequency versus time
- **Frequency Signals:** Control acceleration, derived velocity, or derived displacement versus frequency

Specifications – Transient Replication Control (TRC) Type 8613-A

This add-on module for Classical Shock Vibration Control Type 8613 reproduces arbitrary waveforms imported from disk files.
TRC can reproduce everything from short duration high-frequency drop shocks to long duration low-frequency earthquakes. The user can process the imported data with interpolation, editing, and compensation tools. TRC also has pre-stored waveforms for sine, chirp, triangular bursts, and other signals

Profile Import

To import a waveform you simply specify the source file format and then use a Browse window to locate a file and import a profile. Digital resampling adjusts the data's sample interval (time step between data points) to match standard system sampling rates

FILE FORMATS
ASAM-ODS XML; UFF ASCII; UFF Binary; Excel CSV; NI TDM; Pacific Instruments format; and binary format

DIGITAL RESAMPLING
From 102 k samples per second down to 28 samples per second in 54 stages

FRAME SIZE
128, 256, 1024, 2048 or 4096 points
Extends up to 65536 points with optional software High Frame Size for Shock Control Type 8613-F

PRE-STORED PROFILES
Bellcore Z1 and Z2, Bellcore Z3, Bellcore Z4, sine, chirp, triangular, triangular bursts, and white noise

Profile Editing and Compensation

PROFILE EDITING
Select and apply editing techniques to modify the profile while viewing the acceleration, velocity and displacement waveforms
Rescale: Adjust the reference waveform's magnitude or polarity by applying a scale factor to each data point
Fill-in: Select a range of data points and specify a new Y value for all data points
Taper End Points: Applies a Hann window over a specified percentage of the leading and trailing parts of the waveform

COMPENSATION METHODS
Multiple compensation techniques ensure initial and final conditions of zero acceleration, velocity and displacement
- Acceleration DC removal
- Velocity DC removal
- High-pass filter
- Low-pass filter

Control Technique

Control process is identical to Classical Shock Vibration Control Type 8613. For each data frame, the software computes the spectra for the drive and control signals and then updates the system transfer function

Transfer Function Equalisation

TRC offers a variety of methods for fast and accurate equalisation of the test load

QUICK START METHOD
Browse through disk files, recall a stored transfer function and skip the pre-test

CLOSED-LOOP METHODS
Pulse Waveform: This method uses the pulse waveform, either as a positive or negative pulse, as an excitation signal. The system outputs a drive waveform based on the profile and then measures the transfer function. The software then creates a new drive waveform and repeats the process until the control response matches the profile at the specified goal level
Random PSD Profile: The software uses a user-defined breakpoint table of frequencies and PSD values to define a shaped random excitation signal

OPEN-LOOP METHODS
Pulse Waveform: Uses the profile waveform as the drive output with an open-loop estimate of the system transfer function
Shaped Random: The spectrum of the profile waveform is used to create a random signal with the same frequency amplitude distribution as the profile waveform
Random White Noise: System creates the drive waveform from a flat broadband random profile
Shaped Random Noise: System uses the spectrum shape of the profile waveform to create a shaped random output

Test Compliance and Safety

VALIDATION TOOLS
Waveform displayed and updated as it is created, imported or edited. Automatic display of profile acceleration, velocity and displacement waveforms together with shaker limits. Pre-test check validates the waveform profile demands against the shaker limits

AUTOMATIC OR MANUAL ABORT
High and low abort limits can be entered directly by the user. Continuous point-abort checking occurs during testing. This allows aborts during a test rather than only at the end of an entire data frame (critical for long duration low-frequency events)

Test Management

TRC includes all of the automatic and manual test controls that are included in the Classical Shock Vibration package. Any or all of the input channels are available to display as acceleration, velocity or displacement waveforms during testing or for post-test analysis.
During testing, special displays with a scrolling mode allow the user to see the data as it is acquired point-by-point. This display gives fast visual validation even for very low frequency tests

Specifications – SRS Synthesis and Control (SRS) Type 8613-B

This add-on module for Classical Shock Vibration Control Type 8613 allows you to create a special transient waveform and reproduce it on a shaker. Use the SRS software to simulate a wide range of environments from brief high-frequency pyrotechnic events to long duration low-frequency events

