CRYSTAL instruments

Spider-81 Specifications (v2.00)

Spider-81

February 15, 2013

Spider-81B

Table of Contents

CRYSTAL instruments

Introduction

Spider-81 is a highly modular, distributed, scalable vibration control system developed by Crystal Instruments. It represents the fourth generation of vibration control systems with advanced technology unavailable in the current generation.

DSP Centralized Architecture

Unlike traditional controllers that rely heavily on an external computer for real-time operations, Spider is the first controller that directly integrates time-synchronized Ethernet connectivity with embedded DSP technology. This greatly increases the control performance, system reliability, and failure protection of the controller. It also allows large number of channels to be configured without sacrificing system performance.

Latest Hardware Design

Spider-81 modules have voltage, charge, and IEPE inputs which are ideal for shock, vibration and acoustic measurement or general purpose voltage measurement. The internal flash memory stores test configuration data for controlling up to hundreds of channels simultaneously and stores real-time analysis data. Multiple output channels provide various signal output waveforms that are synchronized with the input sampling rate. A bright LCD displays testing status information. Ten monitoring connections on each unit can be used to read the signals of analog input and output. The front panel has a dozen function buttons. There are built-in isolated digital I/O and RS-485 serial ports to interface with other hardware.

Simple Network Connection

Ethernet connectivity allows the Spider-81 to be physically located far from the host PC. This distributed structure greatly reduces the noise and electrical interference in the system. One PC can monitor and control multiple controllers over the network. Since the control processing and data recording are executed locally inside the controller, the network connection does not affect control reliability. With wireless network routers, the PC can easily connect to the Spider remotely via Wi-Fi.

Time Synchronization between Multiple Modules

The Spider-81 is built on IEEE 1588 time synchronization technology. Spider modules on the same network can be synchronized with up to 100 ns accuracy, which guarantees ±1 degree cross channel phase match up to 20 kHz. With such unique technology and high-speed Ethernet data transfer, the distributed components on the network truly acts as one integrated system.

Black Box Mode: Run without PC

The Spider-81 can be executed in *Black Box mode* which allows it to operate without a PC. In this mode, a PC is used only to configure the control system before the system starts operation and to download data after the test is complete. During the test, the controller can be operated according to a preset schedule or from a variety of external devices, such a Wi-Fi enabled PDA or iPad. Black Box mode is included with every Spider-81/81B.

For hardware with version 5.8 and lower, up to 4 tests can be uploaded and stored on each device. For hardware with version 7.3 and higher, up to 8 tests can be uploaded and stored on each device.

On-Board LCD Display

Each Spider-81 is equipped with a bright front-panel LCD that displays system status and test information. Real-time status such as control RMS or sweeping frequency can be instantly viewed.

Designed for High Reliability

Spider-81 is the very first vibration control system designed for fail-safe operation even in the event of network or power loss. Advanced safety routines allow sensor failures to be detected within milliseconds. The Spider-81 hardware passed strict environmental tests including EMI, temperature, drop shock, sine and random vibration. The system is built to withstand the rigors of the testing environment with long-lasting durability. The unique floating ground design reduces ground loop problems typically found in testing laboratories.

Designed for High Accuracy

Using a patented dual parallel A/D design, Spider-81 is the first vibration control system that achieves 130 dB input dynamic range. Each measurement channel can detect signals as small as 6 µV and as large as 20 V. This design completely eliminates the need for the input range or gain settings found on traditional controllers.

Designed for High Control Performance

By using enhanced control algorithms and a simplified DSP architecture, the feedback loop time of Sine and Random control are all greatly reduced. A reduced control loop time gives much better capability for resonance search and dwell or control for a structure with high Q resonances. It also provides faster responses for better safety protection.

Ease of Use

The Spider-81 software is further improved at the user interface level. More graphic guidance, wizards, and tools are added to simplify setup. The interface has been rearranged to make it more logical and useful. Event-Action Rules, Abort-Sensitivity, and numerous other new concepts are introduced in the software to simplify operation. Keyword searching through a large number of tests is easy.

ASAM-ODS Data and File Model

ASAM is an international organization that is supported by more than 150 companies in the testing and measurement industry. Spider-81 is fully compliant with the ASAM-ODS data and file model. With ASAM-ODS, the engineering unit, user control, testing article description and data exchange of Spider-81 are all governed by the ASAM standard. The Spider-81 data can be read by the software of LMS, B&K, BBM, and many other providers.

Integrated with Dynamic Signal Analysis

Spider-81 is integrated with general signal analysis functions including time stream recording, transient capture, FFT, auto power spectra, and transfer function analysis. Multiple Spider-81 modules can work together to form one integrated system. For more details about the development of VCS technology see the CI white paper.

iPad Control

The iPad app can be downloaded from the Apple Store. The software runs on iPad from Apple Inc. and accesses the Spider hardware when it runs in the black box mode. The iPad app enables users to access preloaded tests to run and control when they are mobile but within the range of the wireless network. Display window can show one or multiple signals. The user can print or email screen shots. For hardware versions 7.x and higher, up to 8 tests can be uploaded to the hardware for selection while running the iPad app.

