EDM VIBRATION CONTROL SYSTEM (VCS)

SOFTWARE SPECIFICATIONS (VERSION 4.2)

CRYSTAL instruments

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PRODUCT SPECIFICATION SHEET

EDM VIBRATION CONTROL SYSTEM (VCS)

EDM (Engineering Data Management) is a PC based software program designed for vibration control and real time data processing. The VCS functions includes Random, Sine-on-Random, Random-on-Random, Swept Sine, Resonance Search and Dwell, Sine Oscillator, Classic Shock, Transient Time History, Shock Response Analysis/Synthesis, Time Waveform Replication, Dual Drive Control and all typical applications used for environment testing. EDM comes with a user interface in multiple languages. Template based report functions provide testing results in seconds.

TEST MANAGEMENT

Tests are managed through MS SQL Server database. Signal files, test setup, and UUT (machine) information are stored in the database. User can search the previous tests using keywords, time, or date information. LDS Laser projects of Sine and Random types can be automatically imported.

SPIDER HARDWARE SYSTEM MANAGEMENT

A Spider system can consist of one or more Spider hardware front-ends. The user constructs the system by combining Spider front-ends detected on the same LAN. The software validates and displays hardware attributes of each Spider front-end. Once constructed, multiple Spider front-ends operate as one integrated system. A self-test utility is included with each system for verifying the conditions of the input and output channels using an internal precise signal source. The test validates that the input channels are within factory defined tolerances.

HARDWARE ACCESS CODE CONTROL

Administrator users can edit the access privileges to hardware. Each Spider front-end has its own access control password code to prevent unauthorized access on LAN.

ENGINEERING UNITS

The user selects the preferred physical quantity at the system level with corresponding Engineering Units (EU) and transducer sensitivity (mV/EU) for each input channel. Typical units are:

Acceleration: m/s^2, cm/s^2, mm/s^2, g, ft/s^2, in/s^2, mil/s^2
Time: seconds, ms
Velocity: m/s, cm/s, mm/s, µm/s, nm/s, ft/s, in/s, mil/s
Frequency: Hz, mHz, kHz, MHz, CPM, Rad/s
Displacement: m, cm, mm, µm, nm, ft, in, mil
Angular Velocity: Rad/s, Degree/s, RPM
Force: Newton, Dyne, kN, Kgf, KIPF, LBF, OZF
Current: A, mA
Pressure: Pa, µPa, Bar, PSI, KSI
Sound Pressure: Pa (ref to 20 µPa)
Voltage: V, mV
Mass: kg, g, LBS, Ounce

MEASUREMENT DATA STORAGE

Data Format: compliant with ASAM-ODS hierarchy and structure
Data Precision: data saved in 32 bit (4 byte) single precision floating point words

EXPORT DATA FILE FORMATS

ASAM-ODS XML: ASAM Open Data Source binary format (default, recommended)
UFF ASCII: ASCII format of UFF files
UFF Binary: binary format of UFF files
ASCII: User-defined format with selectable attributes.
Excel CSV: Comma Separated Value, CSV, can be opened directly in Microsoft Excel
MATLAB: *.mat binary format can be opened and analyzed using MATLAB
.WAV: sound wave files

IMPORT DATA FILE FORMATS

ASAM-ODS XML, UFF ASCII, UFF Binary, ASCII, Excel CSV, MATLAB, WAV files, Pacific Instruments format, TEAC format, San-Esu format

LANGUAGES

English, Japanese, Simplified and Traditional Chinese are available. Language can be switched without reinstalling software.

REPORT

Testing reports are directly created in the Open XML format that can be read by Microsoft Word or many open source Office tools. Fields and attributes are customizable. Using Windows ActiveX technology, Active Report supports the embedded graphic drawing functions in Microsoft Word. Active Report is only available if Microsoft Office 2007, 2010, or newer version is installed.

ADMINISTRATOR CONTROL

Different users can access certain portion of test settings (testing parameters, profile, channel and display) depending on the specified account level, with the privileges managed by an administrator.

DIGITAL I/O INTERFACE
Each Spider-81/Spider-TBD module has 8 isolated digital inputs and 8 isolated digital outputs (Spider-81B has 4 of each), corresponding to the pins on the Digital I/O connector, which are used to send and receive low level electrical signals to and from other devices to coordinate their operation during a test.

Configurable Actions for Digital Inputs: start test, flash screen, beep, create report, save screen, send emails, send Windows message to other program, set digital output signals, start recording, stop recording, save signals in the list, next level, increase level, decrease level, abort test, abort check-off, abort check-on, open control loop, close control loop
Configurable Digital Output Events: user stop, channel overload, output maximum, exceed high abort or alarm line, below low abort or alarm line, RMS high than alarm or abort, RMS lower than alarm or abort
Output Pulse Types: High-Low, Low-High and variations

TEST SEQUENCE
Create a list of tests and run them sequentially. Test sequences can be initiated and controlled by a user command, digital input event, or Windows socket message.

