Brüel & Kjær

LASER$_{USB}$

Table of Contents

LASER$_{USB}$ VIBRATION CONTROL SYSTEM

The New ERA of USB 2.0 Connectivity

LDS

LASER$_{USB}$ Shaker Control System

INPUTS

Analog channels	Two standard, expandable to 16 simultaneous channels. Each can be control, monitor, or disabled. All are differential inputs with 220k Ohm impedance.
Electronics	Differential amplifier, programmable gain amplifier, anti-aliasing filters, and 24-bit Analog to Digital Converter (ADC).
Filtering	An analog filter plus a 160 dB/octave digital filter eliminates non-linear phase distortion and aliasing.
Frequency range	Up to 42000 Hz analysis frequency (96000 samples per second).
Voltage ranges	± 10, 1, 0.1 Volts
Input coupling	DC or AC (analog circuitry)
Signal condoitioning	Voltage or ICP sensor power (4.7 mA, 23 Vpeak open circuit.) and TEDS (Transducer Electronic Data Sheet).
Maximum Input	± 36 Vpeak without damage
Resolution	24-bit
Dynamic range	120 dBfs, 110 dB minimum in FFT mode.
Accuracy	± 0.08 dB (1 kHz sine at full-scale)
Channel Match	
Amplitude	Within ± 0.04 dB
Phase	Within ± 0.1 degree to 2 kHz; ± 0.5 degree to 20 kHz. (Channel match specification per 8 channel frontend box).
Signal-to-noise	›100 dB (from DC to 1000 Hz measured with half-full-scale sine wave).
Cross-talk	‹ -110 dB
Total harmonic distortion	‹ -105 dBfs
Digital input and output	48 parallel lines for 5 volt TTL signals - used for remote start/stop/pause/continue and other functions such as close/open control loop, manual/auto schedule, and enable/disable aborts.

OUTPUTS

Analog channels	Drive and COLA/shock trigger outputs standard.
Output Protection	Prevents output transient if power is switched off
Electronics	24-bit Digital to Analog Converter (DAC), anti-imaging filter, programmable gain attenuator, and shutdown circuitry.Single ended output with 50 Ohm impedance.
Filtering	A 160 dB/octave digital filter plus an analog filter eliminates non-linear phase distortion and imaging.
Frequency range	Up to 22000 Hz output frequency (48000 samples per second).
Voltage range	± 10 Vpeak with adjustable attenuator.
Resolution	24-bit
Dynamic range	110 dBfs

Control loop

Random dynamic	Random - 95 dB Sine - 100 dB
Loop time	Random - 100 msec typical

SAFETY

Manual abort	Red button on Front End DSP box, software button on screen, and F4 button on keyboard.
Pre-test	Drive waveform validated against shaker performance table. Integrity checking of system and control loop.
Test	Open loop checks, loss of control signal checks, input overload checks, alarm and abort tolerance band checks, and RMS abort limit checks. Graceful shutdown at a user specified rate.

SOFTWARE

Operating system	Windows XP/vista
Architecture	Distributed processing removes the PC from the control loop process. True multitasking allows the PC to deliver maximum graphics performance and responsiveness to the user. The software provides both on-line test status and management through text displays, software toggle buttons, and screen displays of multiple time and/or frequency signals.
Applications	• Random, Sine on Random, Random on Random, Sine and Random on Random • Swept Sine, Resonance Search, Track and Dwell • Sine Oscillator • Classical Shock, Shock Response Spectrum, Transient Time History Control • Long Time History Control for road simulation testing • Multi-Layer Password Security, High Frequency, and Drive Notching/Limiting Options • Realtime Spectrum Analysis & SRS Analysis • Re-Calibration
Features	On-line help, consistent management of user defined engineering units, on-line graphics, and one click test reports as Microsoft Word documents with active data plots that can be rescaled, cursored, etc., in Word. Project Sequencing for automated testing to a mission profile.

HARDWARE

Front End DSP box	Control loop processing done independent of PC using dual DSP chips. Rear panel connectors for inputs and output, connection to PCI card, and 48 digital I/O lines. Front panel power switch, abort button, and status LEDs.
Input channels	2 to 16 simultaneous inputs; extension to 12 to 16 inputs via channel expansion box option.
Output channels	Two analog outputs standard; Drive and COLA (Constant Output Level Amplitude)/shock trigger.
PC configuration	PC with USB 2.0 port, Vista/XP Operating System, and Microsoft Word are the only requirements. With more than 8 input channels, it is recommended that the graphics card have 8 MB of memory.
PC expansion	PC upgrades and peripheral additions do not delay or interrupt the control loop processing.

GENERAL

AC Power	100 to 240 Volts, 50/60 Hz, auto-sensing	
Power consumption	30 Watts	
Dimensions		
Height	3.5 in.	8.9 cm
Width	16.5 in.	41.9 cm
Depth	14.3 in.	36.3 cm
Weight	13 lbs.	6 kg
Temperature	41 to 132 °F	5 o 45 °C
Humidity	10 % to 90% RH non-condensing	

REGULATORY COMPLIANCE

Compliance	CE Marking
Safety	EN 61010-1, IEC 1010-1
EMC	FCC Par 15 (CFR 47) Class A, EN 61326 Class A, CISPR22 Class A

Random Vibration Control

Control Parameters

Frequency range	Zero to 10000 Hz in seventeen ranges. Closed loop control up to 4000 Hz standard; High Frequency Option extends to 10000 Hz.
Resolution	110, 225, 450, 900, or 1800 lines.
delta F resolution	User selectable, including 5 Hertz and its multiples.
Dynamic range	Up to 95 dB
Randomization	Frequency domain phase randomization technique produces a true gaussian distribution.
Loop time	Typically 100 milliseconds
Transfer function	Measure during pre-test or, for quickest test startup, recall a function from disk.
Variable Resolution	Provides enhanced low frequency control with up to 8 to 1 improvment in spectral resolution.
DoF	Two to 1000
Control accuracy	± 1 dB at 99% confidence with 200 DoF.
Control strategy	Single or multiple input channels combined by minimum, maximum, or weighted average.
Drive clipping	Two to 6 sigma or disabled.
Kurtosis control	The Kurtosis Parameter Control option 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.

Reference Profile

Entered as a table of breakpoints, recalled stored profile or PSD, or imported ASCII or UFF file. Reference can be rescaled to a new RMS value.

Breakpoints	Unlimited combination of PSD levels and slopes (dB/octave) at user defined frequencies.
Abort/alarm	High and low profile limits defined independently at each breakpoint in dB 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. Automatic listing of RMS and peak acceleration, velocity, and displacement values for profile. Profiles are validated against shaker parameter table.
Engineering units	English, SI, Metric, mixed; linear or angular.