Spider-81B, the Basic Version

The Spider-81B is designed to meet the requirements of basic vibration testing applications. It has 4 inputs, 1 output, and 4 pairs of digital I/O. Available software includes Random, Sine, Shock, and RSTD testing suites.

Hardware Specifications

Analog Input Channels

Input Channels per Spider-81: 4 – 8
Max Input Channels per Spider-81 System: 64

Input Channels per Spider-81B: 2 – 4

Connector Type: isolated BNC
TEDS: IEEE 1451.4 compliant
Coupling: AC Voltage, DC Voltage, Charge, or IEPE (ICP®)
IEPE DC offset Voltage and Current: 21 V at 4.7 mA
Charge Input: 10,000 pC and 49,000 pC
Input Range: ±20 V_{pk}
Input Impedance: 500 kΩ
Input Protection Voltage: ±40 V_{pk}
AC Coupling: analog high-pass filter, -3 dB @ 0.3 Hz and -0.1 dB @ 0.7 Hz
A/D Resolutions: 2 x 24-bit (per input channel)
Anti-Aliasing Filter: analog anti-aliasing low-pass filters in addition to sigma-delta converters
Digital Filter: high-pass and low-pass filters (user programmable)
Input Dynamic Range: 130 dB
Sampling Rate: 0.48 Hz to 102.4 kHz, with 54 stages
Maximum Useful Bandwidth: 46.08 kHz
Total THD + Noise: -95 dBfs (DC to 1 kHz)
Amplitude Channel Match: 0.1 dB
Channel Phase Match: better than ±1.0 degree, up to 20 kHz
Crosstalk: less than -100 dB
Frequency Accuracy: 0.00025%
Common Mode Range: ±10 V_{pk}
Common Mode Rejection: better than 90 dB
Amplitude Accuracy: 0.5%

Analog Output Channels

Spider-81 Output Channels: 2 (Additional 2 outputs reserved for future expansion)
Spider-81B Output Channels: 1
Connector Type: isolated BNC
D/A Resolution: 24 bit
Sampling Rate: up to 102.4 kHz per channel, synchronized with input channels
Output Dynamic Range: 100 dB
Maximum Output Current: 25 mA
Sine Amplitude Accuracy: ±1% (0.34 dB) at 1 kHz for 0.1 V_{pk} to 5 V_{pk}
Anti-Imaging Filter: 160 dB/oct digital and analog filters
Digital Filters: high-pass and low-pass digital filters
Output Range: ± 10 Volts

Isolated Digital Input and Output

Connector: 25-pin female D-SUB
External Circuit Power Supply: 3.3 – 12 V_{DC} (±10%)
Internal Power: 3.3 V_{DC} 350 mA, 12 V_{DC} 400 mA
Maximum Allowable Distance of Signal Extension: 50 meters

Inputs

Input Format: opto-isolated input (compatible with current-sink output)
Spider-81 Channels: 8
Spider-81B Channels: 4

Input Resistance: 6.1 kΩ
Input On Current: 2.0 mA or more
Input Off Current: 0.16 mA or less
Interrupt: 8 input signals are arranged into a single interrupt output signal. An interrupt is generated either at the rising edge (HIGH-to-LOW transition) or falling edge (LOW-to-HIGH transition).

Outputs

Output Format: opto-isolated input (current sink output)
Spider-81 Channels: 8
Spider-81B Channels: 4
Output Rating: output voltage 12 V_{DC} max, output current 100 mA per channel max
Residual Voltage with Output On: 1.0 V or less (Output current < 100 mA)

Analog Monitoring Channels

Not available on Spider-81B

Purpose: voltage replication of each input and output channel
Number of Channels: 10 (8 analog inputs, 2 analog outputs.)
Connector Type: 25-pin female D-SUB
Monitoring Magnitude: 50% of input channel
Output Format: single-ended
Output Rating: 10 V_{DC} max, 25 mA per channel max

High Speed Data Port interfacing to Spider-NAS

Not available on Spider-81B
Number of Port: 1
Connector Type: 5-pin LEMO
Maximum distance of cable: 2 meters
Theoretical Physical Data Transfer Speed: 480 Mbits/second
Data Transfer Speed: Higher than 819.2ksample/second. Data saved in 32-bit single precision floating point. (Data from all input channels can be streamed to Spider-NAS)

RS-485

Not available on Spider-81B

Purpose: connection of other customized interface devices
Connector Type: 9-pin female D-SUB
Pin Assignment: RS-485 receiver, RS-485 driver, +5 V power, abort line, GND

Front Panel LCD Display

Not available on Spider-81B

Display Area: 115.05 x 28.65 mm
Color: blue-green
Technology: VFD, 8 level brightness, font size user customizable
LCD Control Buttons: five buttons: left, right, up, down and enter

Ground Connection

Purpose: connect to common ground of power amplifier to reduce ground-loop interference
Connector Type: 0.166 inch (4.23 mm) jack connector for standard 0.166 inch banana plug

System Specifications

On-Board Memory: 4 GB non-volatile flash memory, 32 MB DRAM
Ethernet: 100Base-T, RJ45 female connector
Internal Clock: maintains date and time

Cooling: no cooling fan required

Network Protocols and IEEE 1588 Time Synchronization

Multiple Spider modules are synchronized through the IEEE 1588 protocol. The synchronization accuracy is better than ±100 ns when using a certified network switch, such as the Spider-HUB. Data acquired by all the measurement channels will be synchronized and the phase match across different Spider modules is within 1.0 degree of 20 kHz.

