

# EDM Vibration Control System (Single Axis) Standard Software Specifications (Version 12.0)



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## EDM VIBRATION CONTROL SYSTEM (VCS) SOFTWARE FOR SINGLE AXIS SHAKER

EDM (Engineering Data Management) is a powerful PC software program used with Spider hardware to provide a user interface for vibration test control and real-time data processing.

Crystal Instruments provides two types of Vibration Control Software (VCS): Standard and Enterprise versions. Both versions provide the same categories of control types for single-axis shaker control, but the Enterprise version offers more powerful functions. The biggest difference between the two versions is that the Standard version is designed to fit into the application of one user per installation while the Enterprise version is designed for a team of users working collaboratively in an Intranet environment.

The Standard version should be considered for users who require less data exchange and sharing between multiple EDM software installed PCs and are not using advanced features such as temperature/strain measurement, real-time data recording, CAN bus or video monitoring functions. The EDM-VCS Standard version is easy to install and operate and is priced significantly lower than the EDM-VCS Enterprise version.

The Enterprise version should be considered for multiple users working in an Intranet environment with a shared testing setup to share testing results. Users of advanced data management tools such as data query, security administration control functions beyond 3 kHz, real-time data recording, and non-acceleration measurement using strain gauge and/or temperature sensors are also recommended to use the EDM-VCS Enterprise version. The EDM-VCS Enterprise version software allows users to configure multiple Spider hardware systems and a SQL server on a company network. Crystal Instruments will provide tailored solutions for each user group to configure their database and hardware systems.

The Vibration Control System (VCS) software in the EDM Testing installation package includes the following control functions applicable for single-axis shaker testing:

- **Random family:** Random, Sine-on-Random, Random-on-Random
- **Sine family:** Swept Sine, Resonance Search and Dwell, Turbine Blade Fatigue Testing, Sine Oscillator, Multi-Sine
- **Shock family:** Classic Shock, Transient Time History, Shock Response Analysis/Synthesis, Earthquake Testing, Transient Random
- **Other typical tests:** Time Waveform Replication, Acoustic Control, Sine Beat Seismic

MIMO and MESA Vibration Control functions are only included in the Enterprise version. Please refer to the EDM MIMO Vibration Control Software specifications.

### EDM VCS STANDARD SOFTWARE

EDM VCS Standard software includes the following specifications. The MIMO/MESA/MDOF vibration control software is not available in the Standard version.

#### Test Management

- **Database management system:** SQLite
- **Database server host:** local computers
- **Backup and restore:** single database
- **Test operations:** new, created from templates, search database, import from a file, export, save as, duplicate, rename, delete, change directory

#### Spider Hardware System Management

A Spider system can consist of one or more Spider hardware front-ends on the same LAN.

- **System level:** multiple individual Spider front-ends are configured as ONE system in EDM
- **Board level:** multiple individual Spider boards in the same chassis are configured as ONE system in EDM.
- Hardware supported by EDM VCS software for vibration control, monitoring, and data acquisition.
  - Spider-81/81B, Spider-80X/80Xi, Spider-80M, Spider-80Hi/80Ci
  - Spider-80SG/SGi (Enterprise only)
- The following hardware is supported by EDM VCS software for monitoring and data acquisition only.
  - Spider-80Ti (Enterprise only)
- **System time:** manually assigned, synchronized with a local PC, or synchronized with a designated/NTP server.
- **System configuration:** import, export, switch test regardless of different channel count, attach/detach a Spider-NAS.

#### Access Control

Each Spider front-end can have a user-configured access code which must be entered in the software to connect.

#### Black Box Mode: Operate Without Computer

A supported front-end can operate in Black Box mode which allows it to perform a test without a connected computer. In this mode, a computer is used only to configure the system before the test and then to download data after the test is complete. During the test, the front-end can be operated according to a preset schedule or from a variety of external devices, such as a Wi-Fi enabled tablet. For hardware with version 7.3 and higher, up to eight tests can be uploaded and

stored on each front-end. When EDM VCS is disconnected from a Spider running a test, the Spider automatically runs in Black Box mode. EDM may reconnect to the Spider and have it run in normal mode.

### Measurement Quantities

- **Supported quantities:** acceleration, velocity, displacement, pressure, force, voltage, current, sound pressure, time, frequency, angular acceleration, angular velocity, angle, mass, moment, strain, temperature, resistance, and humidity.
- **Application:** Global, Custom
- **Features:** one-click default Metric/English units, customized quantities, customized units

### Measurement Data Storage

- **Data format:** compliant with ASAM-ODS hierarchy and structure
- **Signal data structure:** all signals are combined and saved in one file per each save command executed

### Export Data File Formats

ASAM-ODS XML, UFF ASCII, UFF Binary, ASCII, Excel, CSV, MATLAB, WAV

### Import Data File Formats

ASAM-ODS XML, UFF ASCII, UFF Binary, ASCII, Excel CSV, SIG format

### Languages

English, Russian, Japanese, simplified and traditional Chinese are available. Switch without reinstalling the software.

### Report

- **Formats available:** Open XML, MS Word (.doc, .docx), PDF
- **Customizable template:** title, logo, fonts, page layout, page size, page orientation, test information, test configuration, the position of test status, user note, date and time format, file name, measurement status, pagination, page margin, header, footer
- **Customizable signal printing:** color, black/white, line types, and signal line width
- **Selectable contents:** title section, user notes, saved results, composite display, signal display, channel status, annotations and attachments, run log, test parameters, input channel table, profile, run schedule, shaker limits, limit profiles, test check list, calibration, sensor list, Spider system config, license key, software screenshot, account permissions, EU settings, cursors, markers.
- **Report objects:** current signals, saved signals, active window, active tab, a run folder

### Flexible and Customizable Display Windows and Tabs

- **Default display windows:** users can Create, Save, Load, and Delete user-defined windows
- **Window types:** Overlaid, Stack, Numeric Text
- **Status windows:** Channel Status, Digital I/O, Run Log, Run Schedule, Recording Status, Cursor/Marker Values
- **Special windows:** Cross Plot, Lissajous Plot, Online Visualization
- **Default display tabs:** Create/Save/Load display tabs
- Fullscreen mode, multiple monitor support, auto arrange windows, copy/paste display settings, docked/undocked windows
- Arrange all tabs and windows by selecting one and dragging it with the mouse.