Test Schedule

User defined sequence of events, or profiles, that are automatically executed during the test.

Events	Level and duration, timed pause, save signals, abort enable/disable, digital output trigger, and control loop closed/open; logic for sequence loop and nested loops.
Profile sequencing	Flow diagram of blocks with each block defining a Profile and Schedule.

Safety Features

Control signal	Automatic detection of input overload, open loop, and loss of control signal.
Line-abort trigger	Ratio of spectral lines allowed to exceed limits to total number of lines; from zero to one.
Test shutdown	Shutdown initiated by operator or software is performed gracefully at a user specified rate.
Abort rate	One to 120 dB/sec
Emailsupport	Email message automatically sent on abort.

Fatigue Monitor

The Fatigue Monitor automatically stops the test if the inverse of the system transfer function (Hinverse), or selected transmissibility, or input channel spectrum, exceeds specified abort limits. Hinverse could change because of fatigue in the test article, looseness in the fixture and mounting, or degradation of the shaker.

Signals	Hinverse, any transmissibility or input spectrum
Source	Active signal or imported from disk file
Tolerances	User specified upper and lower aborts and alarms in dB
Check Level	From 10% to 100% of the full test level

Test Execution

The system performs pre-test checks, equalizes 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).
Automatic mode	System executes the events specified in the schedule. If a profile sequence is defined, profile-schedule blocks in the flow diagram are sequentially executed. The reference is changed in one loop, eliminating the need to stop and restart the test to change the profile.
Manual mode	User can over-ride the automatic mode to manage the test using manual commands.

Test Management

Control Panel toggle buttons and tool bar icons provide easy access to test controls. For added convenience, commonly used commands are accessible via keyboard function keys. Text messages and numerical readouts on the Control Panel enhance test status monitoring.

Buttons	Start/stop, pause/continue, enable/disable abort check, loop closed/open, schedule clock on/off.
Icons	Test level set/increase/decrease, reset average, move to next event/profile, and save signals.
Status displays	Control and Demand RMS acceleration, Demand velocity and displacement, test %/dB/ratio level, peak drive volts, full level and total test time elapsed, time remaining, activity status, and a red-alert message box.

Signal Displays

Unlimited number of display windows in tile or cascade format with click & drag zoom, user annotation, and cursors.

Window format	Per window choice of single, dual, or four pane formats. Each pane can display single or multiple signals overlaid in either time or frequency. Independent choice of color and texture for signals, grids, tick marks, labels, titles, etc.
Scale format	Linear or logarithmic scales for X and Y axes with automatic or manual scaling.
Cursors	Single or dual with X, Y, ΔX, ΔY, ΔRMS and Q value readouts; manual peak marks; automatic peak/valley detection and marks; harmonic and side band cursors.
Frequency signals	Control, any input, transfer function (amplitude & phase), coherence, drive, profile, alarms, and aborts.
Strip chart plots	Scrolling record (data point per frame) of input channel RMS, max, min, or mean values.
Oscilloscope plots	Drive and input time histories.

On-Line Math

This feature allows you to create customized signals. All signals are calculated and displayed “live” during testing. Operations include add/subtract/multiply/divide and transmissibility between PSDs for any two inputs or an input PSD and the Control PSD.

Post-Test Documentation

Icon for single click generation of data plots and test reports, including setup parameter listings, test logs, and formatted signal plots, within Microsoft Word.

Swept Sine Vibration Control

Control Parameters

Frequency range	0.1 to 12000 Hz. Up to 4000 Hz standard; High Frequency Option to extend to 12000 Hz.
Resolution	512, 1024 or 2048 points per sweep
Dynamic range	Up to 100 dB
Loop time	Typically 10 msec
Control accuracy	1 dB through a peak-notch with a Q of 50, at 1 octave/min, 8 control channels, with 25% proportional tracking filters.
Compression rate	Adaptive or fixed 0.3 to 3000 dB/sec.
Control strategy	Single or multiple input channels combined by minimum, maximum, or weighted average. Input amplitude estimated with peak, mean, RMS, or digital tracking filter on a per channel basis.
Tracking filter	Proportional (bandwidth: seven to 100% of drive frequency) or Fixed (bandwidth: one to 500 Hz).
Sweep rate	Linear from zero to 6000 Hz/min or logarithmic from zero to 100 octaves/min.
Drive resolution	As fine as 0.000001 Hz

Reference Profile

Entered as a table of breakpoints for acceleration, velocity, and displacement segments.

Breakpoints	Unlimited combination of amplitudes (A, V, or D) and right and/or left constant A/V/D slopes at defined frequencies; automatic crossover calculations.
Abort/alarm	High and low profile limits defined independently at each breakpoint in dB with respect to reference.
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.
Engineering units	English, SI, Metric, mixed, linear or rotary.

Test Schedule

User defined sequence of events, or profiles, that are automatically executed during the test.

Events	Sweeps (duration, sweep range and start frequency, sweep direction, and sweep rates), dwells (frequency and cycle or time duration), level, timed pause, digital output trigger, enable/disable abort checking, control loop open/closed, save results; logic for sequence loop and nested loops.
Profile sequencing	Flow diagram of blocks with each block defining a Profile and Schedule.

Safety Features

Control signal	Automatic detection of input overload, open loop, and loss of control signal.
Abort trigger	Continuous time allowed outside abort limits: zero to one second.
Test shutdown	Shutdown initiated by operator or software is performed gracefully at a user specified rate.
Abort rate	One to 120 dB/sec
Email support	Email message automatically sent on abort

COLA Features

Constant amplitude	Sine output with programmable amplitude from 0.1 to 10 volts.
DC proportional	Varying DC output proportional to frequency; programmable frequency with linear or log interpolation.

Test Execution

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

Pre-test	System performs safety checks then increases the drive voltage, starting at the user specified initial value, at the specified ramp-up rate (slow or fast). Maximum voltage allowed during ramp-up is also user specified.
Automatic mode	System executes the events specified in the schedule. If a profile sequence is defined, profile-schedule blocks in the flow diagram are sequentially executed.
Manual mode	User can over-ride the automatic mode to manage the test using manual commands.

Test Management

Control Panel toggle buttons and tool bar icons provide easy access to test controls. For added convenience, commonly used commands are accessible via keyboard special function keys. Text messages and numerical readouts on the Control Panel enhance test status monitoring.

Buttons	Start/stop, pause/continue, enable/disable abort check, loop closed/open, schedule clock on/off.
Icons	Level adjustment, sweep up/down, sweep hold/release, set frequency, move to next event/profile, and save signals.
Status displays	Frequency, Control and Demand peak acceleration, Demand velocity and displacement, test %/dB/ratio level, peak drive volts, full level and total time elapsed, time remaining, activity status, and a red-alert message box.