IPv4 Protocol Stack: ICMP, IP, UDP, TCP, IGMP
IPv4 Configuration: manual or via DHCP
IEEE 1588v2 Protocol: PTP ordinary clock, with both E2E and P2P synchronization supported and hardware level timestamp for PTP event messages. *Not available on Spider-81B*
Time Sync Accuracy for sampling clocks between modules: ±100 ns or better (Multiple Spider-81 modules connected by specified switch)

Power Specifications

Power Supply: external DC power
External DC Power: AC adaptor accepts 100 to 240 V_{AC} (47 – 440 Hz), DC power 15 V (±10%)
Backup Super Capacitor: 8 seconds for emergency shutdown
Power Consumption: less than 18 watts

Environmental and General Specifications

Enclosure: metal box compliant with CE electrical safety and EMI shielding standards
Spider-81 Dimension: 440 x 66 x 330 mm (W x H x D)
Spider-81B Dimension: 220 x 66 x 276 mm (W x H x D)
Weight: 4.2 kg
Safety Standards: electromagnetic compatibility and sensitivity: EN 61326:1997+A1:1998+A2:2001, EN61000-3-2: 2000, EN61000-3-3: 1995+A1:2001
Operating Temperature: -10 °C to +55 °C
Storage Temperature: -20 °C to +70 °C
Shock: 50 g's, 315 in/sec, tested at 6 sides, non-operational test
Vibration: 5 – 500 Hz, 0.3 g, tested at 3 sides, operational test
Vibration: 5 – 500 Hz, 2.42 g, tested at 3 sides, non-operational test

PC Requirements

OS Support: Microsoft XP SP3, Microsoft Vista, Microsoft Windows 7, Microsoft Windows 8
OS Type: 32-Bit and 64-Bit
Minimum Processor Speed: 1.5 GHz Dual Core x86
Minimum RAM Memory: 2 GB
Minimum Free Space: 10 GB

Microsoft Office 2003 or newer must be installed to use the Report Feature. Active X reporting feature requires Office 2007 or newer to be installed.

General Functions of EDM Software in VCS Mode

Spider Hardware System Management

The Spider system consists of one or more Spider modules. The user constructs the system by combining Spider modules on the same LAN. The software validates and displays hardware attributes of each Spider module. Once constructed, multiple Spider modules are viewed as one integrated system.

Hardware Access Code Control

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

Hardware Self-Test

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.

Test Management

Test data and configurations are managed through a MySQL or Microsoft SQL 2008 database. Tests are searchable by keyword, time, and date. Users can conduct test setups with or without hardware device connection.

Dimensions and Units

Dimensional units are user configurable at the system level. Each input channel is configurable for measurement quantity, sensitivity, and dB reference level.

Acceleration: m/s^2, cm/s^2, mm/s^2, g, ft/s^2, in/s^2, mil/s^2
Velocity: m/s, cm/s, mm/s, ft/s, in/s, mil/s
Displacement: m, cm, mm, ft, in, mil
Force: Newton, Dyne, kgf, KIPF, LBF, OzF
Pressure: Pa, µPa, ATM, Bar, PSI, KSI
Voltage: Volts, mV
Time: seconds, milliseconds
Frequency: Hz, kHz, MHz
Angular Velocity: Rad/s, Degree/s, RPM
Current: Amp, mA
SPL: dB in reference to 20 µPa
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
NI- TDM: National Instruments structured storage format
.WAV: sound wave files

Import Data File Formats

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

Languages

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

Report

Testing reports are directly created in MS-WORD based on system settings or user-defined templates. Many fields and attributes are customizable. Using Windows ActiveX technology, Active Report supports the embedded graphic drawing functions in MS-WORD. Active Report is only available when Office 2007, Office 2010 or later installed.

General Software Options

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

Password Control (VCS-00-02)

Different users can only access certain parts of test settings (channel, parameter, signal save and display) depending on account level, with the privileges managed by an administrator.

Digital I/O Interface (VCS-00-04)

Each Spider-81 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

Shaker Diagnosis Tool (VCS-00-05)

Run manufacturer-defined random or sine tests to diagnosis shaker problems before tests. Manual sine oscillator and random excitation are included.

Sine Oscillator

The Sine Oscillator is essentially a sine controller with more manual control functions. It is typically used to test and diagnose a shaker system.

Frequency Range: automatically calculated based on profile, or selectable from multiple ranges: 2 Hz to 4,000 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, Cycles/Min

Spectrum Display Resolution: 256 to 4096

Loop Time: 10 ms typical (Loop time is *the maximum time rate at which a controller can execute complete cycles of sampling, processing data and transmitting control signals. It is the inverse of so called "The real-time control bandwidth". The real-time control bandwidth of Spider in Sine mode is about 100 Hz.*)

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

User Commands: run, stop, hold, pause, continue, save signals or record time stream signals, reset average, next schedule, set level, level up, level down, restore level , hold sweep, sweep up, sweep down, release sweep, increase frequency, set frequency, abort check on/off, schedule clock timer on/off, closed loop control on/off, increase/decrease output

3D Graphic Display: Waterfall, Spectrogram, Campbell diagram (VCS-00-06)

Waterfall: A series of spectral maps taken at regular intervals of time.