### Signal Display Window Properties

- **Time format:** test time, absolute time, when the x-axis is time.
- **Displays RMS:** time signals, APS
- **Customizable properties:** line width, grid, background color, text color, cursor color, number of markers, the color of markers, color of marker text, global or local numerical notation

### Annotations

- **Object attached to:** live signals, saved signals.
- **Annotation types:** user-entered strings, a cursor value, two cursor values, marker values, pictures, all file types.

### Digital I/O Interface

- **Connector types:** DB-25, DB-15, DB-9
- **Time to send a digital output signal:** before a test, triggered by an event, schedule, manual
- **Configurable default digital output status:** Yes
- **Configurable actions for digital inputs:** start test, run a specific test, run a test sequence, 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, close control loop.
- **Configurable digital output events:** user stop, channel overload, sensor 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
- **Configurable digital input and output:** each isolated pin is configurable to be used as a digital input or output. This flexibility allows users to change the number of digital inputs or outputs according to their application.

(Available for Spider-80X and Spider-80Xi only.)

- **Output pulse types:** High-Low, Low-High and variations
- **Real-time state display:** digital output channels, digital input channels
- **On-line state changing:** digital output

### Test Sequence

Create a list of tests and run them sequentially and repeatedly.

A test sequence can be initiated and controlled by a user command, digital input event, or a Windows socket message.

### Test Group

Create a list of tests to execute. The tests use the same channel table and shaker limits.

- **Sections:** tests in a list can be grouped into multiple sections.
- **Status display:** displays status as 'Done' or 'Not Done.'

### Send Emails and Instant Message as Event-Actions

Send emails or instant messages as custom actions in response to a system or user event.

- Customize email content for each action.
- SSL encryption support
- Supports normal and Black Box mode.

### 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, users can configure the system to either save all data and ramp down the test or continue running the test in Black Box mode.

### Continue an Unfinished Test

Tests can be resumed after being aborted (e.g., abort limit reached, unexpected power outage).

If no test parameter is changed, an unfinished test can continue after:

- Restarting the vibration controller
- Restarting the EDM VCS software
- Switching to another test and switching back

This feature supports all test types except TWR. Black Box mode is not supported.

### 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 with IEPE sensor detection
- **Channel type:** control, monitor and limiting
- **Input mode:** AC-single end, AC-differential, DC-single end, DC-differential, IEPE, charge, in-line charge converter, external charge amplifier
- **TEDS:** read TEDS sensors
- **Sensor library:** created, delete, modified, exported (CSV), and imported (CSV, excel) sensor information. Load/Save the settings of a single channel from/to the sensor library.
- **Integration:** for acceleration/velocity/displacement conversion
- **High-pass filter:** user-defined cutoff frequency or disabled
- **Measurement point/coordinate/DOFs:** label of the direction and position of the connected sensor
- **Channel library:** settings of all channels are saved to a library and reused in different tests.
- **Channel table import/export:** settings of all channels can be imported from/exported to a txt/csv/xml file.
- **Copy/paste:** Ctrl+c to copy from an Excel sheet and Ctrl+v to paste into the software.
- **Signal range estimation:** estimate input signal range based on input mode, input range, and sensitivity.

### Event-Action Rules

Custom "if-then" logic for programming how the Spider hardware should respond in certain scenarios. For example: "if the High Abort was exceeded, then send an email and stop the test". Common actions include "Save Data", "Send Email", "Create Report".

Actions can also be pre-programmed to run in the Run Schedule without an outside event taking place.

- **Event types:** user-stop, channel overload, sensor 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, time signal RMS/High limit exceeded, monitor/limit/control channel lost, external power lost, connection lost, download complete.
- **Actions:** flash screen and beep, create report, capture screen, send emails, send socket message, send digital output signals, start recording, stop recording, save signals in the list, next entry, increase level, decrease level, pause test, continue test, abort check-off, abort

check-on, open control loop and close control loop, stop the test, reset average (Random only), schedule timer on/off

### Shaker Parameters

Shaker limits are calculated from the shaker parameters and the payload mass. The profile checking status is displayed after the key shaker limits and can be turned on or off.

- **Shaker library:** shaker parameters are saved to a library and used repeatedly in different tests. A library can be imported from or exported to a Microsoft Excel spreadsheet.

### 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). Signals in the pre-test can be recorded. If the user is confident about a pre-test result, an option in the test configuration can be enabled to skip user confirmation.

- **Pre-test options:** measure FRF in a closed-loop, run with FRF saved on the computer
- **Drive voltage:** user-defined initial drive voltage, max drive voltage with a selectable ramp-up rate
- **Noise floor measurement:** measures the noise floor and compares with the control signals
- **Checks:** IEPE sensor check, open-loop check, safety check
- **Display:** pop up window shows the current stage of the pre-test, control signal, noise signal, transfer function, and drive signal

### 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

### Time History (Continuous Time Data Recording to Computer)

Acquired and saved simultaneously to computer storage.

- **Live display:** shows latest data of the specified length of the signal

- **History review:** shows all or the specified range of the signal
- **Raw time signals:** input signals in TWR tests, Spider-80SG/SGi input signals (sampling rate  $\leq$  80 Hz), Spider-80Ti input signals
- **Statistic time signals:** all Statistics signals (Peak, RMS, Pk-Pk)

### Monitoring Through EDM Cloud (<https://cloud.go-ci.com/>)

All tests in EDM VCS support status check through EDM Cloud. With EDM Cloud support, users can set up any VCS test to upload live data or run logs for completed tests to a cloud storage space provided by Crystal Instruments, where data is securely stored in the user's account.