Signal Displays

Unlimited number of display windows in tile or cascade format with click & drag zoom, user annotation, and cursors.

Window format	Per window choice of single, dual, or four pane formats. Each pane can display single or multiple signals overlaid in either time or frequency. Independent choice of color and texture for signals, grids, tick marks, labels, titles, etc.
Scale format	Linear or logarithmic scales for X and Y axes with automatic or manual scaling. Dimension: A, V, or D.
Cursors	Single or dual with X, Y, ΔX, ΔY and ΔRMS and Q value readouts; manual peak marks; automatic peak/valley detection and marks; harmonic and sideband cursors.
Frequency signals	Control, any input, transfer function (amplitude & phase), coherence, drive, profile, alarms, and aborts.
Strip chart plots	Scrolling record of peak value versus time for the control signal or any input signal; frequency versus time.
Oscilloscope plots	Input time histories.
Resonance search	Table display of resonance frequencies and Q factors

On-Line Math

This feature allows you to create customized signals. All signals are calculated and displayed “live” during testing. Operations include add/subtract/multiply/divide/transmissibility between spectra for any two inputs or an input spectrum and the Control spectrum.

Post-Test Documentation

Icon for single click generation of data plots and test reports, including setup parameter listings, test logs, and formatted signal plots, within Microsoft Word.

Resonance Search, Track and Dwell (RSTD) Vibration Control

Test Setup and Management

All of the features of Swept Sine Control software are included in the RSTD package. Users can follow familiar procedures for quick test set up. In Schedule, 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 either 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 Software.

Resonance Search

Resonance search creates a Dwell List from a measured transmissibility function using specified detection criteria.

Transmissibility	Measurement between any pair of inputs or an input and the control signal.
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 or user specified special sweep rate.
Detection criteria	Identification of resonances based on Q and transmissibility amplitude thresholds.

Resonance Dwell and Tracked Dwell

Automated and interactive test modes reduce test time and allow tailored testing.

Test modes	Choice of three modes: (1) search and dwell as each resonance is detected during the sweep; (2) search then automatically dwell using the generated Dwell List; (3) search, pause for user review and editing of the Dwell List, then automatically dwell using the edited Dwell List.
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.

Signal Displays

RSTD offers all of the flexible window displays and plot attribute selections available in the Swept Sine Control software. RSTD also provides a special four-pane window that updates during search and dwell operations:

Search log	Provides a time stamped list of all activities including search start/end, resonance frequencies found, and resonance tracking status
Dwell list	Shows the frequency, amplitude, phase, Q, and elapsed time for each resonance found. Interactive editing via Add and Remove buttons; Add inserts a resonant frequency value, Remove deletes resonances based on screening by list entry number, Q, or amplitude.
Amplitude plot	Plot of transmissibility magnitude versus frequency.
Phase plot	Plot of transmissibility phase angle versus frequency.

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.

Post-Test Documentation

Documentation and reports of both setup parameters and signals produced through Microsoft Word as printed media or disk files.

Run log	Time and test frequency (Hz) stamped list of all test operations including test start/end, schedule actions, operator commands, and error or abort conditions.
Search log	Time stamped list of all resonance search and dwell operations including search start/end, resonance frequencies found, and dwell start/end.
Resonance list	Tabulated list of resonance frequencies and corresponding amplitude, phase, Q, dwell status, and dwell duration.
Data plots	Transmissibility function, control acceleration versus time, drive frequency versus time; saved either automatically or manually.

Classical Shock Transient Control

Control Parameters

Frequency range	Zero to 22000 Hz
Frame size	128 to 16384 points or automatically optimized. Linear filter design minimizes distortion and preserves the true waveform shape.
Transfer function	Measure during pre-test or, for quickest test startup, recall a function from disk.
Averaging	User set 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 set delay between pulses from zero to 1000 seconds.

Reference Waveform

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	From 0.5 to 3000 msec
Compensation	Pre- and post-pulse, post-pulse only, or pre-pulse only. Single or double sided for minimum acceleration and full use of shaker stroke. Choice of displacement optimum, Half-sine, rectangular, rounded rectangular, or triangular compensation pulses. Pre-pulse and post-pulse amplitudes settable in percentage of reference peak acceleration
Abort limits	Set to MIL-STD 810 guidelines or customized by user in percentage of reference waveform amplitude and percentage of pre-pulse and post-pulse amplitudes.
Validation tools	Waveform displayed and updated as it is created. Automatic display of profile acceleration, velocity, and displacement waveforms together with shaker limits. Shock profile is validated against shaker parameter table.
Engineering units	English, SI, Metric, mixed

Test Schedule

User creates a schedule of events to perform during the test. Looping and nested looping logic speed and simplify programming.

Events	Level and number of pulses, digital output trigger, abort enable/disable, and loop open/closed, save results, pause, invert pulse.

Safety Features

User creates a schedule of events to perform during the test. Looping and nested looping logic speed and simplify programming.

Control signal	Automatic detection of input overload, open loop, and loss of control signal.
Point-abort trigger	Allowable ratio of points exceeding abort limits to total number points in a frame: Zero to one.
Test shutdown	Shutdown initiated by operator or software is performed gracefully.
Email support	Email message automatically sent on abort.

Test Execution

The system performs pre-test checks, equalizes 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).
Automatic mode	System sequentially executes each event in the schedule.
Manual mode	User can over-ride the automatic mode to manage the test using manual commands.

Test Management

Control Panel toggle buttons and tool bar icons provide easy access to test controls. For added convenience, commonly used commands are accessible via keyboard special function keys. Text messages and numerical readouts on the Control Panel enhance test status monitoring.

Buttons	Start/stop, enable/disable abort check, loop closed/open, schedule clock on/off, invert pulse.
Icons	Test level set/increase/decrease, output a single pulse, move to next event, and save results.
Status displays	Control and Demand peak acceleration Demand velocity and displacement, test %/dB/ratio level, peak drive volts, full level and total pulses elapsed, remaining pulses, activity status, and a red-alert message box.

Signal Displays

Unlimited number of display windows in tile or cascade format with click & drag zoom, user annotation, and cursors.

Window format	Per window choice of single, dual, or four pane formats. Each pane can display single or multiple signals overlaid in either time or frequency. Independent choice of color and texture for signals, grids, tick marks, labels, titles, etc.
Scale format	Linear or logarithmic scales for X and Y axes with automatic or manual scaling. Dimension: A, V, or D.
Cursors	Single or dual with X, Y, ΔX, ΔY, ΔRMS and Q value readouts; manual peak marks; automatic peak/valley detection and marks; harmonic and sideband cursors
Time signals	Control, drive, any input, profile, aborts, composite (control, profile, aborts).
Frequency signals	Control.
Strip chart plots	Scrolling record (data point per buffer) of any input channel's RMS, max, min, or mean.
SRS analysis	Up to 14 octave range (maxi-max, negative maximum, and positive maximum). User specifies high and low frequency, center frequency, damping ratio or Q value, and resolution (1/1, 1/3, 1/6, 1/12, 1/24, or 1/48).