Spectrogram: Plotting vibration vs. frequency and regular intervals of time simultaneously. Frequency is plotted along the *x*-axis, time along the *y*-axis and the level is shown by the color.

Campbell diagram: A diagram used to check for coincidence of vibration sources with natural resonances. It resembles a spectral map, but the amplitude is represented by a circular plot, the larger the amplitude the larger the circle.

Test Sequence (VCS-00-07)

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

Send Emails and IM as Event-Actions (VCS-00-08)

Add the ability to send emails or instant messages as custom actions in response to events. User can add customized text to Emails.

Remote Operation Communication using Socket Messages (VCS-00-09)

Communicate with and control Spider systems remotely with Window socket messages.

Non Acceleration Control (VCS-00-12)

The control quantity in VCS mode can be changed to non-acceleration quantity. 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 be controlled in Sine and Random test using appropriate selection. Low frequency displacement/velocity control combined with acceleration control is available for Sine test (See VCS-40-04)

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: control in any non-acceleration unit

Sensor Calibration (VCS-00-36)

The Sensor Calibration tool can be used to calculate the sensitivity of the sensors while the measurements of the sensors are compared against reference sine wave input signals. The user enters the following information: Calibration signal nominal frequency, select either RMS reading or dB RMS reading, reference dB value. Spider automatically calculates the RMS levels and updates the sensitivity table. The user can accept or reject the calibration results and view reports.

Instrument Calibration Software (SPIDER-CAL)

The system is calibrated at the factory before shipping and should be recalibrated annually by a factory authorized calibration service. EDM has an optional calibration tool that can be operated by either the user or a calibration specialist.

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. Report includes model number, text for the calibration meter, and calibration operator's name. The report can be viewed or printed from the host PC.

CRYSTAL instruments

Dynamic Signal Analysis Specifications (S80-P10)

The DSA functions of Spider-81 are identical to those available to Spider-80x. Please refer to Spider-80x DSA specification for details.

EDM Software Specifications: Vibration Control Modules

Basic Random Vibration Control (VCS-20)

The Spider Random Vibration Control System provides precise, real-time, multi-channel control and analysis. Up to 1000 channels can be enabled for limit monitoring and data acquisition. The recording option can record 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 15 ms. Black Box mode allows a user to run the controller without a PC. VCS-20-00 is the evaluation mode of Random.

Control Parameters

Frequency Range: automatically calculated based on profile, or selectable from multiple ranges: up to 5,000 Hz (High Frequency option VCS-20-02 available)

Spectral Resolution: 225, 450, 900, and 1800 (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 can execute complete cycles of sampling, processing data and transmitting control signals. It is the inverse of so called "The real-time control bandwidth". The real-time control bandwidth of Spider 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: 95 dB

Control Accuracy: ±1 dB at 99% confidence with 200 DOF

Drive Sigma Clipping: 3 – 6, or disabled

Input Channels

Location ID: Allows the naming of signals by the physical location of sensor on 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 can be enabled on master Spider-81. Monitoring and limiting channels can be enabled on both master and slave Spiders.

Channel Library: settings can be saved to a library and used repeatedly in different tests.

Output Channels

First Output: drive channel

Second Output: configurable as one of following: no output, same as the first output, negative of first output, control RMS level, or RMS or Peak value of any input channel

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 control signal and each input channel. Detection can be 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

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.

Event-Action Rules

Test events such as alarms and digital inputs can trigger 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 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 and close control loop

Reference Profile and Run Schedule

Profile Definition: Control profiles are defined by breakpoints and connecting lines, and can be 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 can be 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 Scaling: The profile can be scaled using RMS value.

Profile Import: A profile can be imported from ASCII and other file types. See option VCS-20-07.

Profile Library: Settings can be saved to a library and used repeatedly in different tests.

Run Schedule: A schedule can include an unlimited number of test stages and user-defined events

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 can be saved to a library and used repeatedly in different tests. Shaker parameters can be imported from or exported to a MS Excel spreadsheet.

UUT Weight: can be changed per test in the confirmation page

Pre-Test

Pre-test checks the integrity of all signal paths and measures the system FRF.

Pre-test Options: measure FRF in a closed-loop, run with the last FRF saved on PC, or saved on Spider.

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, schedule clock timer, closed loop control, reset average, next schedule, save FRF function, show pre-test results, save signals or record time stream signals

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

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

Multiple Point Control (VCS-20-01)

Allow multiple channels to be used for control.
Multiple Point Control Strategies: RMS weighted average, maximum, and minimum.

High Frequency Extension (VCS-20-02)

Extend the frequency range from 5 kHz up to 36 kHz. May reduce the maximum channel count and highest allowed overlap ratio.

Long Waveform Recording (VCS-20-03)

Record long waveform signals from all input channels during Random, SoR, and RoR tests. Data is recorded to the internal Spider memory.
Typical Continuous Recording Time: 4 hours for 4 input channels with frequency range 2,000 Hz with 4 GB flash memory installed

High Line Resolution (VCS-20-04)

Not available on 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: 3,600 and 7,200 for all channels. 12,800 for up to 8 inputs.