Test Setup

SRS includes all of the features found in the Classical Shock Vibration software package.
Preparing the profile waveform is a three-step process:

1. The user specifies a Required Response Spectrum (RRS)
2. The software uses independent wavelets to create a waveform matching the energy content of the RRS
3. The software compensates the waveform to ensure zero final velocity and displacement to make the waveform suitable for use on a shaker system

REQUIRED RESPONSE SPECTRUM (RRS)
The RRS is an acceleration versus frequency spectrum that can be defined with as few as two breakpoints. The user enters a table of breakpoints and high/low abort limits, then selects parameters to divide the RRS into discrete Nth-octave bands centred on the reference frequency
Breakpoints: Unlimited combination of frequencies and acceleration amplitudes plus slopes (dB/octave) or imported from a signal file or CSV file
Abort Limits: Specified in dB or % with respect to the target acceleration amplitudes
RRS Parameters: Low, high and reference frequency; damping ratio (%) or Q; Nth-octave resolution (1/1, 1/3, 1/6, 1/12, 1/24, 1/48)

WAVEFORM SYNTHESIS
The software uses the wavelet parameters and synthesis parameters to automatically generate wavelets for each of the Nth octave bands.
The software combines the wavelets to create an initial estimate of the composite transient waveform. The SRS of that waveform is calculated and overlaid on the RRS. If the initial estimate has converged to the RRS, the user can either accept it and move on to Compensation, or modify the synthesis parameters and/or individual wavelet parameters, then iterate to achieve the desired level of convergence
Wavelet Types: Half-cycle sinusoids with sine, exponential (gives damped sine), rectangular or Hann window
Waveform Criterion: Pyroshock, minimum acceleration, or specified time duration (ms)

WAVELET PARAMETERS
Wavelet Table: Per wavelet list of frequency (Hz), RRS value (acceleration), number of half-cycles, delay (ms), and amplitude (acceleration)
Analysis Type: Maxi-max, positive maximum, or negative maximum
Damping: Percent of critical damping or Q value
Resolution Reduction Factor: Allows the user to automatically deactivate every Nth wavelet (N = 2 to 48)

Fitting Error: Numeric readout of overall % difference between the RRS and the SRS created from the synthesised waveform

Pulse Compensation

COMPENSATION METHODS
Multiple compensation techniques ensure initial and final conditions of zero acceleration, velocity and displacement
- Acceleration DC removal
- Velocity DC removal
- High-pass filter
- Low-pass filter

Control Method

The software updates the system transfer function after each pulse output. Following each pulse output, the control SRS abort limits are checked

FRAME SIZE
Automatically optimised (up to 4096 points) for the reference waveform. Extends up to 65536 points with optional software High Frame Size for Shock Control Type 8613-F

SAMPLING RATE
Up to 102 k samples per second automatically set based on pulse duration with selectable oversample factor; linear filter design minimises distortion and preserves the true waveform shape

TRANSFER FUNCTION
Measured during pre-test or, for quickest test startup, recall a function from disk

AVERAGING
User-specified coefficient from 1 to 500

FILTERING
User specifies cut-off frequency for low-pass filtering applied to the reference waveform, drive, and all input channels

SRS ANALYSIS
SRS analysis supports up to a 14-octave range using maxi-max, negative maximum, and positive maximum analysis techniques. User specifies high and low frequency, reference frequency, damping ratio or Q value, and resolution (1/1, 1/3, 1/6, 1/12, 1/24, 1/48)

POINT ABORT
Allowable percentage of data points exceeding abort limits

PULSE DELAY
User-specified delay between pulses from 0 to 1000 s

Signal Displays

TIME DOMAIN
During testing, the user can display measured waveforms as acceleration, velocity and/or displacement

FREQUENCY DOMAIN
SRS as acceleration, velocity and/or displacement versus frequency

Specifications – Calibration Software Types 8641 and 8642

Brüel & Kjær recommends annual calibration of Vibration Controllers Type 7541 and 7542 by a factory authorised calibration service. Calibration Software for 7541 Type 8641 and Calibration Software for 7542 Type 8642 allow a qualified calibration laboratory, or the system operator, to calibrate the controller

Functions

The software first calibrates the drive output and corrects the output gain and offset. Then using the calibrated drive and an internal connection, the software adjusts the gain and offset for each of the input channels. The calibration report includes the model number, identification of the calibration multimeter, and name of operator who performed the calibration. The report can be viewed or printed from the host PC