The EDM Cloud website is located at <https://cloud.go-ci.com/>. Users can conveniently access EDM Cloud from anywhere in the world to check the status of current or past tests. A secure log-in to access the cloud ensures the status can only be checked by authorized personnel with credentials to access the account. The option to create multiple log-ins to access the same Cloud account is available.

- **Sever deployment options:** company private server, public server
- **Information available for Cloud upload:** live status for currently running tests, run logs for all runs of any test, abort conditions for any run of any test, EDM information, license information, hardware device information
- **File sharing:** upload/download files, access controlled by user's Team and Group
- **Storage limit:** 20 MB/account (free users)
- **Number of users per account:** up to 10 users per account
- **Privacy/security:** ability to turn on/off data upload, secured account with password control, ability to control the type of data upload

## VIBRATION CONTROL MODULE SPECIFICATIONS

### Random Vibration Control (VCS-20)

The Random Vibration Control System provides precise, real-time, multi-channel control and analysis. Random supports up to 512 input channels. Users can enable up to 128 channels for control and notching. Users can designate the rest of the channels as monitoring and time data recording channels. The recording option records time stream data at a full sample rate on all input channels. A unique hardware design provides a fast loop time of less than 15 ms. An 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 46 kHz (12.5 kHz when all 512 input channels are enabled)
  - Time domain acquisition on Monitor channels up to 115 kHz (Spider-80Hi only)
  - Standard: up to 3 kHz
  - Enterprise: up to 46 kHz/115 kHz (control/monitor)
- **Spectral resolution:** 200, 400, 800, 1,600, 3,200 and 6,400. 3,200 for all 8 channels. 25,600 for 1 channel. *Resolution higher than 1,600 may reduce the maximum channel count and the highest allowed overlap ratio. Not available on the Spider-81B system.* With Multi-Resolution enabled, equivalent resolutions of up to 25,600 lines for all 8 channels/module, 51,200 for 4 channels/module and 102,400 lines of resolution for 2 channels/module can be achieved.
  - Standard: up to 1600
  - Enterprise: up to 25600
- **Loop time:** 12.5 ms for 2000 Hz. 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:**  $\pm 1$  dB at 99% confidence with 200 DOF
- **Intelligent drive clipping:** 1.4 - 5
- **Pre-test ramp-up rate:** fast (20 dB/s), slow (2 dB/s), fastest (60 dB/s), down to 0.1 dB/s
- **Level change rate:** 0.1~60 dB/s

### Output Channels

- **First output:** drive channel
- **Second output:** configurable as one of the following: no output, same as the first output, negative of first output, control RMS level, or RMS or peak value of any input channel
- **COLA types:** constant amplitude sweeping sine signal that is proportional to the sweeping frequency of the selected sine tone (in SOR). Not available for the Spider-81B.

### Measured Signals and Display Status

- **Measured signals:** drive signal, input signals, drive spectrum, system transfer function, control(f), tolerance, profile(f), noise(f), auto-power spectra for all channels,

user-defined transmissibility (H1, H2, H3, Hv) (complex with real/imaginary parts), and strip chart plots for the time history of RMS, Peak, and Peak-Peak level of each channel.

- **Enterprise only:** Limiting signals, PC math signals, user-defined signals.
- **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. The 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 the control signal, starts at the full level or low level
- **Max drive limit:** maximum voltage limit for drive output
- **Shutdown:** user-defined shutdown rate in dB per second
- **Sensor response detection:** calculation of coherence signals between input channels and drive through the entire test duration, including pre-test
- **Continue target level:** the target level that the test continues to run after continuing from pause. It ensures the test is running at a lower level when continuing from a paused status and allows the user to ramp up the test to the scheduled target level.

### 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 the reference profile
- **Profile scaling:** the profile is scaled using an RMS value or dB



- **Profile import:**
  - Import saved signals in ATFX, UFF, UNV, TXT, or CSV format as the profile or
  - Import profiles are saved in CSV format or
  - Copy a profile table from a CSV file and paste it into VCS software.
- **Profile export:** export the profile to CSV and ATFX format
- **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

Users can import, modify, or use any saved power spectrum data (in various file formats) as the random profile. For compatible file formats, users can modify the imported spectrum by reducing the number of breakpoints between the two cursors and editing the profile table.

#### *Displacement Optimization for Random*

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

#### **Optional Random Vibration Control Functions (VCS-20-XX)**

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

#### *Kurtosis Control (VCS-20-06)*

Kurtosis is a measurement of large peak occurrence frequency in a waveform. Kurtosis Control allows users to specify a target kurtosis for a random control signal, which tells the controller to adjust the vibration amplitude distribution to match the target. This is completed with minimal effect on the frequency content and dynamic range. Possible kurtosis values are 3 - 10. Supports up to 512 input channels.

#### *Sine on Random Control (VCS-20-08)*

- **Sweeping mode:** free sweeping mode where each sine tone has its 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, up to 32 when RoR is disabled
- **Operation controls:** Tone On and Tone Off controlled by a run schedule, external events, or user commands
- Supports up to 512 input channels.
- **Dedicated signals:** profile of each tone, peak of each tone, envelope of all tone sweep
- **Broadband and tone display:** test profile page and

display window supporting second spectrum type

- **Sweeping duration estimation:** sweep rate, number of sweeps, sweep time
- **Sweeping type:** log, linear, fixed frequency
- **Sweeping speed:** log (oct/min) up to 25; linear (Hz/sec) up to 50
- **Variable sweep rate:** customizable frequency of the sine tone at different time

#### *Random on Random Control (VCS-20-09)*

- **Sweeping mode:** a free sweeping mode where each narrow random band has its schedule and sweeping speed
- **Number of bands:** 1 - 12, up to 32 when SoR is disabled.
- **Operation controls:** Band On and Band Off controlled by a run schedule, external events or user commands
- **Sweeping duration estimation:** sweep rate, number of sweeps, sweep time
- **Sweeping type:** log, linear, fixed frequency
- Supports up to 512 input channels.