Random Test Limiting (VCS-20-05)

Limiting can be applied to control or monitor channels. Available limiting types are notching limit and abort limit. Limiting profiles may be edited by amplitudes and frequencies of breakpoints or imported from saved spectra. 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 – 8.

Random Profile Import, Editing, and Reduction (VCS-20-07)

Any saved power spectrum data, in various file formats, can be imported and used as the random profile. The spectrum can be edited. For allowable file formats refer to the general EDM specification. User can reduce the number of break points between two cursors.

Sine on Random Control (VCS-20-08)

Sweeping Mode: free sweeping mode where each sine tone can have their own schedule and sweeping speed, and harmonic mode where the 1st 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 bands can have their 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 Drives with Single Control (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 (VCS-20-11)

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

iPad Control for Random, SoR, and RoR (VCS-20-15)

Any Random, SOR or ROR test uploaded to the hardware can be run and controlled by 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.

Basic Swept Sine Control (VCS-40)

The Spider Swept Sine Vibration Control System provides precise, real-time, multi-channel control and analysis. Up to 1,000 channels can be enabled for limit monitoring and data acquisition. The recording option can record 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. VCS-40-00 is the evaluation mode of Sine.

Control Parameters

Frequency Range: automatically calculated based on profile, or selectable from multiple ranges: 2 Hz to 5,000 Hz (Low and *High Frequency* option available)

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, Cycles/Min

Spectrum Display Resolution: 256 to 4,096

Loop Time: 10 ms typical (Loop time is *the maximum rate at which a controller can execute 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

Input Channels

Location ID: Allows the naming of signals by the physical location of sensor on 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 can be enabled on master Spider-81. Monitoring and limiting channels can be enabled on both master and slave Spiders.

Channel Library: settings can be saved to a library and used repeatedly in different tests.

Output Channels

First Output: drive channel

Second Output: configurable as one of the following: no output, same as the first output, COLA, control RMS level, or RMS or Peak value of any input channel

COLA Types: constant amplitude sweeping sine signal or amplitude 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 can be 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 can be based on maximum control loss or maximum RMS rate of change in the input channels.

Control Spectral Limits: spectral limits for control signal

Max Drive Limit: maximum voltage limit for drive output

Shutdown: user defined shut-down rate in dB per second

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.

Event-Action Rules

Test events such as alarms and digital inputs can trigger 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, digital input detected

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, close control loop

Reference Profile

Profile Definition: Control profiles are defined by breakpoints and connecting lines, and can be 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 can be 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 can be saved to a library and used repeatedly in different tests.

Run Schedule

Run Schedule: A schedule can include 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 can be assigned to each frequency separately.

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 can be saved to a library and used repeatedly in different tests. Shaker parameters can be imported from or exported to an Excel spreadsheet.

UUT Weight: can be changed per test in the confirmation page

Pre-Test

Pre-test uses random excitation to check the integrity of signal paths and measures the system Frequency Response Function (FRF).

Pre-test Options: measure FRF in a closed-loop, run with the last FRF saved on PC, or saved on Spider.

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, save signals or record time stream signals, reset average, next schedule, set level, level up, level down, restore level , hold sweep, sweep up, sweep down, release sweep, increase frequency, set frequency, abort check on/off, schedule clock timer on/off, closed loop control on/off

Front Panel LCD Display

The LCD on the front panel of the Spider-81 displays real-time system status.

Display Pages: Spider system configuration, IP setting, software version, hardware versions and testing status pages

Testing Status: Ethernet connection status, running status, sweep frequency, control level, drive peak, control peak, target peak, remaining time, total elapsed time and time of day

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) (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.

Resonant Frequency Search: Uses Q or amplitude of transmissibility to automatically search the resonances within certain range.

Tracked Dwell Entry: Resonant frequencies can be 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.

Multiple Point Control for Sine (VCS-40-02)

Allow multiple channels to be used for control.

Multiple Point Control Strategies: RMS weighted average or amplitude weighted average

High Frequency Extension for Sine and RSTD (VCS-40-03)

Extend the frequency range from 5 kHz up to 46 kHz. 1 input for up to 46kHz; 4 inputs up to 32kHz; all channels up to 20kHz. Data recording (VCS-40-06) cannot be enabled when frequency is more than 20kHz.

Sine Displacement Control (VCS-40-04)

Adds the ability of using a displacement sensor in one of the control channels. The displacement control increases the control accuracy in low frequencies.

Sine THD Computation (VCS-40-05)

This option adds the ability of computing Total Harmonics Distortion (THD) of the control signals.

Long Waveform recording during Sine and RSD (VCS-40-06)

Record long waveform signals from all input channels during Sine and RSTD tests. Data is recorded to the internal Spider memory.

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

Sine Drive Notching (VCS-40-07)

Limiting can be applied to control or monitor channels. Available limiting types are notching limit and abort limit. Limiting profiles may be edited by the amplitudes and frequencies of breakpoints or imported from saved spectra. The max expected peak acceleration, velocity and displacement of profile is calculated.

Step Sine Control (VCS-40-08)

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

Low Frequency Extension for Sine and RTSD (VCS-40-09)

Extend the frequency range of test from 2 Hz down to 0.1 Hz.