SEND EMAILS AND IM AS EVENT-ACTIONS
The ability to send emails or instant messages as custom actions in response to a system or user event. Content of emails can be customized.

REMOTE OPERATION COMMUNICATION USING SOCKET MESSAGES
Communicate with and control Spider systems remotely with Window socket messages. Socket messages also allow communication with other hardware, such as temperature chambers. Please refer to document for Socket Message for detail specs.

SYSTEM FAILURE PROTECTION
Power Loss Emergency Shutdown: When a power loss is detected, the system will save all test data into non-volatile flash memory and safely shut down.

Ethernet Connection Loss Detection: When a network loss is detected, the system can be configured to either save all data and ramp down the test or continue test running in Black Box mode.

INPUT CHANNELS
Location ID: Allows the naming of signals by the physical location of the sensor on the UUT.
Level Display: Bar graphs display the input level of each channel. Indicator shows IEPE sensor detection.
Sensitivity: user defined engineering unit and input sensitivity setting for each channel
Channel Type: control, monitor and limiting. Up to 8 control channels are enabled on the master module. Monitoring and limiting channels are enabled on both master and slave modules.
Channel Library: settings are saved to a library and reused in different tests.

EVENT-ACTION RULES
Test events such as alarms and digital inputs will trigger the user-assignable actions.

Event Types: user-stop, channel overload, output maximum, exceed high abort or alarm line, below low abort or alarm line, RMS high than alarm or abort, RMS lower than alarm or abort, any of digital input events
Actions: flash screen, beep, create report, save screen, send emails, send Windows message to other programs, set digital output signals, start recording, stop recording, save signals in the list, next level, increase level, decrease level, abort test, abort check-off, abort check-on, open control loop and close control loop

SHAKER PARAMETERS
Shaker limits are calculated from the shaker parameters and the weight of the Unit Under Test (UUT).

Shaker Parameters: maximum amplifier input voltage, shaker acceleration, velocity, displacement, force, drive frequency, and mass of UUT
Shaker Library: Settings are saved to a library and used repeatedly in different tests. Shaker parameters are imported from or exported to a Microsoft Excel spreadsheet.
UUT Weight: is changed per test in the confirmation page

PRE-TEST
Pre-test checks the integrity of all signal paths and measures the system FRF. (VCS-00-05 is required for Random excitation pre-test in Sine/RSTD/Shock/TTH/SRS tests)

Pre-test Options: measure the FRF in a closed-loop, run with FRF saved on the PC.
Drive Voltage: user-defined initial drive voltage and max drive voltage with selectable ramp-up rate
Noise Floor Measurement: measures the noise floor and compare with the control signals.
Checks: IEPE sensor check, open loop check, safety check

MANUAL CONTROLS DURING TEST
User Commands: run, stop, hold, pause, continue, level up, level down, restore level, set level, abort check on/off, schedule clock timer on/off, closed loop control on/off, reset average, next schedule, save signals or record time stream signals
User Commands (not in Sine/RSTD): save FRF function, show pre-test results
User Commands (only in Sine/RSTD): hold sweep, sweep up, sweep down, release sweep, increase frequency, set frequency

MULTIPLE POINT CONTROL
Allow multiple control channels to be used for the control signal.

Multiple Point Control Strategies (Random/Sine/RSTD): weighted average, maximum, and minimum.
Multiple Point Control Strategies (Shock/TWR): weighted average

GENERAL SOFTWARE OPTIONS

The software options listed in this section can be applied to any vibration control software module.

SINE OSCILLATOR (VCS-00-05)
Sine Oscillator is a diagnosis tool with manual control to the sine output while the system displays various time signals and frequency spectra. Random excitation can be enabled as a checkup function. When closeloop option is enabled, the Sine Oscillator is essentially a limited sine controller with more manual control functions.

Frequency Range: automatically calculated based on profile, or selectable from multiple ranges: 2 Hz to 5,000 Hz
Sweeping Rate: Log (Oct/Min): 0.001 to 120; Log (Dec/Min): 0.001 to 40; Linear (Hz/Sec): 0.001 to 120
Sweep Rate Control: Oct/Min, Hz/Sec, Dec/Min, Sweeps/Min, Sweep Duration/Sweeps
Spectrum Display Resolution: 256 to 4096
Tracking Filters: Proportional: 7% – 100%; Fixed (Hz): 1 – 500 Hz
Frequency Resolution: as fine as 0.000001 Hz
Control Mode: either open-loop or with close-loop control

NON-ACCELERATION CONTROL (VCS-00-12)
With this option, a non-acceleration measurement quantity can be applied to the control signal. This provides an option of choosing from multiple quantities including force, sound, and voltage to be controlled when appropriate sensors are used. Angular acceleration can controlled in Sine and Random tests using the appropriate selection.