#### *Fatigue Damage Spectrum (VCS-20-11)*

Generate a random profile from time stream data recorded in the real-world and view its Fatigue Damage Spectrum (FDS) to understand the potential damage. Users can adjust the profile to reduce testing time.

- **Max number of profile points:** 400
- **Display:** APS and FDS
- **Options:** low and high frequency at 1/24 octave max, target life and test duration.

#### *Swept Sine Control (VCS-40)*

The Spider Swept Sine Vibration Control System provides precise, real-time, multi-channel control using a sine waveform. Swept Sine supports up to 512 input channels.

Users can enable up to 128 channels for control and notching while designating the remaining as monitoring and time data recording channels. 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 operate the controller without a computer.

#### *Control Parameters*

- **Frequency range:** automatically calculated based on the profile. Up to 30 kHz when 4 input channels are enabled. Up to 20 kHz when 512 channels are enabled.
- **Time domain acquisition on monitor channels:** up to

115 kHz (Spider-80Hi only)

- Standard: up to 3 kHz
- Enterprise: up to 30 kHz/115 kHz (control/monitor)
- **Sweeping speed:** Log (Oct/Min): 0.001 to 6000; Log (Dec/Min): 0.001 to 2000; Linear (Hz/Sec): 0.001 to 6000
- **Sweep rate increment:** Log (Oct/Min): 0.001 to 6; Log (Dec/Min): 0.001 to 2; Linear (Hz/Sec): 0.001 to 6
- **Sweep speed control:** Oct/Min, Hz/Sec, Dec/Min, Sweeps/Min, Sweep Time/Sweep, Cycles/Min
- **Level change:** customizable in both logarithmic and linear rate
- **Compression rate:** Fast (60 dB/S), Slow (20 dB/S), and customized (from 0.01 dB/S and up, pre-defined table available)
- **Ramp rate:** Fast, Slow, Customized, Fastest, customized in specified frequency ranges (Enterprise only)
- **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
- **Measurement strategy to control channels:** Filter, RMS, Mean, Peak (one selection)
- **Measurement strategy to monitor channels:** Filter, RMS, Mean, Peak (multiple selections)
- **Measurement strategy to limit channels:** Filter, RMS, Mean, Peak (one selection, Enterprise only)
- **Tracking filters:** Proportional: 7% – 100%; Fixed (Hz): 1 – 500 Hz
- **Control accuracy:**  $\pm 1$  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
- **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 signals, drive spectrum, system transfer function, control(f), tolerance, profile(f), noise(f), spectra for all channels, independent sweep up and sweep down spectra for all channels, transmissibility, and strip chart plots for the time history

of RMS, Peak and Peak-Peak level of each channel. Transmissibility signals are in complex format with real/imaginary parts.

- **Enterprise only:** limiting signals, PC math signals, user-defined signals, PC coherence
- **Block signals:** block time signals are used to display the time waveform or history of an 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, recording status, run schedule, Lissajous plot, search resonance, vibration visualization
- **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, the 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 the pre-defined lowest allowed control level or maximum level change rate.
- **Control spectral limits:** spectral limits for the 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
- **Connection types between breakpoints:** constant acceleration, constant velocity, constant displacement, log-log constant slope, linear-linear constant slope
- **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 the reference profile
- **Profile scaling:** the profile is scaled to a value or dB
- **Profile maximum:** calculation of maximum expected

acceleration, velocity and displacement, checked against shaker limits

- **Profile import:**
  - Import saved signals in ATFX, UFF, UNV, TXT, or CSV format as the profile or
  - Import profiles saved in CSV format or
  - Copy a profile table from a CSV file and paste to the VCS software
- **Profile export:** export the profile to CSV and ATFX format.
- **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 are 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)

Users can add software option VCS-40-XX to 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 between input channels on the master front-end. In real-time control, the tracked dwell entry tracks each resonant frequency. Dwell entries (fixed dwell, tracked dwell, phase tracked dwell) are added manually or automatically after a sweep entry is completed or the list of resonances is determined. Supports up to 512 input channels.

- **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 the 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 phase changes out of limits. The “Phase Tracked Dwell” entry must be added to the schedule. Users can pre-configure the control level while tracking phase changes.

### Multi-Sine Control (VCS-40-11)

Multi-Sine Control enables the simultaneous sweeping of multiple sine tones and provides the option to excite multiple resonant frequencies of the structure. Multiple sine tone excitation can significantly reduce the required time duration of sine testing. Independent tracking filters are applied to each tone separately.

- **Number of Sine tones:** up to 10 tones
- **Type of Sine tone interval:** even interval, user-defined interval, or Harmonic type
- **Operation controls:** Tone On and Tone Off controlled by a run schedule, or user commands
- **Number of inputs:** supports up to 512 input channels

### Control Parameters

- **Frequency range:** automatically calculated based on profile, up to 5,000 Hz.
- **Sweeping speed:** Log (Oct/Min): 0.01 to 6000; Log (Dec/Min): 0.001 to 2000; Linear (Hz/Sec): 0.001 to 6000
- **Spectrum display resolution:** 256 to 4,096
- **Control dynamic range:** 90 dB typical
- **Tracking filters:** proportional bandwidth: 7%, 12%, 25%, 50%, 100%; fixed bandwidth (Hz): is automatically calculated
- **Control accuracy:**  $\pm 1$  dB at 99% confidence with 100 average number
- **Frequency resolution:** as fine as 0.0001 Hz
- **Average number:** 1 – 2000

### Run Schedule

- **Run schedule:** a schedule includes an unlimited number of test entries and user-defined events
- **Multi-Sine sweep entry:** fixed range and speed for multiple tones
- **Multi-Sine dwell entry:** set dwell time duration and level for multiple tones

### Limiting

Limiting is applied to control or monitor channels. The abort limit is the only available type. Limiting profiles may be edited by the amplitudes and frequencies of breakpoints. The max expected peak acceleration, velocity and displacement of the profile is calculated. Supports up to 512 input channels.