Dual Drives with Single Control (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 can be 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 applicable to RSTD.

iPad Control for Sine and RSTD (VCS-40-15)

Any Sine or RSTD test uploaded to the hardware can be run 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. Up to 1,000 channels can be enabled for limit monitoring and data acquisition. Classical pulse types include half-sine, haver-sine, terminal-peak sawtooth, initial-peak saw tooth, triangle, rectangle, and trapezoid. The Transient Control option uses imported transient waveform files. The recording option can record time stream data at the full sample rate on all input channels, regardless of the total channel number. Black Box mode allows a user to run the controller without a PC. VCS-60-00 is the evaluation mode of Shock.

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 – 500

Test Start Method: four options: pretest then start, skip pretest, use saved FRF, or use saved drive signal

Input Channels

Location ID: Allows the naming of signals by the physical location of sensor on 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 can be enabled on master Spider-81. Monitoring and limiting channels can be enabled on both master and slave Spiders.

Channel Library: settings can be saved to a library and used repeatedly in different tests.

Output Channels

First Output: drive channel

Second Output: configurable as one of following: no output, same as the first output, negative of first output, control RMS level, or RMS or Peak value of any input channel

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 can be 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

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.

Event-Action Rules

Test events such as alarms and digital inputs can trigger user-assignable actions.

Event Types: user-stop, channel overload, output maximum, exceed high abort line, below low abort line, digital input detected

Actions: 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

Reference Profile and Run Schedule

Test Standards: MIL-STD-810F, MIL-STD-202F, ISO, 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 25,600 sec

Compensation Shapes: half-sine, rectangular, rounded-rectangular or displacement optimum

Compensation Locations: pre-compensation, post compensation 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 can be saved to a library and used repeatedly in different tests.

Run Schedule: A schedule can include unlimited number of pulse entries and user-defined events.

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, mass of UUT

Shaker Library: Settings can be saved to a library and used repeatedly in different tests. Shaker parameters can be imported from or exported to an Excel© spreadsheet.

UUT Weight: can be changed per test in the confirmation page

Pre-Test

Pre-test checks the integrity of all signal paths and measures the system FRF.

Pre-test Options: measure FRF in a closed-loop, run with the last FRF saved on PC, or saved on Spider.

Drive Voltage: user-defined initial drive voltage and max drive voltage with selectable ramp-up rate

Noise Floor Measurement: measures the noise floor.

Checks: IEPE sensor check, open loop check and safety check

Manual Controls during Test

User Commands: run, stop, hold, pause, continue, level up, level down, restore level, set level, abort check, schedule clock timer, closed loop control, reset average, next schedule, save FRF function, show pre-test results, save signals or record time stream signals

Front Panel LCD Display

The LCD on the front panel of the Spider-81 displays real-time system status.

Display Pages: Spider System configuration, IP setting, software version, hardware versions and testing status pages

Testing Status: Ethernet connection status, running status, control level, drive peak, control Peak, target Peak, remaining pulses, total elapsed pulses, time of day

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

Software options VCS-60-XX can be applied to basic Shock controller VCS-60.

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

Using template based importing tools, time waveform in various formats can be imported into EDM. Scaling, editing, digital resampling, high-pass, low-pass filtering and compensation will tailor the waveform so it can be 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 Analysis (SRSA) (VCS-60-02)

SRSA is an analysis tool to generate shock response spectra for measured signals.

Type: maxi-max, primary, residual, composite
Measurement: positive, negative, absolute
Octave Spacing: 1 to 24
Damping: 0.1 to 99%

Shock Response Spectrum Synthesis and Control (SRS) (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 SRSA option, VCS-60-02, is included in this option.

Waveform Synthesis Methods: Control time waveform is generated from damped sine or sine beat
      components; or from imported time transient history.
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.

Long Waveform Recording (VCS-60-04)

Record long waveform signals from all input channels during Shock, Transient or SRS tests. Data is recorded to the internal Spider memory.

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

Burst Chirp Shock Control (VCS-60-05)

Support for burst, chirp and burst-chirp excitation signals.

Large Block Size (up to 65k points) (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. (Not available for Spider-81B).

Time Waveform Replication (VCS-80)

Time Waveform Replication (TWR) provides precise, real-time, multi-channel control and analysis. TWR is capable of running unlimited number of profiles in schedule. Up to 8 channels can be enabled for limit monitoring and data recording. Multiple long waveforms can be duplicated precisely on the shaker just as they were recorded. Includes a flexible importing and editing tools for long waveform signals called EDM – Waveform Editor. Recording option allows recording 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. VCS-80-00 is the evaluation mode of TWR.

Key Features

Number of Waveform Profiles: Infinite number of Waveform recordings (subject to the available Flash memory) can be supplied simultaneously to automatically run one after the other on the test specimen.

Maximum number of points: All internal flash memory space can be 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 profile and drive frequency: Waveforms of up to 18 kHz (fa) can be replicated.

Maximum Sampling Rates: Waveforms of any sampling rate could be imported into the Waveform Editor tool and could be converted to the waveforms with desired sampling rates which can be accepted by the TWR.

Control Parameters

Sampling Rate: Up to 18 kHz. Automatically calculated based on profile

Display Time Block Size: 4,096 points and larger

Average Number for Control: 1 – 500

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.