The controller is also capable of using mixed displacement, velocity and acceleration sensors and synthesize a control signal in the acceleration domain.

Random: control in angular acceleration, control in any non-acceleration unit
Sine: control in angular acceleration, control in any non-acceleration unit, control in linear acceleration while allowing displacement or velocity measurement
Shock/TTH: control in any non-acceleration unit

REAL-TIME SINE REDUCTION (VCS-00-14)
The real-time sine reduction function offers a solution to extend the number of measurement channels of a vibration controller system in a swept sine test. When a Spider dynamic measurement system is running in the Sine Reduction Mode while an independent vibration controller controls a shaker, the Sine Reduction application will calculate all time and frequency spectra as those available in the controller. This function requires a COLA signal from the vibration controller system for instantaneous frequency and phase detection and spectrum analysis.

MULTI-MASTER OPTION (VCS-00-20)
Create a special license key so a multiple module system can be split into several independent systems. Any unit enabled with this license key can be used as a Master unit. Ordering this option will enable the same set of software running on each or any combination of the Spiders that are defined in this license key.

EMA DC-OFFSET CONTROL (VCS-00-24)
Create a second output can be used with an Electro Magnetic Actuator (EMA) Control System. Output has DC component in addition to control signal. Only available on Spider-81.

SENSOR CALIBRATION (VCS-00-36)
The Sensor Calibration tool is used to calculate the sensitivity of sensors while the measurements of the sensors are compared against referenced sine wave input signals. The user enters the following information: Calibration signal nominal frequency, select either RMS reading or dB RMS reading, and reference dB value. The front-end automatically calculates the RMS levels and updates the sensitivity table. The user accepts or rejects the calibration results and views the reports.

SPIDER FRONT-END CALIBRATION SOFTWARE (SPIDER-CAL)
The front-end is calibrated at the factory prior to shipping and should be recalibrated annually by a factory authorized calibration service. EDM has an optional calibration tool that is operable by either the user or a calibration specialist. Calibration data is stored inside of the Spider front-end.

Calibration Software Functions: The calibration software calibrates the signal source and adjusts the DC and AC gains and offset. It also calibrates the input channels at all coupling types and adjusts the DC and AC error. The report includes the model number, text for the calibration meter, and the calibration operator's name. The report is viewed or printed from the host PC.

EDM SOFTWARE SPECIFICATIONS: VIBRATION CONTROL MODULES | RANDOM VIBRATION CONTROL (VCS-20)

The Random Vibration Control System provides precise, real-time, multi-channel control and analysis. Up to 64 channels can be enabled for control, notching, monitoring and time data recording. The recording option records time stream data at the full sample rate on all input channels. A unique hardware design provides a fast loop time of less than 15 ms. Optional Kurtosis control can create a non-Gaussian random signal.

CONTROL PARAMETERS
Frequency Range: automatically calculated based on profile, or selectable from multiple ranges: up to 4,900 Hz (High Frequency option VCS-20-02 available)
Spectral Resolution: 200, 400, 800, and 1600 (High Resolution option VCS-20-04 available)
Loop Time: 12.5 ms for 2000 Hz f_a/200 lines (Loop time is the maximum time rate at which a controller executes complete cycles of sampling, processing data and transmitting control signals. It is the inverse of the so called "real-time control bandwidth". The real-time control bandwidth of the Spider-81 in Random mode is about 80 Hz.)
Average Number: 1 – 500 (2 – 1000 DOFs)
Overlap Ratio: none, 50%, 75%, and 87.5%
Control Dynamic Range: 90 dB
Control Accuracy: ±1 dB at 99% confidence with 200 DOF
Drive Sigma Clipping: 3 – 10, or disabled

OUTPUT CHANNELS
First Output: drive channel
Second Output: configurable as one of followings: no output, same as the first output, negative of first output, control RMS level, or RMS or Peak value of any input channel. Not available for Spider-81B

MEASURED SIGNALS AND DISPLAY STATUS
Measured Signals: Drive signal, input time stream, drive signal spectrum, system transfer function, high abort, high alarm, low abort, low alarm, control spectrum, profile, noise spectrum, auto-power spectra for all channels, user defined transmissibility, and strip chart plots for the time history of RMS, Peak, and Peak-Peak level of each channel. Limiting signals are optional. Transmissibility signals are in complex format with real/imaginary parts.
Display Windows: Composite, signal plot window, signal value window, digital I/O view window, runlog window, large numerical value display window and channel status window
Status Display on Control Panel: control level, drive peak, control RMS, target RMS, remaining time, full level elapsed time, total elapsed time, peak-to-peak displacement, peak velocity, cursor readings
Runlog: A test log continuously records real-time status changes and user commands. Maximum number of runlog entries is 1024.