The Measured Signals specifications are identical to the Swept Sine Control specifications.

### Turbine Blade Fatigue Testing (VCS-40-12)

This RSTD control feature is tailored for turbine blade fatigue testing, where mostly phase tracked dwell is used. Large blades and small blades have different characteristics so turbine blade fatigue testing is designed to meet the requirements of both types of blades. Dwell entries (phase tracked dwell, fixed dwell, tracked dwell) are added manually or automatically after a sweep entry is completed or the list of resonances is determined. Supports up to 512 input channels.

- **Resonant frequency search:** see VCS-40-01 and note the following: *Specify different configuration for sweep and dwell:* control channel, control quantity, profile
- **Tracked dwell:** see VCS-40-01
- **Phase tracked dwell:** see VCS-40-01 and note the following Searched Tracked Dwell: automatically search for resonance when the resonance drifts
- **Manual tracked dwell:** dwell at the frequency given by the user. The user can modify parameters before switching to Search Tracked Dwell.
- **Modify parameters in a run on-the-fly:** target pk-pk, target phase, dwell time, dwell cycles, tracking speed, compression rate
- **Dwelling status table:** displays the following information and saves to a CSV file during a test or when a test ends. Dwelling status can be saved in the frequency given by the user.
  - *Dwelling frequency, control peak, input channel pk-pk, phase, target phase, dwell time, dwell cycles, time stamp*

### 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 8 channels are enabled for control, alarm checking, and time data recording on the master module. Up to 511 channels are enabled for monitoring and time data recording. Classical pulse types include half-sine, haversine, 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 computer.

### Control Parameters

- **Sampling rate:** automatically calculated based on profile, or selectable from multiple ranges up to 102.4 kHz
- **Time domain acquisition on monitor channels:** up to 256 kHz (Spider-80Hi only)
- **Time block size:** 512 to 65,536 points. (32,768 points for 4 inputs; 65,536 points for 2 inputs. For newer hardware (v7.x and later), it supports 65,536 points for 4 inputs.)
- **Average number for control:** 1 – 4
- **Test start method:** pretest runs with four excitation types: positive pulse, negative pulse, Random with close-loop control (Enterprise only), Random with open loop (Enterprise only). Pretest may be skipped with saved FRF's (signal properties must match test settings.)
- **Low-pass filter:** applied to profile, drive, all input signals; applied to drive only; not applied to the profile
- **High-pass filter:** applied to profile only
- **Pulse width measurement:** show shock pulse width
- **Over sampling:** Auto, 2:1, 4:1, 8:1, and up to 102.4 kHz
- **Block size selection:** Auto, 2:1, 4:1, 1024, 2048, 4096, 8192, 16384, 32768, 65536

### Output Channels

- **First output:** drive channel
- **Second output:** configurable as no output, same as the first output, or 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.
- **Enterprise only:** auto-power spectra for all channels, PC math signals, user-defined SRS signals, PC SRS
- **Display windows:** control composite, signal plot window, signal value window, digital I/O view window, runlog window, large numerical value display window, channel status window, recording status, run schedule, Lissajous plot, vibration visualization, cross plot
- **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. The maximum number of runlog entries is 1024.

- **Display options:** display main pulse/whole block, extend high/low limits to the whole block
- **SRS statistic window:** displays damping ratio, max, frequency of max, min, frequency of min, exceed profile, and exceed tolerance for all SRS spectrum in a clean table format.

### 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, 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
- **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
- **Time domain limit:** Raw, or RMS to any input channel

### Reference Profile and Run Schedule

- **Test standards:** MIL-STD-810F/G/H, MIL-STD-202F, ISO 8568, 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 an unlimited number of pulse entries and user-defined events

### Shock Response Spectrum (SRS) for Shock and TTH

Shock response spectra of measured signals are available for analysis.

- **Analysis type:** positive, negative, maximax (absolute)
- **Octave spacing:** 1 to 24
- **Damping:** 0.001 to 100%

### Optional Shock Vibration Control Functions (VCS-60-XX)

The following software options for VCS-60-XX are available in addition to basic shock control VCS-60.

#### Transient Time History Control (TTH) (VCS-60-01)

Time waveform in various formats are imported into EDM VCS using template-based importing tools. Scaling, time-shifting, windowing, editing, digital re-sampling, high-pass, low-pass filtering, and compensation will tailor the waveform and duplicate it on a 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, (Burst) Sine, Triangle, Chirp, Burst Chirp, White Noise (Burst Random), Sine Beat, Sine Beat (multiple frequencies), Door Slam (Ford), Decay Sine (linear/angular frequency), Sine Burst, Half-Sine Shock, and Power Down Shock.

An additional option required to run profiles with a sampling frequency lower than 120 Hz is included by default since EDM 7.0. Supports up to 512 input channels.

#### Control parameters

- **Sampling rate:** same as the imported profile, or selectable from multiple ranges up to 102.4 kHz.
- **Time block size:** 512 to 65,536 points. (16,384 points for 4 inputs; 32,768 points for 2 inputs)
- **Average number:** 1 – 4

#### Pre-stored profiles

- Bellcore Z1 & Z2, Bellcore Z3, Bellcore Z4,
- Sine, Triangle, Chirp, Burst Chirp, Decay Sine (linear/angular frequency), Sine Burst,
- White Noise (Burst Random),
- Sine Beat, Sine Beat (multiple frequencies), Door Slam (Ford), and Half-Sine Shock.