Post-Test Documentation

Icon for single click generation of data plots and test reports, including setup parameter listings, test logs, and formatted signal plots, within Microsoft Word.

Shock Response Spectrum (SRS) Transient Control

Test Setup

All of the features of the Classical Shock software are included in SRS. Users will recognize the same implementation of Schedule, Test Execution, Test Management, and Signal Displays. Preparing the reference waveform is a three step process:

(1) The user specifies a Required Response Spectrum (RRS).

(2) The software uses independent wavelets to synthesize a waveform matching the energy content of the RRS.

(3) The software compensates the waveform to ensure zero final 6 matching the energy content of the RRS.

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 the user selects parameters to divide the RRS into discrete Nth octave bands centered on the reference frequency.

Breakpoints	Unlimited combination of target acceleration amplitude with right and/or left slopes (dB/octave) up to 22000 Hz.
Abort limits	Specified in dB with respect to the target amplitude.
RRS parameters	Low, high and reference frequency; damping ratio (%) or Q; Nth octave bands - 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 wavelets are combined (synthesized) to produce 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 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	Pyro-shock, minimum acceleration, or specified time duration (msec).
Wavelet parameters	
Listing	Per wavelet list of frequency (Hz), RRS value (acceleration), Synthesized Amplitude (acceleration).
Definition	Number of half cycles, delay (msec), wavelet amplitude (acceleration).
Analysis type	Maxi-max, positive maximum, and 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.
Error display	Numeric display of RMS difference between the RRS and synthesized spectrum.

Waveform Compensation

Compensation	High Pass Filtering or DC removal to bring the final Acceleration, Velocity, and Displacement to zero.

Test Execution

The system performs pre-test checks, equalizes 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).
Automatic mode	System sequentially executes each event in the schedule.
Manual mode	User can over-ride the automatic mode to manage the test using manual commands.
Signal displays	During testing the user can display measured waveforms as acceleration, velocity, and/or displacement; standard SRS or A/V/D nomograph SRS.

Control Technique

The control loop transfer function is updated after each pulse. Following each pulse, the control SRS abort limits are checked.

Frame size	Automatically optimized (up to 16384 points) for the reference waveform. Linear filters minimize distortion and preserve the true waveform shape.
Sampling rate	Up to 48000 samples per second.
Transfer function	Measure during pre-test or, for quickest test startup, recall a function from disk.
Averaging	User set 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	Up to 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, or 1/48).
Line-abort trigger	Allowable ratio of lines exceeding abort limits to total number of lines in the RRS: zero to one.
Pulse delay	User set delay between pulses from zero to 1000 seconds.

Transient Time History (TTH) Control

Profile Import

Waveforms are imported by specifying the source file format and then using “browse” 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	ASCII delimited format (tab, comma, or space) using Y values or X-Y data pairs, ASCII Universal File Format (UFF), MTS RPC3 and Dactron binary format.
Digital resampling	From 48000 samples per second down to 20 samples per second in 24 stages.
Frame size	256, 512, 1024, 2048, 4096, 8192 or 16384 samples.
Pre-stored profiles	Bellcore Z1 & Z2, Bellcore Z3, Bellcore Z4, Sine, Chirp, Burst Sine, and other waveforms.

Profile Editing and Compensation

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 of those data points.
Taper end points	Applies a Hann window over a specified percentage of the leading and trailing parts of the waveform.

Multiple compensation techniques ensure initial and final conditions of zero acceleration, velocity, and displacement.

Compensation	Pre and post pulses, brick-wall high pass filter, high pass filter, DC removal, or disabled.

Control Technique

Control process is identical to the Classical Shock Transient Control Software. The spectra for the drive and control channels are calculated per data frame and used to adjust the control loop transfer function.

Transfer Function Equalization

TTH provides flexible and accurate control loop transfer function equalization, with six methods offered.

Quick start method
Browse through disk files, recall a stored transfer function, and skip the pre-test.

Closed loop methods
The system outputs a drive waveform and measures the transfer function. A new drive waveform is computed and the process repeated until the control response matches the profile at a specified goal level.

Open loop methods
The system outputs a drive waveform and measures the transfer function. This process is repeated several times with the exact same drive waveform output every time. The peak drive voltage and the number of outputs are user specified.

(1) Profile(t) - Uses the profile waveform as the drive output.

(2) Random White Noise - System creates the drive waveform from a flat broadband random profile.

(3) Shaped Random Noise: System uses the spectrum shape of profile(t) to create a shaped random output.

Test Management

TTH includes all of the automatic and manual test controls that are included in the Classical Shock software. 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, a special strip chart scrolling display is standard on all time domain input signals. This display gives fast visual validation even for very low frequency tests.

Over-Test Protection

Waveforms are imported by specifying the source file format and then using “browse” 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.

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. Profile demands are validated against the shaker parameters.
Automatic or manual abort	High and low abort limits can be entered directly by the user. Continuous point-abort checking is performed 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).

Long Time History (LTH) Road Simulation Control

Profile Import
Waveforms are imported by specifying the file format and using "browse" to locate and import a profile. Digital resampling adjusts the data's sample interval to match standard system sampling rates.

File formats	ASCII delimited format (tab, comma, or space) using Y values or X-Y values, MTS RPC3 ASCII Universal File Format (UFF), and Dactron binary.
Digital resampling	From 20 to 12000 samples per second in 20 stages.
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.

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.

Profile

Single profile	One profile with associated test schedule.
Multiple profile	Unlimited profiles each with independently specified number of repetitions and level

Test Schedule
Pre-programmed schedule of test events including test level, number of output repetitions, and save results.

Over-Test Protection

Validation tools	Waveform displayed and validated against the shaker parameters.
Automatic or manual abor	Continuous point-abort checking is performed during testing. This allows an immediate abort during a test rather than only at the end of an entire output data frame.

Initial Equalization
Quick start method
Browse through disk files, recall a stored transfer function, 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 with right and/or left slope (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, or imported ASCII or UFF file. You 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 adjustment as the test progresses. A unique overlapped convolution algorithm ensures a continuous drive signal with smooth transitions between output frames.

On-Line Control
The transfer function is continuously updated during the test at a user specified rate. This technique adjusts for nonlinear effects and changing load dynamics to deliver high accuracy without the need for multiple pre-test iterations.

Signal Displays
Unlimited number of display windows in tile or cascade format with click & drag zoom, user annotation, and cursors.