SAFETY
Abort Sensitivity: A single parameter allows the sensitivity and tolerance of various safety checks to be easily adjusted between customizable lower and upper bounds.
Shaker Safety Limits: limits for shaker acceleration, velocity, and displacement
Open Loop Detection: Open loop detection for the control signal and each input channel. Detection is based on maximum control loss or maximum RMS rate of change in the input channels.
RMS Limits: RMS limits for control signal
Control Spectral Limits: spectral limits for control signal
Max Drive Limit: maximum voltage limit for drive output
Shutdown: user defined shutdown rate in dB per second

REFERENCE PROFILE AND RUN SCHEDULE
Profile Definition: Control profiles are defined by breakpoints and connecting lines, and are edited in a table or graphically by dragging points on a plot.
Breakpoints: defined as level or slope
Crossover Calculation: By entering "?" the crossover frequency and amplitude is automatically calculated.
Alarm and Abort: limits defined in dB or % relative to reference profile

Profile Scaling: The profile is scaled using RMS value.
Profile Import: A profile is imported from ASCII and other file types.
Profile Library: Settings are saved to a library and used repeatedly in different tests.
Run Schedule: A schedule includes an unlimited number of test stages and user events

RANDOM PROFILE IMPORT, EDITING, AND REDUCTION
Any saved power spectrum data, in various file formats, can be imported, modified, and used as the random profile. For allowable file formats, refer to the general EDM specification. The imported spectrum may be modified by reducing the number of break points between two cursors and editing the profile table.

OPTIONAL RANDOM VIBRATION CONTROL FUNCTIONS (VCS-20-XX)

Software options VCS-20-XX can be applied to basic Random Vibration Control VCS-20.

HIGH FREQUENCY CONTROL FOR RANDOM (VCS-20-02)
Extend the frequency range from 4.9 kHz up to 46 kHz. This may reduce the maximum channel count and highest allowed overlap ratio.

DATA RECORDER FUNCTION FOR RANDOM (VCS-20-03)
Continuously record all input signals during Random, SoR, and RoR tests to the front-end. If Spider-NAS hardware is ordered, the data can be recorded to the Spider-NAS, a device that hosts one or two SATA hard-disks.

Typical Continuous Recording Time: 4 hours for 4 input channels with frequency range 2,000 Hz with 4 GB flash memory installed

HIGH RESOLUTION FOR RANDOM (VCS-20-04)
Not available on the Spider-81B
Increase the number of FFT spectral lines up to 12,800. This may reduce the maximum channel count and highest allowed overlap ratio.

Spectral Lines: 3,200 and 6,400 for all channels. 12,800 for up to 8 inputs.

DRIVE NOTCHING/LIMITING FOR RANDOM (VCS-20-05)
Limiting is applied to control or monitor channels. Available limiting types are notching, abort, and alarm limit. Limiting profiles may be edited by amplitudes and frequencies of breakpoints. The max expected peak acceleration, velocity, and displacement of profile is calculated.

KURTOSIS CONTROL (VCS-20-06)
Kurtosis is a measure of the frequency of occurrences of large peaks in a waveform. Kurtosis control allows the user to specify the target kurtosis of the random control signal, and the controller will adjust the amplitude distribution of the vibration to match the target. This is done with minimal effect on the frequency content and dynamic range. Possible kurtosis values are 3 – 10.

SINE ON RANDOM CONTROL (VCS-20-08)
Sweeping Mode: free sweeping mode where each sine tone has their own schedule and sweeping speed, and harmonic mode where the first tone controls the sweeping speed.

Number of Sine Tones: 1 – 12 in free-sweeping mode; 1 – 20 in harmonic mode
Operation Controls: Tone On and Tone Off controlled by run schedule, external events or user commands

RANDOM ON RANDOM CONTROL (VCS-20-09)
Sweeping Mode: free sweeping mode where each narrow random band has its own schedule and sweeping speed
Number of Bands: 1 – 12
Operation Controls: Band On and Band Off controlled by run schedule, external events or user commands

DUAL-SHAKER CONTROL FOR RANDOM (VCS-20-10)
This option enables the system to output two random drive signals simultaneously to control two shakers. The phase difference between each drive and control signal is calculated and taken into account during real-time operation. This option can be applied to two shaker systems in push-pull or parallel configurations.

DISPLACEMENT OPTIMIZATION FOR RANDOM (VCS-20-11)
A proprietary algorithm was developed to minimize the displacement during Random Vibration Control testing. Displacement is reduced by 10% to 20% while the target PSD profile can still be reached. (Patent pending)

IPAD APPLICATION FOR RANDOM (VCS-20-15)
Any Random, SOR or ROR test uploaded to the front-end is operated and controlled by the EDM iPad app. The control options in the

app include reset average, next entry button, level adjustments, and ON/OFF switch for abort checks, closed loop and schedule timer apart from Run, Pause, and Stop buttons.

SWEPT SINE CONTROL (VCS-40)

The Spider Swept Sine Vibration Control System provides precise, real-time, multi-channel control and analysis. Up to 64 channels can be enabled for control, notching, monitoring and time data recording. The recording option records time stream data at the full sample rate on all input channels, regardless of the total channel number. A unique hardware design provides a fast loop time of less than 10 ms. Black Box mode allows a user to run the controller without a PC.