#### Compensation methods

Remove Acc. DC, High Pass filter, Low Pass filter, re-scaling, Brick Wall High Pass, Flip Horizontally

### 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. Users can apply high frequency waveforms or alarm and abort tolerances to any active channel to provide an extra degree of safety for delicate test articles. The SRS spectrum of monitor channels has a higher frequency range than RRS.

- **SRS up-sampling:** Auto, None (1:1), 2:1, 4:1
- **Waveform synthesis methods:** control time waveform is generated from damped/decay sine or sine beat components
- **Wavelet window type:** Sine, Decayed Sine, User-defined (Enterprise only)
- **User-defined wavelet window type:** allows the user to upload a custom time wavelet shape to fit a given SRS requirement. This is a different synthesis method intended to match the expected shape of a given pulse, as opposed to traditional wavelet synthesis methods such as Damped Sine (also known as “Wavesyn” or Exponential Decayed Sine).
- **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
- **Full envelope:** configure test response spectrum to be greater than RRS in terms of dB
- **TE calculation:** MIL-STD-810H, MIL-STD-810G + CHG1, MIL-STD-810G, MIL-STD-810F
- **Te calculation:** MIL-STD-810H, MIL-STD-810G + CHG1, MIL-STD-810G, MIL-STD-810F
- **SRS statistic window:** max value & frequency, min value & frequency, percentage of an SRS spectrum within tolerance, primary duration, and peak count

#### **Transient Random Control (VCS-60-12)**

Transient Random Control drives a chain of pulses with random nature to a shaker. The target profile power spectrum is defined in the same way as Random control, with the addition of defining the transient pulse interval. Applications include simulation gunfire or road simulation. Supported by hardware versions 7.x and above and supports up to 512 input channels.

#### **Control Parameters**

- **Sampling rate:** automatically calculated based on profile, or selectable from multiple ranges up to 102.4 kHz

- **Spectral resolution:** 200, 400, 800, 1,600, 3,200 and 6,400. 3,200 for all 8 channels. Resolution higher than 3,200 reduces the maximum channel count.
- **Time block size:** 512 to 65,536 points. (16,384 points for 4 inputs; 32,768 points for 2 inputs)
- **Average number:** 1 – 500 (2 – 1000 DOFs)
- **Drive Sigma Clipping:** 3 – 10

#### **Measured signals and display status**

The same as Classical Shock Control. In addition, it includes the following: high abort, high alarm, low abort, low alarm, control spectrum, profile, auto-power spectra for all channels.

#### **Safety**

The same as Classical Shock Control. In addition, it includes the following:

- **Control spectral limits:** spectral limits for control signal

#### **Reference profile and run schedule**

The reference profile of Transient Random Control is defined in the frequency domain. It is the same as Random Vibration Control. Users can define the drive shape and apply a customized window applied to the drive signal. Drive shape is defined in breakpoints.

#### **Random profile import, editing, and reduction**

The same as Random Vibration Control.

#### **Earthquake Testing Control (VCS-60-13)**

The Earthquake Testing Control package provides controls to meet a target Required Response Spectrum (RRS). Waveforms are automatically synthesized from a user-specified SRS reference profile using uniform or shaped random wavelets. Alarm and abort tolerances may be applied to any active channel to provide an extra degree of safety for delicate test articles.

- **Compliance:** IEEE 344-2013
- **Waveform synthesis methods:** damped sine, sine beat, uniform random, or shaped random
- **Component generation:** auto or manually controlled
- **Random wavelet definition:** frequency, amplitude
- **Shaped Random time window:** user-defined rising time, hold time and decay time
- **Component generation:** auto or manually controlled
- **Synthesis parameters:** waveform duration, max % of error, max number of iterations
- **Full envelope:** configure test response spectrum to be greater than RRS in terms of dB

### Sine Beat Seismic Control

Sine Beat Seismic Control provides seismic qualification of electrical equipment. It complies with IEEE 344 and IEC 980. The profile is defined by the RSS, where the amplitude of each frequency point determines the amplitude of the wavelet applied to the sine beats time waveform at each frequency of the RSS. Each sine beat is defined by wavelet amplitude, cycles/beat, beat count, and time interval.

- **Compliance:** IEEE 344 and IEC 980
- **Profile definition:** RSS profiles are defined by breakpoints and connecting lines. Edit in a table or graphically by dragging points on a plot.
- **Time waveform profile:** generated from sine beat parameters
- **Wavelet window type:** Sine
- **Sine beat parameters:** frequency, wavelet amplitude, cycles per beat, beat count, a time interval

### 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 duplicate precisely on the shaker just as they were recorded. It includes Waveform Editor (EDM-WE), a flexible importing and editing tool for long waveform signals. The recording option allows the recording of time stream data at the full sample rate on all input channels. Users can enable up to 8 channels for control and time data recording on the master front-end. Users can enable up to 511 channels for monitoring and time data recording.

### Key Features

- **Number of waveform profiles:** infinite number of Waveform recordings (subject to the available flash memory) is simultaneously supplied to automatically run sequentially 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/second 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:** users can import waveforms of any sampling rate up to 102.4 kHz into the Waveform Editor tool and convert them to a suitable frequency range.