Required Equipment

Traceable multimeter with an accuracy of at least ±0.25%

Charge Input Calibration

Charge calibration requires a board with the appropriate capacitors. This board is available from Brüel & Kjær as Charge Amplifier Calibration Cable and Connector Board Kit ZH-0695

Ordering Information

Type 8611-08 **Random Vibration Control (Random) – Supports up to 8 input channels**

OPTIONAL SOFTWARE FOR TYPE 8611

Type 8611-A Sine-on-Random Vibration Control (SoR)
Type 8611-B Random-on-Random Vibration Control (RoR)
Type 8611-C Kurtosis Parameter Control
Type 8611-E High Frequency Control for Random
Type 8611-F Data Recorder Function for Random
Type 8611-G High Line Resolution for Random, SoR and RoR
Type 8611-H Drive Notching/Limiting for Random
Type 8611-K Displacement Optimisation

Type 8612-08 **Swept Sine Vibration Control (Sine) – Supports up to 8 input channels**

OPTIONAL SOFTWARE FOR TYPE 8612

Type 8612-A Resonance Search Track and Dwell (RSTD)
Type 8612-C High-frequency Control for Sine
Type 8612-E Total Harmonic Distortion Computation
Type 8612-F Data Recorder Function for Sine
Type 8612-G Drive Notching/Limiting for Sine
Type 8612-I Low-frequency Sine Control

Type 8613-08 **Classical Shock Vibration Control (Shock) – Supports up to 8 input channels**

OPTIONAL SOFTWARE FOR TYPE 8613

Type 8613-A Transient Replication Control (TRC)
Type 8613-B SRS Displays for Classical Shock and Transient Replication
Type 8613-C SRS Synthesis and Control (SRS)
Type 8613-D Data Recorder Function for Shock
Type 8613-F High Frame Size for Shock Control

Type 8614-08 **Time Waveform Replication and Control (TWRC) – Supports up to 8 input channels**

OPTIONAL SOFTWARE FOR TYPE 8613

Type 8614-A Data Recorder Function for TWRC

Type 8615 **Shaker Response Characterisation (SRC)**
Type 8616 **Transducer Sensitivity Check**

Software Bundles

		Bundle 1 Type 8620	Bundle 2 Type 8621	Bundle 3 Type 8622	Bundle 4 Type 8623
8611-08	Random Vibration Control (Random). Supports up to 8 inputs.	x	x	x	x
8611-A	Sine-on-Random (SoR) Vibration Control			x	x
8611-B	Random-on-Random (RoR) Vibration Control				x
8611-G	High Line Resolution for Random, SoR and RoR (increases max. FFT lines from 1800 to 28800)		x	x	x
8612-08	Swept Sine Vibration Control (Sine). Supports up to 8 input channels.	x	x	x	x
8612-A	Resonance Search Track & Dwell (RSTD) Vibration Control		x	x	x
8613-08	Classical Shock Control (Shock) Supports up to 8 input channels.	x	x	x	x
8613-A	Transient Replication Control (TRC)			x	x
8613-B	SRS Displays for Classical Shock and Transient Replication			x	x
8613-C	SRS Synthesis and Control (SRS)				x

General Options

Type 8610-L Non-acceleration Control

HARDWARE

ZH-0693 Monitor Breakout Box, 8-in BNC (F), 4-out BNC (F) to 25-pin sub-D (M)
ZH-0695 Charge Amplifier Calibration Unit, 12 BNC (F) to 25-pin sub-D (M) for 8641 or 8642

Calibration Software

Type 8641 Calibration Software for 7541
Type 8642 Calibration Software for 7542

Service

M1-861Z-xx* Vibration Control Software Maintenance and Support Agreement
M1-861Z-Y† Vibration Control Software Maintenance and Support Agreement
M1-8615 Vibration Control Software Maintenance and Support Agreement
M1-8616 Vibration Control Software Maintenance and Support Agreement
M1-8617 Vibration Control Software Maintenance and Support Agreement

See Software Maintenance and Support Agreement product data (BP 1800) for details on M1 agreements.

* xx = input channel count if applicable, Z = 0– 4
† Y = optional software letter (for example, Type 8611-A)

BU 3084 – 14 2013-07

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