Input Channels

Location ID: Allows the naming of signals by the physical location of sensor on 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 can be enabled on master Spider-81. Monitoring and limiting channels can be enabled on both master and slave Spiders.

Channel Library: settings can be saved to a library and used repeatedly in different tests.

Output Channels

First Output: drive channel

Second Output: configurable as one of following: no output, same as the first output, negative of first output, control RMS level, or RMS or Peak value of any input channel

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 adjusted 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 can be 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

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.

Event-Action Rules

Test events such as alarms and digital inputs can trigger user-assignable actions.

Event Types: user-stop, channel overload, output maximum, exceed high abort line, below low abort line, digital input detected

Actions: 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

Reference Profile and Run Schedule

Profile Definition: Any existing signal can be treated as a profile and can be imported and defined as a control

Profile Import: Waveforms with any of the following file types can be imported into Waveform Editor: UFF ASCII (.uff, .unv), UFF Binary (.buff, .bunv), NI – TDM Format (.tdm), Save Point File Format (.spf), EDM View Project (.vpj) and ODS ATF/XML Format (.atfx)

Profile Editing: Waveforms with any sampling rates can be digitally re-sampled, rescaled, filtered, and different compensation techniques can be 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 can be 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 can be saved to a library and used repeatedly in different tests.

Run Schedule: A schedule can include unlimited number of profile entries and user-defined events.

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, mass of UUT

Shaker Library: Settings can be saved to a library and used repeatedly in different tests. Shaker parameters can be imported from or exported to an Excel© spreadsheet.

UUT Weight: **c**an be changed per test in the confirmation page

Pre-Test

Pre-test checks the integrity of all signal paths and measures the system FRF.

Pre-test Profile: A unique pre-test profile for each Imported profile can be defined / imported based on which a random noise signal is output to calculate the transfer function using a closed loop method.

Pre-test Profile Options: Pre-test profile can be imported from CSV files, Exported to CSV files and can Rescaled to a new RMS value.

Drive Voltage: user-defined initial drive voltage and max drive voltage with selectable ramp-up rate

Noise Floor Measurement: measures the noise floor.

Checks: IEPE sensor check, open loop check and safety check

Manual Controls during Test

User Commands: run, stop, hold, pause, continue, level up, level down, restore level, set level, abort check, schedule clock timer, closed loop control, reset average, next schedule, save FRF function, show pre-test results, save signals or record time stream signals

Front Panel LCD Display

The LCD on the front panel of the Spider-81 displays real-time system status.

Display Pages: Spider System configuration, IP setting, software version, hardware versions and testing status pages

Testing Status: Ethernet connection status, running status, control level, drive peak, control Peak, target Peak, remaining pulses, total elapsed pulses, time of day

Optional Time Waveform Replication Functions (VCS-80-XX)

Software options VCS-80-XX can be applied to basic TWR software VCS-80.

Software Bundles

VCS-Bronze 1	Basic Random, Sine, and Shock. Only available for Spider-81B.
VCS-Bronze 2	Basic Random, Sine, and Transient. Only available for Spider-81B.
VCS-Silver	Random, Sine, RSTD, and Shock with multiple-point control, high-resolution, THD and profile importing. This bundle only applies to Spider-81.
VCS-Gold 1	Random, SoR, RoR, Sine, RSTD, Shock, Transient, SRS with multiple-point control, high-resolution, THD and profile importing. Calibration, DIO, diagnosis tools included. This bundle only applies to Spider-81.
VCS-Gold 2	Random, SoR, RoR, Sine, RSTD, Shock, Transient, SRS with multiple-point control, high-resolution, THD, recording, high frequency and profile importing. Calibration, DIO, diagnosis tools included. This bundle only applies to Spider-81.

Part Number	Function	Bronze 1 Bundle	Bronze 2 Bundle	Silver Bundle	Gold 1 Bundle	Gold 2 Bundle
VCS-20	**Random**	✓	✓	✓	✓	✓
VCS-20-01	Multiple point			✓	✓	✓
VCS-20-02	High frequency					✓
VCS-20-03	Recording					✓
VCS-20-04	High resolution			✓	✓	✓
VCS-20-05	Limiting				✓	✓
VCS-20-06	Kurtosis control					✓
VCS-20-07	Profile import			✓	✓	✓
VCS-20-08	SoR				✓	✓
VCS-20-09	RoR				✓	✓
VCS-40	**Sine**	✓	✓	✓	✓	✓
VCS-40-01	RSTD			✓	✓	✓
VCS-40-02	Multiple point			✓	✓	✓
VCS-40-03	High frequency					✓
VCS-40-05	THD			✓	✓	✓
VCS-40-06	Recording					✓
VCS-40-07	Drive notching				✓	✓
VCS-40-08	Step sine			✓	✓	✓
VCS-40-09	Low frequency			✓	✓	✓
VCS-60	**Shock**	✓		✓	✓	✓
VCS-60-01	Transient		✓		✓	✓
VCS-60-02	SRS Analysis			✓	✓	✓
VCS-60-03	SRS Synthesis				✓	✓
VCS-60-04	Recording					✓
VCS-60-05	Burst Chip Control				✓	✓
VCS-60-06	Large block size			✓	✓	✓
VCS-60-07	Multiple point				✓	✓
VCS-00-02	Password Control					✓
VCS-00-04	DIO				✓	✓
VCS-00-05	Diagnosis tool				✓	✓
VCS-00-07	Test Sequence				✓	✓
VCS-00-08	Emails, IM				✓	✓
SPIDER-CAL	System Calibration				✓	✓