### Control Parameters

- **Sampling rate:** up to 18 kHz, automatically calculated based on the profile

- **Display time block size:** up to 4,096 points
- **Transfer function update ratio:** the transfer function is updated continuously in real-time depending on the transfer update ratio which the user can enter (between 0 – 0.5).
- **Pretest:** a random close-loop pretest logic is built-in to generate an initial FRF value. The random profile automatically adjusts to match the frequency range of profile(t)
- **Low pass filter:** applied to all input channels

### Output Channels

- **First output:** drive channel
- **Second output:** configurable as one of the 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
- **Enterprise only:** PC math signals
- **Display windows:** signal plot window, signal value window, digital I/O view window, runlog window, large numerical value display window, channel status window, recording status, run schedule, Lissajous plot, vibration visualization
- **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

- **Time domain limit:** Raw or RMS to any input channel

### Reference Profile and Run Schedule

- **Profile definition:** any existing signal is treated as a profile and is imported and defined as a control
- **Profile scaling:** apply a scalar or set scale to.
- **Profile import:** waveforms with the following file types can import 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 can import directly into EDM VCS: 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 Waveform Editor tool. It also contains options for cropping, appending and inserting parts of waveforms.
- **AVD plot:** calculation of the other two quantities among Acceleration, Displacement or Velocity when the imported profile 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

### Acoustic Control (VCS-110)

Acoustic Control provides accurate control of high-level noise testing for reverberant chambers or progressive wave tubes. Based on the Spider hardware platform, Acoustic Control achieves quick and reliable control of the noise level to the reference octave spectrum and the overall sound pressure level (OASPL). Included safety features guarantee the safety of the unit under test.

### Inputs

- **Number of supported input channels:** up to 512

### Drives

- **Number of supported drives:** up to 4
- **Output channel:** On/Off
- **Horn label:** user defined

- **Signa clip:** user defined
- **Alarm (V)/max (V):** user defined
- **Min freq (Hz)/max freq (Hz):** user defined

### Control Parameters

- **Control strategy:** single channel, weighted average, maximum, minimum
- **Octave band:** 1/1, 1/3
- **Low band (Hz):** from 16 to 4000 (1/1 Octave), from 20 to 5,000 (1/3 Octave)
- **Upper band (Hz):** from 250 to 16,000 (1/1 Octave), from 125 to 20,000 (1/3 Octave)
- **Frequency lines:** 400, 800, 1600, 3200
- **Multi-resolution:** automatic cutoff frequency or user defined
- **Ramp-up rate:** Fast (20 dB/s), Slow (2 dB/s), Fastest (60 dB/s)

### 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, octave spectrum, control spectrum, profile, noise spectrum, auto-power spectra for all channels, user-defined FRF type (H1, H2, H3, Hv), and strip chart plots for the time history of RMS, Peak, and Peak-Peak level of each channel.
- **Enterprise only:** PC math signals
- **Display windows:** composite, signal plot window, signal value window, digital I/O view window, runlog window, large numerical value display window, channel status window, recording status, run schedule, Lissajous plot, vibration visualization
- **Status display on Control Panel:** control level, drive peak, control OASPL, target OASPL, remaining time, full level elapsed time, total elapsed time
- **Runlog:** a test log continuously records real-time status changes and user commands. The 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
- **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 the control



signal, starts at the full level or low level

- **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. Edit in a table or graphically by dragging points on a plot.
- **Breakpoints:** defined as level or slope
- **Crossover calculation:** enter “?” to automatically calculate the crossover frequency and amplitude
- **Alarm and abort:** limits defined in dB or % relative to the reference profile
- **Profile scaling:** the profile is scaled using RMS value or dB
- **Profile import:**
  - Import saved signals in ATFX, UFF, UNV, TXT, or CSV format as the profile or
  - Import profiles are saved in CSV format or
  - Copy a profile table from a CSV file and paste into VCS software.
- **Profile export:** export the profile to CSV and ATFX format
- **Profile library:** settings are saved to a library and used repeatedly in different tests
- **Octave:** narrow band, 1/3, or 1/1
- **Run schedule:** a schedule includes an unlimited number of test stages and user selected events

#### General Software Options

Users can apply the software options listed in this section to any vibration control software module.

##### Sine Oscillator (VCS-00-05)

Sine Oscillator is a diagnosis tool that provides manual control of the sine output while displaying various time signals and frequency spectra. Users can enable Random excitation as a checkup function. Tracking filters are applied to each input channel to extract the signals at a sweeping frequency. When the close-loop 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)

This option allows users to apply a non-acceleration measurement quantity to the control signal. Users can choose from multiple quantities including force, sound, and voltage to control with an appropriate sensor. Angular acceleration is controlled in Sine and Random tests using the appropriate selection.

The controller is also capable of using mixed displacement, velocity and acceleration sensors to 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
- **Control quantity other than acceleration:** velocity, displacement, pressure, voltage, current, force, sound pressure, angular acceleration, angular velocity, strain, angle, and moment.

##### Multi-Master Option (VCS-00-20)

Creates a special license key that allows multiple front-end systems to split into several independent systems. Any front-end enabled with this license key can operate as a Master unit. Ordering this option will enable the same set of software to run on each or any combination of Spiders that are defined in this license key.

##### Multi-Shaker Control (VCS-00-40)

EDM Multi-Shaker Control (MSC) is a software option included in the EDM VCS Testing package. MSC provides one centralized interface to interact with multiple controllers running separate tests at the same time. Multi-shaker controllers are not time-synchronized unlike in MIMO Control, in which all drives are time-synchronized.

- **Test types:** Random, Sine on Random, Random on Random, Swept Sine
- **Number of controllers running simultaneously in an instance of EDM:** up to 12
- **Test operation:** individual controller or all controllers (not synchronized or correlated)
- **Display:** individual window showing test status and

composite window of each controller

- **Common commands:** connect/disconnect, run/stop a test; connect/disconnect all tests, run/stop all tests; save signal all; display composite/status or both
- **Manual control commands for SINE:** set level, level up, level down, restore level, reset average, next entry, set frequency, save signal, pause
- **Manual control commands for RANDOM:** set level, level up, level down, restore level, reset average, next entry, save signal, pause
- **Manual control commands for SOR/ROR:** set level, level up, level down, restore level, reset average, next entry, save signal, pause
- **Testing parameter status:** current level, current drive, control RMS, demand RMS, total elapsed time, full level time, remaining time (by default)
- **Display signals:** time stream, time block, power spectrum (high abort, high alarm, profile, control, low alarm, low abort, drive, noise, APS), FRF
- **Test photo:** individual photo for each shaker/test
- **User control:** admin/user privilege

#### Resonance Search (VCS-00-41)

The search function determines the resonant frequencies using a transmissibility signal between input channel 1 as the excitation and input channel 2 as the response. Specify the range of the search to locate the first bending, second bending, first torsion, and second torsion frequencies. Input channel 1 is the control channel that receives the signal from the shaker armature.