CONTROL PARAMETERS

Frequency Range: automatically calculated based on profile, or selectable from multiple ranges: 2 Hz to 4,900 Hz (Low and High Frequency option available)
Sweeping Speed: Log (Oct/Min): 0.01 to 6000; Log (Dec/Min): 0.001 to 2000; Linear (Hz/Sec): 0.001 to 6000
Sweep Speed Control: Oct/Min, Hz/Sec, Dec/Min, Sweeps/Min, Sweep Time/Sweep, Cycles/Min
Spectrum Display Resolution: 256 to 4,096
Loop Time: 10 ms typical (Loop time is the maximum rate at which a controller executes complete cycles of sampling, processing data and transmitting control signals.)
Control Dynamic Range: 100 dB typical
Tracking Filters: Proportional: 7% – 100%; Fixed (Hz): 1 – 500 Hz
Control Accuracy: ±1 dB through resonance with Q of 50 at 1 Oct/min
Frequency Resolution: as fine as 0.000001 Hz

OUTPUT CHANNELS

First Output: drive channel
Second Output: configurable as one of the followings: no output, same as the first output, COLA type 1, COLA type 2, first output plus DC (VCS-00-24)
COLA Types: constant amplitude sweeping sine signal or voltage signal that is proportional to the sweeping frequency.

MEASURED SIGNALS AND DISPLAY STATUS

Measured Signals: Drive signal, input time stream, drive signal spectrum, system transfer function, high abort, high alarm, low abort, low alarm, control spectrum, profile, noise spectrum, auto power spectra for all channels, user defined transmissibility, and strip chart plots for the time history of RMS, Peak and Peak-Peak level of each channel. Limiting signals are optional. Transmissibility signals are in complex format with real/imaginary parts.
Block Signals: Block time signals are used to display time waveform or the history of acceleration peak, velocity peak or displacement peak-peak.
Display Windows: Composite, signal plot window, signal value window, digital I/O view window, runlog window, large numerical value display window, channel status window
Status Display on Control Panel: control level, drive peak, control RMS, target RMS, remaining time, full level elapsed time, total elapsed time, peak-to-peak displacement, peak velocity, cursor readings
Runlog: A test log continuously records real-time status changes and user commands. Maximum number of runlog entries is 1024.

SAFETY

Abort Sensitivity: A single parameter allows the sensitivity and tolerance of various safety checks to be easily adjusted between customizable lower and upper bounds.
Shaker Safety Limits: limits for shaker acceleration, velocity, and displacement
Open Loop Detection: Open loop detection for control signal and each input channel. Detection is based on the pre-defined lowest allowed control level or maximum level change rate.
Control Spectral Limits: spectral limits for control signal
Max Drive Limit: maximum voltage limit for drive output

REFERENCE PROFILE

Profile Definition: Control profiles are defined by breakpoints and connecting lines, and are edited in a table or graphically by dragging points on a plot.
Breakpoints: defined as level
Crossover Calculation: By entering “?” the crossover frequency and amplitude is automatically calculated.
Alarm and Abort: limits defined in dB or % relative to reference profile
Profile Maximum: calculation of maximum expected acceleration, velocity and displacement, checked against shaker limits
Profile Library: Settings are saved to a library and reused in different tests.

RUN SCHEDULE

Run Schedule: A schedule includes an unlimited number of test entries and user-defined events.
Sweep Entry: fixed range and time or fixed range and speed
Fixed Dwell Entry: Set dwell time duration and level for multiple frequencies. Duration and level is assigned to each frequency separately.

STEP SINE CONTROL
Step Sine uses a sequence of short dwells within a frequency range. The steps are uniformly distributed in a log or linear frequency scale.

Step Sine Entry in Run Schedule: user defines the frequency range, step resolution and dwell durations or cycles at each frequency

OPTIONAL SWEPT SINE VIBRATION CONTROL FUNCTIONS (VCS-40-XX)

Software options VCS-40-XX can be added to the Basic Sine Control VCS-40.

RESONANCE SEARCH AND TRACKED DWELL (RSTD) CONTROL (VCS-40-01)
The search function determines the resonant frequencies using a transmissibility signal. In real-time control, the tracked dwell entry tracks each resonant frequency. Dwell entries (Fixed dwell, Tracked dwell, Phase tracked dwell) may be added manually or automatically after a sweep entry is done or the list of resonances is determined.

Resonant Frequency Search: Uses Q or amplitude of transmissibility to automatically search the resonances within a certain range.
Tracked Dwell: Resonant frequencies are manually entered or loaded from the search table. Dwelling continues until time duration is reached, resonant frequency changes out of limits, or amplitude changes out of limits. The “Tracked Dwell” entry must be added to the schedule.
Phase Tracked Dwell: Resonant frequencies are manually entered or loaded from the search table. Dwelling continues until time duration is reached or resonant frequency changes out of limits. The “Phase Tracked Dwell” entry must be added to the schedule.