Appendix 1: Spider-81 and Spider-81B Comparison

	Spider-81	Spider-81B
Number of Input Channels	4, 6, 8 and expandable	2, 4
Number of Output Channels	2	1
Input Mode	Charge TEDS IEPE AC-Differential DC-Differential AC-Single End DC-Single End	Charge TEDS IEPE AC-Differential DC-Differential AC-Single End DC-Single End
Digital I/O	8 in/out, isolated	4 in/out, isolated
Backup Super Capacitor	Yes	Yes
Available Software Bundles	Silver, Gold	Bronze
Front Panel LCD	Yes	No
High Speed Data Port for direct data recording to Spider-NAS	Yes	No
RS-485	Yes	No
Front Panel LCD	Yes	No
Analog Monitor Channels	Yes	No

Appendix 2: Typical System Configurations

The Spider hardware platform can operate in two working modes: Black Box and PC Tethered mode. When Spider runs in Black Box mode, preset projects are executed based on a user defined schedule. In PC tethered mode, the PC is used as a control terminal to access the Spider through an Ethernet network. The Spider can be switched between the two modes during tests. The PC Tethered mode is ideal for applications such as structural testing in a laboratory environment. The Black Box mode is ideal for remote monitoring. The connection between your PC and LAN can be either wired or wireless.

PC Tethered with One Spider Module

One Spider-81 can be directly connected to a PC or to a LAN network through Ethernet. No switch is needed. The PC is used as a control and monitoring terminal via the EDM software.

PC Tethered with Multiple Spider Modules

Multiple Spider modules can be connected to form a high channel count system. Multiple switches can be cascaded to extend the number of modules. For example, to make a 64 channel system, a Spider-81 and 7 Spider-80X's can be used. The PC is used as a control and monitoring terminal via the EDM software.
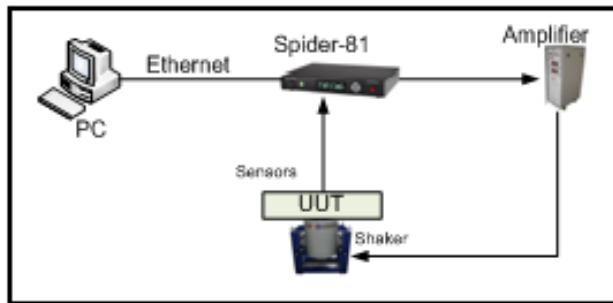
CRYSTAL
instruments

Black Box Mode with One Spider Module

This is the same as Configuration 1 except that the PC is not required during run time. A PC is required to install the Spider Black Box engine to the Spider module, and is used to configure the Spider and to download data files.
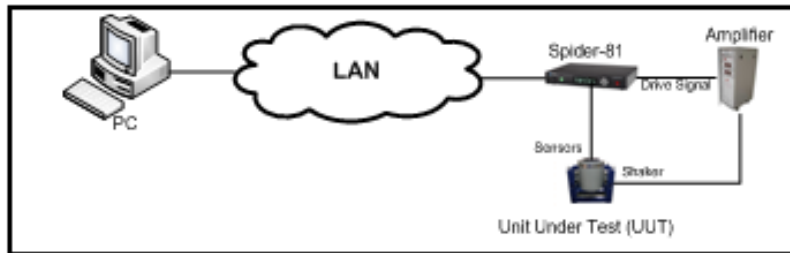
Black Box Mode with Network Switches and Multiple Spider Modules

This is the same as Configuration 2 except that the PC is not required during run time. A PC is required to install the Spider Black Box engine to the Spider module, and is used to configure the Spider and to download data files.
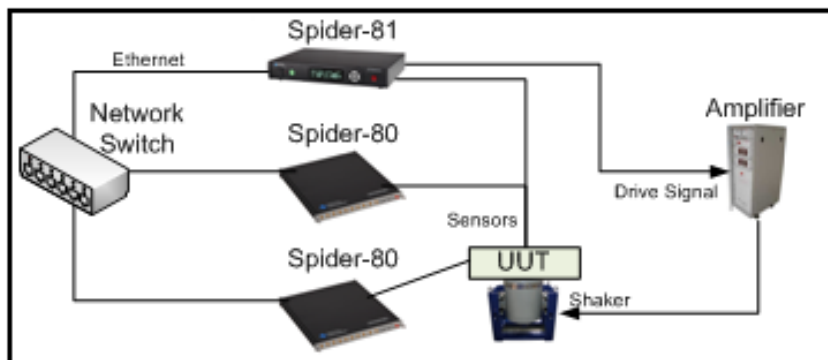
The figures below illustrate some of the many configurations that are possible with the Spider system.

Setup with PC-Controller Directly Connected

Spider VCS controlled remotely through a LAN. The network can be wired or wireless.

Configuration for high channel-count system with one Spider-81 and many Spider-80s.