Window format	Per window choice of single, dual, or four pane formats. Each pane can display single or multiple signals overlaid. Independent choice of color and texture for signals, grids, tick marks, labels, titles, etc.
Scale format	Linear or logarithmic scales for X and Y axes with automatic or manual scaling. Dimension: A, V, or D.
Cursors	Single or dual with X, Y, ΔX, ΔY, ΔRMS and Q value readouts; manual peak marks; automatic peak/valley detection and marks; harmonic and sideband cursors
Time signals	Control, profile, any input, aborts, composite (control, profile, aborts), and drive; scrolling input histories.
Frequency signals	Control, profile, and drive.

Post-Test Documentation
Icon for single click generation of data plots and test reports, including setup parameter listings, test logs, and formatted signal plots, within Microsoft Word.

Sine on Random (SoR) Vibration Control

Test Setup and Control

SoR includes all of the features of the Random package with one exception - the maximum frequency is limited to 4000 Hz (5500 Hz with the high frequency option).

Set up of a SoR broadband PSD profile is the same as in the Random package. Then up to 20 sine tones are added. 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 Power Spectral Densities (PSDs) for the drive and control channels are calculated on a per frame basis and used to continuously update the control loop transfer function. The broadband random drive signal has a true gaussian distribution.

Sine Tone Control Technique

Up to 12 tones can be controlled simultaneously. An individual phase-locked tracking filter is applied to each sine tone to accurately extract its amplitude from the control feedback signal. The sine tone portions of the drive signal are generated digitally with updates to amplitude and frequency made on a per point basis - not on a per frame basis or at zero crossings.

A 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. Tone frequencies are changed with analog-like smoothness. The tone sweep characteristics are not linked to the broadband random spectral resolution or the frame acquisition time.

Special Features

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 (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	The high/low RMS alarm/abort limits can be automatically calculated based on profiles or entered by the user.

Special Displays

SoR provides the following special data displays:

Tone tracks	Acceleration versus frequency on-line displays for all sweeping tones.
Sweep envelope	Amplitude versus frequency sweep envelope for tones provides pre-test validation of the setup.

Sine Tone Characterristics

Number	Up to 20 tones
Target amplitude	Fixed acceleration or amplitude versus frequency profile table.
Profile breakpoints	Unlimited combination of amplitudes (A, V, or D) and right and/or left constant A/V/D slopes at defined frequencies.
High abort/alarm	Limits specified in dB with respect to the target amplitude.
Frequency range	High, low, and initial frequency in Hz (all with a resolution as fine as .000001 Hz).
Initial direction	Increasing or decreasing from the initial frequency.
Sweep mode	Linear or logarithmic specified as rate or time.
Sweep rate	Linear at zero to 1000 Hz/min or logarithmic at zero to 20 octaves/min.
Sweep time	User defined in minutes/sweep.
Ramping rate	Zero to 200 dB/sec (the amplitude changes between zero and the target at this rate after the tone is turned on/off).
Burst on and off	Independent time on and time off with resolution of 0.001 seconds.
Harmonic mode	Sets sine tones #2,3,4,... to be integer multiples of sine tone #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.

Test Management

SoR includes all of the automatic and manual test controls that are included in Random, with the addition that a push-button panel allows the user to turn on and off individual sine tones 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 SoR the push-button panel can be repeatedly inserted as an event to turn on and off individual sine tones or the broadband random at any time. One typical application of this feature is to delay the start time of the sine tones until after the random has reached full level. This flexible implementation of the schedule allows users to write their own script for the test.
Manual mode	During testing, the user can use the push-button panel to activate or deactivate any of the components at any time. The software will validate the overall required RMS value against shaker limits before implementing any changes.

Random on Random (RoR) Vibration Control

Test Setup and Control

RoR includes all of the features of the Random package with one exception - the maximum frequency is limited to 4000 Hz (5500 Hz with the high frequency option).

Set up of a RoR broadband PSD profile is the same as in the Random package. Then up to 12 narrowbands are added. Automatic on/off switching (at arbitrary intervals) of each of the narrowbands, 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 Power Spectral Densities (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.

Safety Features

Automated and interactive test modes reduce test time and allow tailored testing.

Validation tools	Automatic listing of acceleration, velocity, and displacement values for the broadband, narrowbands and overall profile. The sum of the RMS values of all active components (narrowbands and/or random vibration) 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	The high/low RMS alarm/abort limits can be automatically calculated based on profiles or entered by the user.

Special Displays

RoR provides the following special data displays:

Sweep envelope	PSD amplitude versus frequency sweep envelope for narrowbands provides pre-test validation of the setup.

Narrowband Characteristics

Number	Up to 12 narrowbands
Target amplitude	Acceleration Power Spectral Density (e.g., G /Hz, or (m/sec) /Hz, etc.).
Profile breakpoints	Unlimited combination of PSD levels with right and left slopes (dB/octave) at user defined frequencies
Narrowband width	Frequency width specified in Hz.
High abort/alarm	Limits specified in dB with respect to the target amplitude.
Frequency range	(Specified for the center frequency of the narrowband) High, low, and initial frequency in Hz.
Initial direction	Increasing or decreasing from the initial frequency.
Sweep mode	Linear or logarithmic specified as rate or time.
Sweep rate	Linear at zero to 500 Hz/min or logarithmic at zero to 10 octaves/min.
Sweep time	User defined in hours:minutes:seconds.
Ramping rate	Zero to 60 dB/sec (amplitude changes between zero and the target at this rate after the narrowband is turned on/off).
Harmonic mode	Sets narrowbands #2,3,4,... to be integer multiples of narrowband #1's frequency parameters.
Profile composition	Sum of narrowbands and broadbands or maximum between narrowbands and broadband.

Test Management

RoR includes all of the automatic and manual test controls that are included in Random, with the addition that a push-button panel allows the user to turn on and 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 push-button panel can be repeatedly inserted as an event to turn on and 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. This flexible implementation of the schedule allows users to write their own script for the test.
Manual mode	During testing, the user can use the push-button panel to activate or deactivate any of the components at any time. The software will validate the overall required RMS value against shaker limits before implementing any changes.

Sine and Random on Random (SRoR) Vibration Control

This add-on module for the SoR and RoR Vibration Control software packages allows the user to create a vibration environment by combining fixed or sweeping sine tones and fixed or sweeping random narrowbands with broadband random vibration.

The ultimate in closed loop control applications, SRoR enables the user to simulate the most demanding environments in their test lab. Similar to SoR and RoR, the user can individually activate and de-activate any component (sine tone, narrowband, or the broadband) of the environment.

SRoR is very easy to set up and run, and is unique in that it uses the power of 60 MHz DSPs (with floating point math) to execute an advanced phase-locked tracking filter technique simultaneously on each of the independent sine tones.