HIGH FREQUENCY CONTROL FOR SINE (VCS-40-03)
Extend the frequency range from 4.9 kHz up to 46 kHz. 1 input for up to 46kHz; 4 inputs up to 32kHz; all channels up to 20kHz. Data recorder function (VCS-40-06) cannot be enabled when frequency range is more than 20kHz.

TOTAL HARMONICS DISTORTION (THD) MEASUREMENT FOR SINE (VCS-40-05)
This option adds the ability of computing Total Harmonics Distortion (THD) of the control and input signals.

DATA RECORDER FUNCTION FOR SINE (VCS-40-06)
Continuously record all input signals during Sine and RSTD tests to the front-end. If Spider-NAS hardware is ordered, the data can be recorded to the Spider-NAS, a device that hosts one or two SATA hard-disks.

Typical Continuous Recording Time: 4 hours for 4 input channels with frequency range 2,000 Hz with 4 GB flash memory installed

DRIVE NOTCHING/LIMITING FOR SINE (VCS-40-07)
Limiting is applied to control or monitor channels. Available limiting types are notching limit, abort limit, and alarm limit. Limiting profiles may be edited by the amplitudes and frequencies of breakpoints. The max expected peak acceleration, velocity and displacement of profile is calculated.

LOW FREQUENCY CONTROL FOR SINE (VCS-40-09)
Extend the frequency range of test from 1 Hz down to 0.1 Hz.

DUAL-SHAKER CONTROL FOR SINE (VCS-40-10)
This option enables the system to output two Sine drive signals simultaneously to control two shakers. The phase difference between each drive and control signal is calculated and taken into account during real-time operation. This option is applied to the two shaker systems in push-pull or parallel configurations. When VCS-40-01 option is ordered, the dual drive option will also be applicable to RSTD.

IPAD APPLICATION FOR SINE (VCS-40-15)
Any Sine or RSTD test uploaded to the hardware can be operated and controlled by the EDM iPad app. The control options for the test include reset average, next entry, level adjustments, sweep speed, sweep direction, sweep status and ON/OFF switch for abort checks, closed loop and schedule timer apart from Run, Pause and Stop buttons.

CLASSIC SHOCK CONTROL (VCS-60)

The Spider Classic Shock Vibration Control System provides precise, real-time, multi-channel control and analysis for transient time domain control. Up to 64 channels can be enabled for control, alarm checking, monitoring and time data recording. Classical pulse types include half-sine, haver-sine, terminal-peak sawtooth, initial-peak saw tooth, triangle, rectangle, and trapezoid. The Transient Time History Control option is typically used for low frequency seismic testing. The recording option records time stream data at the full sample rate on all input channels. Shock response spectrum analysis can be applied to any input signals. Black Box mode allows a user to run the controller without a PC.

CONTROL PARAMETERS
Sampling Rate: automatically calculated based on profile, or selectable from multiple ranges up to 102.4 kHz
Time Block Size: 512 to 4,096 points (Larger block size is optional)
Average Number for Control: 1 – 4
Test Start Method: Pretest runs with four excitation types: positive pulse, negative pulse, Random with close-loop control, Random with open loop. Pretest may be skipped with saved FRF's (signal properties must match test settings).

OUTPUT CHANNELS
First Output: drive channel
Second Output: configurable as one of followings: no output, same as the first output, reverse of the first output

MEASURED SIGNALS AND DISPLAY STATUS
Measured Signals: drive signal, input time stream, drive signal spectrum, system transfer function, high abort, low abort, control signal, profile, strip chart plots for the time history of RMS, Peak, Peak-Peak level of each channel.
Display Windows: signal plot window, signal value window, digital I/O view window, runlog window, large numerical value display window, channel status window.
Status Display on Control Panel: control level, drive peak, control Peak/RMS, target Peak/RMS, remaining pulses, full level elapsed pulses, total elapsed pulses, peak-to-peak displacement, peak velocity, cursor readings
Runlog: A test log continuously records real-time status changes and user commands. Maximum number of runlog entries is 1024.