#### Unit under test parameters

- **Search for frequencies:** first bending, second bending, first torsion, second torsion
- **Parameters of each search:** low frequency, high frequency, sweep type (log, linear), sweep rate (Oct/Min, Hz/Sec), target acceleration
- **Sweeping rate:** Log (Oct/Min): 0.001 to 6000; Linear (Hz/Sec): 0.001 to 6000
- **Spectrum display resolution:** 4,096
- **Measurement strategy:** Filter
- **Tracking filters:** Proportional 25%
- **UUT library:** all of the above parameters are saved to a library and reused in different tests

#### Measured signals and display status

- **Measured signals:** drive signal, input time stream, drive signal spectrum, spectra for all channels, and strip chart plots for the time history of Peak and Peak-Peak level of each channel. Transmissibility signals are in complex

format with real/imaginary parts.

- **Block signals:** block time signals are used to display time waveform
- **Display windows:** signal plot window, signal value window, digital I/O view window, runlog window, large numerical value display window, channel status window, recording status, run schedule, Lissajous plot
- **Status display on control panel:** Excitation pk in acceleration and velocity, Excitation pkpk in displacement, UUT model name, Running Step
- **Runlog:** a test log continuously records real-time status changes and user commands, the maximum number of runlog entries is 1024.

#### Resonance search sequence

- **Resonance search sequence:** shows test progress, results, and status. The sequence consists of tasks. Each task tests multiple items. The sequence can be exported and imported.
- **Task entry parameters:** test name, process#, batch#, blade model, blade SN (continuous or discontinuous, which can be imported)
- **Operation:** start from the first entry, start from highlighted, pause, stop
- **Result report:** log file, results table in Word format, CSV format

#### 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 calibration signal nominal frequency, selects either RMS reading or dB RMS reading, and references the 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 (option number: FECT, previous SPIDER-CAL)

A front-end is calibrated at the factory before shipping and should be recalibrated annually by the factory or a factory authorized calibration service. EDM Utility includes an optional stand-alone Front-End Calibration Tool (FECT) that is operable by either the user or a calibration specialist. Calibration data is stored inside of the Spider front-end.

**FECT functions:** The calibration software calibrates the signal source and adjusts the DC and AC gains and offset. Then, it calibrates the input channels at all coupling types and adjusts the DC and AC error. To have measurements at multiple frequency points before and after calibration, the factory calibration procedure and the specified fluke meter must be used. Users can view the calibration report in FECT

or print the report in Word or PDF format. For more details, please refer to the FECT specifications.

#### **Waveform Editor (EDM-WE)**

Waveform Editor is a Windows application that allows the user to edit, cut, paste and scale a time waveform to be duplicated on a shaker. Users can import one or multiple channels of data for editing. Users can also apply displacement compensation so that the resulting waveform is reproduced on a shaker using a Vibration Control System with Time Waveform Replication (TWR) software. From the EDM 6.0 release and above, this option is included in each VCS shipment.

- **Editing:** cut, paste, rescale, fill in, taper endpoints, apply windows, decimate
- **Displacement compensation:** brick-wall high pass filter, high pass filter, DC removal, or disabled
- **Compensation template:** high pass filter, low pass filter, bandpass filter, acceleration DC removal, velocity DC removal.
- **Signal view:** time waveform of acceleration, velocity, and displacement; FFT spectra; shaker limits; histogram
- **Editing redo:** allows the user to redo a previous editing
- **Window:** half-sine, Hann, triangle

#### **PC Requirements for EDM Software**

##### **Minimum system requirements:**

- **Operating system support:** Windows 7 SP1 or higher
- **Operating system type:** 32-bit or 64-bit
- **Processor speed:** 1.5 GHz Dual-Core x86
- **RAM:** 4 GB
- **Available storage space:** 20 GB

##### **Recommended system requirements (Minimum for Spider systems higher than 16 channels):**

- **Operating system:** Windows 10, Windows 11, 64-bit
- **Processor:** Intel Core i7, 2.0 GHz or Higher
- **RAM:** 8 GB or more
- **Available storage space:** 40 GB

**Hardware Module Compatibilities in a VCS System**

List of compatible hardware as slave modules for the selected master module hardware type.

MASTER Module Hardware Type	SLAVE Module Hardware Type	Channel Type
Spider-80Hi Spider-80Ci Spider-80X V2	Spider-80Hi Spider-80Ci Spider-80X V2 Spider-80SGi/Gi Spider-80Ti Spider-NAS	Control, notching, monitor Control, notching, monitor Control, notching, monitor Monitor Monitor Storage
Spider-80Xi Spider-81	Spider-80Xi Spider-80X Spider-81 Spider-80SGi/Gi Spider-80Ti Spider-NAS	Control, notching, monitor Control, notching, monitor Control, notching, monitor Control, notching, monitor Monitor Storage
Spider-80M	Spider-80Xi Spider-80SGi/Gi Spider-80Ti Spider-NAS	Control, notching, monitor Control, notching, monitor Monitor Storage
Spider-80SGi Spider-80Gi	Spider-80SGi Spider-80Gi Spider-80Ti Spider-NAS	Control, notching, monitor Control, notching, monitor Monitor Storage
Spider-81B	Does not support high channel count	

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