For gunfire simulations, it allows especially fine control of burst time on and off. Abrupt changes in level, when turning the sine tones or narrowbands on and off, are managed with a user defined ramping rate.

Test Setup and Control

SRoR includes all of the features of the Random, SoR, and RoR packages with one exception - the maximum frequency is limited to 4000 Hz (5500 Hz with the high frequency option).

Set up of a SRoR broadband PSD profile is the same as in the Random package. Then up to 12 sine tones and up to 12 narrowbands are added. Automatic on/off switching (at arbitrary intervals) of each of the sine tones and narrowbands, or even the broadband random, can be set in the schedule. During testing, the system simultaneously controls the sine tones, random narrowbands, and broadband random.

- **Broadband Random Control Technique**
  The same as for the Random Vibration Control software.
- **Sine Tone Control Technique**
  The same as for the SoR Vibration Control software.
- **Sine Tone Characteristics**
  The same as for the SoR Vibration Control software.
- **Narrowband Control Technique**
  The same as for the RoR Vibration Control software.
- **Narrowband Characteristics**
  The same as for the RoR Vibration Control software.
- **Test Management**
  The same as for the RoR and SoR Vibration Control software.
- **Safety Features**
  The same as for the RoR and SoR Vibration Control software.

Advanced Test Capability, Security, Networking and Re-Calibration Options

Project Sequence
A Project Sequence provides the capability to automatically execute a sequence of project files. 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. This later type of sequence 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.

The Project Sequence capability allows convenient definition, storage and recall, and execution of the test sequence. Individual profiles may be selected, added, or deleted via the graphical user interface. Project Sequence is included as a no-charge option included with every system.

High Frequency Option
This Option extends the control range above 4000 Hz. Without this option, the Random and Sine Control Software can operate up to 4000 Hz but no higher. With this option, they can operate to much higher frequencies (please see their individual specifications for details). Control is done in realtime only at frequencies below 4000 Hz.

Drive Notching / Limiting and Abort Channel
This capability is standard with Premier Random and Sine family software to provide additional safety for fragile test articles or components.

Any channel can be enabled as a Limit or Abort channel. Each Limit channel has a corresponding amplitude versus frequency profile. Both the Limit/Abort channel input spectrum and Limit Profile can be viewed during a test.

If any input channel exceeds its limit during testing, the drive output (at that frequency) will be reduced (notched) until the input channel does not exceed it's limit. The test is automatically aborted if the spectrum of any Abort Channel exceeds its abort profile in any frequency range.

Non-Acceleration Control Option
This feature is standard with all Premier Control packages and it allows control using a force, velocity, or displacement transducer. One application of this capability is for Force Limiting. Another use is for sine testing with transition control from a displacement sensor to an accelerometer. A further use is for control to angular acceleration.

Wireless Remote Control Pendant Option
Using a hand-held pocket PC you can now supervise and monitor your vibration tests even when you are near the shaker and test article. This option provides a wireless connection so that there is no need to deal with the hassle or interference of a cable connection. The software has the flexibility to preprogram the commands and status readouts displayed on the pocket PC. It is even possible to display a signal display so that you can monitor the control and response signals as you are moving around the test article.

Amplifier Controller Option
The Amplifier Controller software provides the capabilities to turn on, set up, and monitor a LDS SPA-K amplifier conveniently and remotely from the same PC used as the host for a Dactron Shaker Control System. It allows the test operator to turn on the amplifier and have it come on-line in a preset configuration. Configurations are easily saved and recalled for complete flexibility in setting the amplifier state for each particular test need.

Sine Oscillator Option
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 also be used to make transmissibility and transfer function (amplitude and phase) measurements. It is a great tool for quick characterization of a fixture or for checkout of the shaker's performance.

Advanced Graphic Option
Waterfall, color intensity (spectragrams) and color contour plots are enabled by this option. These plots provide a convienient tool to overview an entire test. They are particularly valuable for documenting sine on random, rondom on random, shock, on transient replication tests. Since the data is collected in the PC memory, a very large number of spectra on timw histories can be used in each plot.

Multi-Layer Password Security Option
This Option links to all shaker control software modules. An Administrator creates Groups, Users, and Passwords. Create Groups with arbitrary names and assign privileges to access software functions (e.g., create tests, edit test profiles, run tests, operate on-line controls, create reports, etc.). Create Users with unique names and assign them to the previously defined Groups.

NET-Integrator™
NET-Integrator enables other applications to connect to and control a $LASER_{USB}$ System. NET-Integrator ActiveX controls are easily embedded into applications written in languages like Visual Basic or Visual C++. These controls are also usable by applications such as LabVIEWT™, MATLAB™, and Excel.

Re-Calibration Software Option
This Software module allows users to re-calibrate the System at any time interval (typically once per year). Set up by connecting the output channel to a calibrated Volt Meter and then connecting it to all of the input channels. A complete calibration can typically be performed in less than fifteen (15) minutes. The software automatically creates a calibration data file and a text report file containing a complete report on the process.

Value Shaker Control Software Packages

Value Random

Reference profile	Breakpoint table with unlimited combination of PSD levels with right and/or left slope (dB/octave) at user defined frequencies.
Frequency range	Zero to 2400 Hz in eight ranges; 4000 Hz optional.
Resolution	110, 225, or 450 spectral lines; 800 lines optional.
Dynamic range	Up to 95 dB
Randomization	Frequency domain phase randomization technique produces a true gaussian distribution.
Loop time	Typically 100 milliseconds
Transfer function	Measure during pre-test or, for quickest test startup, recall a function from disk.
DoF	Two to 1000
Control accuracy	1 dB at 99% confidence with 200 DoF.
Number of inputs	From two to 8
Control strategy	Control to any single input channel; multiple channel option.
Drive clipping	Three to six sigma or disabled.

Value Swept Sine

Reference profile	Unlimited combination of amplitudes (A, V, or D) and right/left constant A/V/D slopes at defined frequencies.
Frequency range	0.1 Hz to 2400 Hz; optional 4000 and 12000 Hz ranges.
Dynamic range	Up to 100 dB
Loop time	Typically 10 msec
Control accuracy	1 dB through a peak-notch with a Q of 50, at 1 octave/min.
Compression rate	Adaptive or fixed 0.3 to 3000 dB/sec.
Number of inputs	From two to 8
Control strategy	Control to any single input channel; multiple channel option. Peak, mean, or RMS input channel amplitude processing; Digital tracking filters optional.
Sweep rate	Linear from zero to 6000 Hz/min or logarithmic from zero to 100 octaves/min.
Drive resolution	As fine as 0.000001 Hz
Sine dwell	User specified dwell frequency with duration specified in cycles or time.