SAFETY
Abort Sensitivity: A single parameter allows the sensitivity and tolerance of various safety checks to be easily adjustable between customizable lower and upper bounds.
Shaker Safety Limits: limits for shaker acceleration, velocity, displacement
Open Loop Detection: Open loop detection for control signal and each input channel. Detection is based on maximum control loss or maximum RMS rate of change in the input channels.
Control Limits: Enforces abort time limits for control signals. Allowable ratio of points exceeding abort limits to total number points in a frame: 0 – 100%
Max Drive Limit: maximum voltage limit for drive output

REFERENCE PROFILE AND RUN SCHEDULE
Test Standards: MIL-STD-810F, MIL-STD-202F, ISO 9568, IEC 60068, User-defined
Shock Wave Types: half-sine, haver-sine, terminal-peak saw tooth, initial-peak saw tooth, triangle, rectangle, and trapezoid
Pulse Duration: 0.05 ms to 100,000 ms
Compensation Shapes: half-sine, rectangular, double rectangular, rounded-rectangular or displacement optimum
Compensation Locations: pre-pulse, post-pulse, or pre-post compensation.
Profile Maximum: calculation of maximum expected acceleration, velocity and displacement, checked against shaker limits
Abort Limits: According to testing standards or custom
Profile Library: Settings are saved to a library and reused in different tests.
Run Schedule: A schedule includes unlimited number of pulse entries and user-defined events.

OPTIONAL SHOCK VIBRATION CONTROL FUNCTIONS (VCS-60-XX)

Software options VCS-60-XX are applied to basic Shock control VCS-60.

TRANSIENT TIME HISTORY CONTROL (TTH) (VCS-60-01)
Using template based importing tools, time waveform in various formats are imported into EDM. Scaling, editing, digital re-sampling, high-pass, low-pass filtering and compensation will tailor the waveform so it is duplicated on the shaker. Compensation methods include pre-pulse, post-pulse, DC removal and high-pass filters. Pre-stored profiles include Bellcore Z1 & Z2, Bellcore Z3, Bellcore Z4, Sine, Chirp, Burst Sine and others.

SHOCK RESPONSE SPECTRUM (SRS) DISPLAY FOR SHOCK AND TTH (VCS-60-02)
SRS Display is an analysis tool to generate shock response spectra for measured signals.

Type: maxi-max, primary, residual, composite
Measurement: positive, negative, absolute (maximax)
Octave Spacing: 1 to 24
Damping: 0.001 to 100%

SHOCK RESPONSE SPECTRUM (SRS) SYNTHESIS AND CONTROL (VCS-60-03)
The SRS vibration control package provides controls to meet a target Required Response Spectrum (RRS). Waveforms are automatically synthesized from a user-specified SRS reference profile using sine wavelets. The Transient Control option allows control of imported transient files. High frequency waveforms, Alarm and Abort tolerances may be applied to any active channel to provide an extra degree of safety for delicate test articles. The VCS-60-02 is included in this option.

Waveform Synthesis Methods: Control time waveform is generated from damped sine or sine beat components.
Damped Sine Parameters: frequency, amplitude, critical damping factor, delay
Sine Beat Parameters: frequency, amplitude, number of half sine delays
Component Generation: auto or manually controlled
Synthesis Parameters: waveform duration, max % of error, max number of iterations.

DATA RECORDER FUNCTION FOR SHOCK, TTH, AND SRS (VCS-60-04)
Continuously record all input signals during Shock, TTH, or SRS tests to the front-end. If Spider-NAS hardware is ordered, the data can be recorded to the Spider-NAS, a device that hosts one or two SATA hard-disks.

Typical Continuous Recording Time: 4 hours for 4 input channels with frequency range 2,000 Hz with 4 GB flash memory installed

LARGE BLOCK SIZE FOR SHOCK AND TTH (VCS-60-06)
Increase the maximum block size from 4,096 to 65,536. 8,192 to 16,384 points for 8 inputs; 32,768 points for 4 inputs; 65,536 points for 2 inputs. For newer hardware (v7.x and later), supports 65536 points for 4 inputs. (Not available for Spider-81B).

TIME WAVEFORM REPLICATION (VCS-80)

Time Waveform Replication (TWR) provides precise, real-time, multi-channel control for long waveform duplication. TWR is capable of running an unlimited number of time profiles in a defined schedule. Multiple long waveforms can be duplicated precisely on the shaker just as they were recorded. It includes Waveform Editor, a flexible importing and editing tools for long waveform signals. Recording option allows recording time stream data at the full sample rate on all input channels.

KEY FEATURES
Number of Waveform Profiles: Infinite number of Waveform recordings (subject to the available flash memory) is supplied simultaneously to automatically run one after the other on the test specimen.
Maximum number of points: All internal flash memory space is used for storing profile data (currently 3.7 GB), which corresponds to approximately 1 billion data points. At a sampling rate of 200 samples / sec. It can replicate a waveform of about 50 days.
Maximum Frequency Range: Waveforms of up to 18 kHz (fa) can be replicated.
Maximum Sampling Rate of Data: Waveforms of any sampling rate up to 102.4kHz can be imported into the Waveform Editor tool and converted to a suitable frequency range.