Value Classical Shock

Pulse types	Half-sine, Haversine, initial and terminal peak sawtooth, triangle, rectangle, and trapezoid.
Compensation	Pre- and post-pulse, post-pulse only, or pre-pulse only. Single or double sided for minimum acceleration and full use of shaker stroke.
Frequency range	Zero to 22000 Hz.
Frame size	128 to 16384 points or automatically optimized. Linear filter design minimizes distortion and preserves the true waveform shape.
Number of inputs	From two to 8
Transfer function	Measure during pre-test or, for quickest test startup, recall a function from disk.
Averaging	User set 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.
Delay between pulses	User specifies zero to unlimited seconds.

Setup Features

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.
Engineering units	English, SI, Metric, mixed
Test schedule	User defined sequence of events, or profiles, that are automatically executed during the test.

Safety Features

Control signal	Automatic detection of input overload, open loop, and loss of signal.
Line-abort trigger	Ratio of spectral lines allowed to exceed their limits; from zero to one.
Test shutdown	Shutdown initiated by operator or software is performed gracefully at a user specified rate.

Test Execution

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

Pre-test mode	Automatic start-up or prompt for test start.
Operation modes	Automatic or manual operation.

Test Management

Control Panel toggle buttons and tool bar icons provide easy access to test controls. For added convenience, commonly used commands are accessible via keyboard special function keys. Text messages and numerical readouts on the Control Panel enhance test status monitoring.

Signal Displays

Unlimited number of display windows in tile or cascade format with click & drag zoom, user annotation, and cursors.

Window format	Per window choice of single, dual, or four pane formats. Each pane can display single or multiple signals overlaid in either time or frequency. Independent choice of color and texture for signals, grids, tick marks, labels, titles, etc.
Scale format	Linear or logarithmic scales for X and Y axes with automatic or manual scaling.

Post-Test Documentation

Icon for single click generation of data plots and test reports, including setup parameter listings, test logs, and formatted signal plots, within Microsoft Word.

Value to Premier Software Upgrade

As your test needs grow, you can conveniently enhance the capabilities of your Dactron System by upgrading from Value Packages to Premier Packages. The upgrade is simple and no additional hardware is required to make the change. Plus, all of your existing Value test project files are fully compatible with the upgrade Premier Packages.

Value to Premier Comparison & Software Feature Guide

Random	Value	Premier
Maximum frequency range {kHz)	2.4; 4 opt	4; 10 opt
Maximum frequency resolution (lines)	450; 800 opt	1800
Dynamic range	95 dB	95 dB
Loop time	100 msec	100 msec
Control accuracy	±1 dB	±1 dB
Maximum input channels	8	16
Control strategies		
• Single channel control	✔	✔
• Multiple channel control	option	✔
• Non-acceleration control		✔
Loop transfer function		
• Pre-test equalization	✔	✔
• Stored disk file	✔	✔
Reference profile breakpoints	Unlimited	Unlimited
• Import profile	option	✔
Signal displays		
• One, two and four pane	✔	✔
• Math operations & displays		✔
• Scrolling strip chart plots		✔
• Oscilloscope plots		✔
Application expansion		
• Sine on Random		✔
• Random on Random		✔
• Sine and Random on Random		✔
• Automatic drive notching/limiting		✔

Swept Sine	Value	Premier
Maximum frequency range (kHz)	2.4;4,12 opt	4; 12 opt
Dynamic range	100 dB	100dB
Loop time	10 msec	10 msec
Control accuracy*	±1 dB	±1 dB
Compression rate		
• Fixed (dB/sec)	0.3 to 3000	0.3 to 3000
• Adaptive	✔	✔
Maximum input channels	8	16
Control strategies		
• Single channel control	✔	✔
• Multiple channel control	option	✔
• Digital tracking filters	option	✔
• RMS, Peak and Mean	✔	✔
• Non-acceleration control		✔
Sweep type and rate		
• Linear (Hz/min)	6000	6000
• Logarithmic (octaves/min)	100	100
Reference profile breakpoints	unlimited	unlimited
Signal displays		
• One, two and four pane	✔	✔
• Math operations & displays		✔
Application expansion		
• Resonance Search, Track and Dwell		✔
• Automatic drive notching/limiting		✔

Classical Shock	Value	Premier
Maximum frequency range	22000 Hz	22000 Hz
Maximum frame size	16384	16384
Loop transfer function		
• Pre-test equalization	✔	✔
• Stored disk file	✔	✔
Averaging coefficient	1 to 500	1 to 500
Maximum input channels	8	16
Low-pass filtering	✔	✔
Classical pulse types		
• Half-sine	✔	✔
• Haversine	✔	✔
• Sawtooth	✔	✔
• Rectangle	✔	✔
• Triangle	✔	✔
• Trapezoid	✔	✔
Pulse compensation	✔	✔
SRS Analysis		✔
Control Stratagies		
• Single Channel control	✔	✔
• Multipule Channel control		✔
• Non-acceleration control		✔
Signal displays		
• One, two and four pane	✔	✔
• Scrolling strip chart plots		✔
Application expansion:		
• SRS Synthesis and Control		✔
• Transient Time History Control		✔

Setup Features	Value	Premier
Validation tools		
• Listing of dynamic limits	✔	✔
• Overlay of shaker limits	✔	✔
• Shaker limits check	✔	✔
Engineering units	✔	✔

Test Execution	Value	Premier
Test schedule	✔	✔
Pre-test modes		
• Automatic test startup	✔	✔
• Hold for operator prompt	✔	✔
Operation modes:		
• Automatic	✔	✔
• Manual	✔	✔

Safety Features	Value	Premier
Control signal loss checks	✔	✔
Automatic line-abort trigger	✔	✔
Test shutdown		
• Automatic graceful shutdown	✔	✔
• Manual abort	✔	✔

Post-Test Documentation	Value	Premier
Quick reports within MS Word	✔	✔

RT Pro Signal Analysis and Transient Capture Software

Signal Processing Functions

Time domain	Time capture, auto-correlation and cross-correlation functions.
Frequency domain	Realtime spectrum analysis, auto-power spectrum, cross-power spectrum, power spectral density, frequency response function, coherence function, Fourier transforms, and impulse responses.
Amplitude domain	Histogram

Realtime Spectrum Analysis

Realtime rate	20 kHz for auto-spectrum analysis
Dynamic range	120 dBfs, 110 dB minimum in FFT mode.
Frequency range	Zero to 21000 Hz in twenty-four ranges. Extended frequency option available for 36000 Hz and 42000 Hz ranges.
Resolution	110, 225, 450, 900, 1800, 3600, 7200 or 14400 spectral lines*.
Windows	Hanning, Hamming, Flat-Top, Uniform, Force/ Exponential, Kaiser Bessel, Blackman, Blackman Max. Decay, Blackman Min. Sidelobe, Bartlett, Tukey and Welch.

Averaging

Modes	Time or Frequency
Types	Exponential, linear, peak hold, peak hold for specified number of averages.
Overlap processing	User-defined percentage from 0% to 99%. Maximum overlap dependent on sampling rate.
No. of averages	1 to 32767 frames
Frame reject	Automatic reject of frames with voltage overloads; manual accept/reject of overloaded frames; manual accept/reject for all frames.

Triggering

Source	Input channel, source signal, digital input, time delay, or free run.
Slope	Positive, negative or bi-polar
Level	Percent of full-scale range or voltage level
Pre/Post trigger	User selected number of samples; up to the selected frame size before or up to 65535 samples after the trigger point.
Modes	Automatic or manual
Run modes	Trigger first frame followed by free run, auto trigger every frame, manual arm every frame.

Modal Data Acquisition

Modal coordinates	Entry of measurement point, axis and sense in Channel Parameters table or via on-line Coordinate Update table.
Auto-incrementing	Automatic updating of the roving measurements using pre-set measurement point increment.

Transient Capture

Sampling rates	20 sps to 48000 sps in twenty-four settings. Extended frequency option available for 82000 sps and 96000 sps.
Frame size	256, 512, 1024, 2048, 4096, 8192, 16384 or 32768 samples.
Modes	Single frame, multiple frames

Environmental Data Reduction (option)

SRS analysis	Up to 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, or 1/48).

Environmental Data Reduction (option)

Signals	Swept-sine, shaped random, shaped burst random, white noise, pseudo-random, burst random, chirp, sine wave, square wave, and triangle wave, impulse chain, and DC level.

Test Management

Measurement and Source Panel toggle buttons and tool bar icons provide easy access to test controls. For added convenience, commonly used commands are accessible via keyboard special function keys.

Controls	Start/stop, pause/continue, and next frame buttons.
Measurements	Time capture, FFT, correlation, spectrum, FRF/ coherence, and histogram buttons.
Parameters	Spectral lines, frame size, frequency range, spectral window, frames, trigger, average
Waveform source	Start/stop, white noise, pseudo-noise, burst random, sine, chirp, square wave, triangle wave, impulse chain, and DC selection buttons.
Icons	Reset frame averaging, save signals, and quick report.
Status displays	Frame number, activity status, and a message box.

Signal Displays

Unlimited number of display windows in tile or cascade format with click & drag zoom, user annotation, and cursors.

Window format	Per window choice of single, dual, or four pane formats. Each pane can display single or multiple signals overlaid in either time or frequency. Independent choice of color and texture for signals, grids, tick marks, labels, titles, etc.
Scale format	Linear or logarithmic scales for X and Y axes with automatic or manual scaling.
Cursors	Single or dual with X, Y, ΔX, ΔY, ΔRMS and Q value readouts; manual peak marks; automatic peak/valley detection and marks; harmonic and sideband cursors.
Frequency signals	Auto-spectrum, cross-spectrum, FFT, power spectrum density, frequency response function, coherence.
Signal formats	Real, imaginary, magnitude, phase, unwrapped phase, polar, vector (Nyquist).
Engineering units	English/SI/Metric/mixed units for acceleration, velocity, displacement, force, and pressure; user defined.
Normalization	Engineering Units (EU), EU , EU /Hz, EU/ Hz, EU -S/Hz; decibels (dB)
Time signals	Input time histories, auto and cross correlation, orbit plots
Amplitude signals	Histograms

Signal Calculator

This feature allows you to create customized signals. All signals are calculated and displayed “live” during testing. Operations include add/subtract/ multiply/divide and single/double integration or differentiation.

Data Export

RT Pro provides seamless data interfacing to advanced analysis packages such as Math Works MATLAB for customized data analysis and ME Scope for modal analysis.

Binary file formats	Dactron, ME Scope, UFF, MTS ATU/AFI, Agilent SDF
ASCII file formats	UFF, X-Y pair, Y only

Post-Test Documentation

Icon for single click generation of data plots and test reports, including setup parameter listings, test logs, and formatted signal plots, within Microsoft Word.

** Up to 3600 lines with all functions enabled for 8 channels. Higher resolutions dependent on the number of functions and channels active.*

$LASER_{USB}$ – The Solution for Advanced Vibration Control and Analysis

Product Selection Guide

Hardware

LAS-200 **$LASER_{USB}$ Shaker Control System**

Options

LAS-201	One extra Analog Input with voltage, ICP and TEDS input coupling
LAS-203	Remote abort button
LAS-204	$LASER_{USB}$ Rack Mount Kit
LAS-210	$LASER_{USB}$ Channel Expansion Box
ACC-101	Wireless Remote Control Pendant (includes hardware & software)
CAL-100-02	Re-Calibration Software for $LASER_{USB}$

Software

Vibration Control Options

SCO-01P	Random Vibration Control
SCO-01P-01	Sine-on-Random Vibration Control
SCO-01P-02	Random-on-Random Vibration Control
SCO-01P-03	Sine-and-Random-on-Random Vibration Control
SCO-02P	Swept Sine Vibration Control
SCO-02P-01	Resonance Search Track & Dwell Vibration Control
SCO-03P	Premier Classical Shock Transient Control
SCO-03P-01	Transient Time History Control
SCO-03P-02	Shock Response Spectrum Transient Control
SCO-04P	Long Time History (Road Simulation) Control
SCO-05P	Sine Oscillator

General Options

SCO-100-02	Multi-Layer Password Security System
SCO-100-03	High Frequency Control
SCO-100-06	Advanced Graphics Option - Waterfalls and Spectrograms

Other Options

SCO-110	Analyze Anywhere for Shaker Control
SCO-111	Waveform Editor
SCO-113	Thermal Chamber Communication & Control
SCO-114	Amplifier Control Interface
DSA-100-08	Signal Reader (ActiveX commands to read LDS-Dactron binary files)

Networked Enabled Test Options

NET-103-01	NET-Integrator ActiveX Command and Communication Interface
NET-104-01	NET-Integrator Run-time license (per seat license)

Dynamic Signal Analysis Applications

DSA-100	RT Pro (FFT, Transient Capture, Signal Calculator, Modal Data Acquisition, and Waveform Source)
DSA-101	Transient Capture and SRS Analysis

Also available

Offering superior performance at a very affordable price, the $COMET_{USB}$ Vibration Controller is an ideal solution to the everyday demands of your shock and vibration testing. $COMET_{USB}$ provides the flexibility to do random, swept sine, and shock testing on both electrodynamic and hydraulic shakers. Easy to use software together with a Test Setup Wizard make the $COMET_{USB}$ a perfect fit for vibration stress screening and production test applications.

$COMET_{USB}$ Vibration Controller

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