CONTROL PARAMETERS
Sampling Rate: Up to 18 kHz, automatically calculated based on profile
Display Time Block Size: up to 4,096 points
Transfer Function Update Ratio: Transfer function is updated continuously in real time depending on the transfer update ratio which can be entered by the user between 0 – 0.5.
Pretest: A random close-loop pretest logic is build in to generate an initial FRF value

OUTPUT CHANNELS
First Output: drive channel
Second Output: configurable as one of following: no output, same as the first output, reverse of the first output

MEASURED SIGNALS AND DISPLAY STATUS
Measured Signals: drive signal, input time stream, drive signal spectrum, system transfer function, high abort, low abort, control signal, profile, strip chart plots for the time history of RMS, Peak, Peak-Peak level of each channel.
Display Windows: signal plot window, signal value window, digital I/O view window, runlog window, large numerical value display window, channel status window.
Status Display on Control Panel: control level, drive peak, control RMS, target RMS, remaining time, full level elapsed time, total elapsed time, peak-to-peak displacement, peak velocity, cursor readings, RMS error(%)
Runlog: A test log continuously records real-time status changes and user commands. Maximum number of runlog entries is 1024.

SAFETY
Abort Sensitivity: A single parameter allows the sensitivity and tolerance of various safety checks to be easily adjusted between customizable lower and upper bounds.
Shaker Safety Limits: limits for shaker acceleration, velocity, and displacement
Open Loop Detection: Open loop detection for control signal and each input channel. Detection is based on maximum control loss or maximum RMS rate of change in the input channels.
Control Limits: Enforces abort time limits for control signals. Allowable ratio of points exceeding abort limits to total number points in a frame: 0 – 100%
Max Drive Limit: maximum voltage limit for drive output

REFERENCE PROFILE AND RUN SCHEDULE
Profile Definition: Any existing signal is treated as a profile and is imported and defined as a control

Profile Import: Waveforms with any of the following file types are imported into Waveform Editor: UFF ASCII (.uff, .unv), UFF Binary (.buff, .bunv), CI-ODS format (*.ods), EDM View Project (.vpj), TIM format (*.tim), RSP format (*.rsp), ASCII data format (*.asc), User defined ASCII format (*.txt, *.csv) and ODS ATF/XML Format (.atfx). Waveforms with any of the following file types are imported to EDM directly: ODS ATF/XML Format (.atfx), CI-ODS format (*.ods), and User defined ASCII format (*.txt, *.csv).
Profile Editing: Waveforms with any sampling rates are digitally re-sampled, rescaled, filtered, and different compensation techniques are applied to edit the profile using the EDM – Waveform Editor tool. Also contains options for cropping, appending and inserting parts of waveforms.
AVD Plot: Calculation of other two quantities among Acceleration, Displacement or Velocity when profile imported is of any quantity
Profile Maximum: calculation of maximum expected acceleration, velocity and displacement, checked against shaker limits
Abort Settings: Custom Abort settings are implemented using the Advanced Abort setup; this will allow different user–defined abort limits at different points of time in the profile.
Profile Library: Settings are saved to a library and reused in different tests.
Run Schedule: A schedule includes an unlimited number of profile entries and user-defined events.

OPTIONAL TWR VIBRATION CONTROL FUNCTIONS (VCS-80-XX)

Software options VCS-80-XX are applied to basic TWR control VCS-80.

DATA RECORDER FUNCTION FOR TWR (VCS-80-04)
Continuously record all input signals during TWR tests to the front-end. If Spider-NAS hardware is ordered, the data can be recorded to the Spider-NAS, a device that hosts one or two SATA hard-disks.

Typical Continuous Recording Time: 4 hours for 4 input channels with frequency range 2,000 Hz with 4 GB flash memory installed

SOFTWARE BUNDLES

Part Number	Function	Bronze 1	Bronze 2	Silver	Gold 1	Gold 2
Applicable Hardware		81B	81B	80X/81/81B	80X/81/81B	80X/81/81B
VCS-20	**Random**	x	x	x	x	x
VCS-20-02	High Frequency Control					x
VCS-20-03	Data Recorder Function					x
VCS-20-04	High Resolution			x	x	x
VCS-20-05	Drive Notching/Limiting				x	x
VCS-20-06	Kurtosis Control					x
VCS-20-08	SoR				x	x
VCS-20-09	RoR				x	x
VCS-40	**Sine**	x	x	x	x	x
VCS-40-01	RSTD			x	x	x
VCS-40-03	High Frequency Control					x
VCS-40-05	THD Measurement			x	x	x
VCS-40-06	Data Recorder Function					x
VCS-40-07	Drive Notching/Limiting				x	x
VCS-40-09	Low-frequency Control			x	x	x
VCS-60	**Shock**	x		x	x	x
VCS-60-01	TTH		x		x	x
VCS-60-02	SRS Display			x		
VCS-60-03	SRS Synthesis				x	x
VCS-60-04	Data Recorder Function					x
VCS-60-06	Large Block Size			x	x	x
VCS-80	**TWR**					x
VCS-80-04	Data Recorder Function					x
VCS-00-05	Sine Oscillator				x	x
VCS-00-12	Non-Acceleration Control				x	x
SPIDER-CAL	Front-End Calibration Tool				x	x

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