SPIDER-81

The Fourth Generation
Vibration Control System

SPIDER-8I

The Fourth Generation Vibration Control System

◆ Highlights

- DSP centralized design with simple network connection
- 4 - 1024 input channels with excellent phase match
- PC Tethered mode or standalone Black Box mode
- 24 bit A/D and D/A ,130 dB input dynamic range
- Integrated IEPE output, charge amplifier, AC/DC coupling, TEDS
- Continuous recording for all channels at full sampling rate
- AC or DC power and backup battery
- Isolated digital I/O
- Bright LCD display
- Latest programming technology

◆ Application Functions

- Random
- Sine-on-Random
- Random-on-Random
- Swept Sine
- Resonant Search and Tracked Dwell
- Classic Shock, Transient, SRS
- Time Data Replication
- Limiting and Notching
- Shaker Diagnosis Tools
- Data Recording and Dynamic Signal Analysis
- Thermo Chamber Interface

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◆ Spider-81B Basic Version

The 1st generation controllers did not use a PC. They were built on mini-computer architecture with a dedicated user interface. The PC played a critical role in the 2nd, 3rd, and 4th generation systems.

In the 4th generation, the high speed data communication and accurate time synchronization all happens over the network. The PC is only an operator terminal and is not part of the control system. The user has a choice to control the system through a PC, wireless PDA, hardware pendant, or through other devices.

The fully networked controller provides significant advantages over previous generations. A user can place the controller close to the shaker table and operate the controller near the shaker or in a remote control room a long distance away.

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

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◆ 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 all the control processing and data recording are executed locally inside the controller, the network connection will not affect the 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.

◆ Black Box Mode: Run without PC

The Spider-81 can run autonomously in Black Box mode without a PC connected. In this mode, a PC is used only to configure the control system before 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 as a control pendant, Wi-Fi enabled PDA, or iPad.

◆ 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.

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◆ Designed for High Reliability

Spider-81 is the first vibration control system designed for fail-safe operation even in the event of a network or power loss. An internal backup battery allows the controller to continue to function and save status information in the event of a 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 tough to withstand the rigors of the testing environment and for long-lasting durability. The unique floating ground design reduces ground loop problems in the installation.

◆ Designed for High Accuracy

Using a patented technology, Spider-81 is the only vibration control system that achieves 130dB input dynamic range. Each measurement channel can detect signals as small as $6\mu V$ and as large as 20V. This 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 greatly reduced. A reduced control loop time enhances the capability of resonance search and dwell and control for a structure with high Q resonances. This 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 were added to make setup a snap. The interface has been rearranged to make it more logical and more useful. Event-Action rules, Abort-Sensitivity, and other new interface features are used to simplify operation. Searching through a large number of tests is easy with keywords.

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◆ 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-80 DSA modules can work together with a Spider-81 VCS module as one integrated system.

◆ Architecture Comparison

In the past four decades, vibration control technology has gone through four generations: standalone controller, PC-based, PC-tethered, and fully networked. The Spider-81 represents the fourth generation — fully networked, built on Ethernet with IEEE 1588 time synchronization. This configuration provides much greater flexibility, reliability, configurability, and scalability than before.
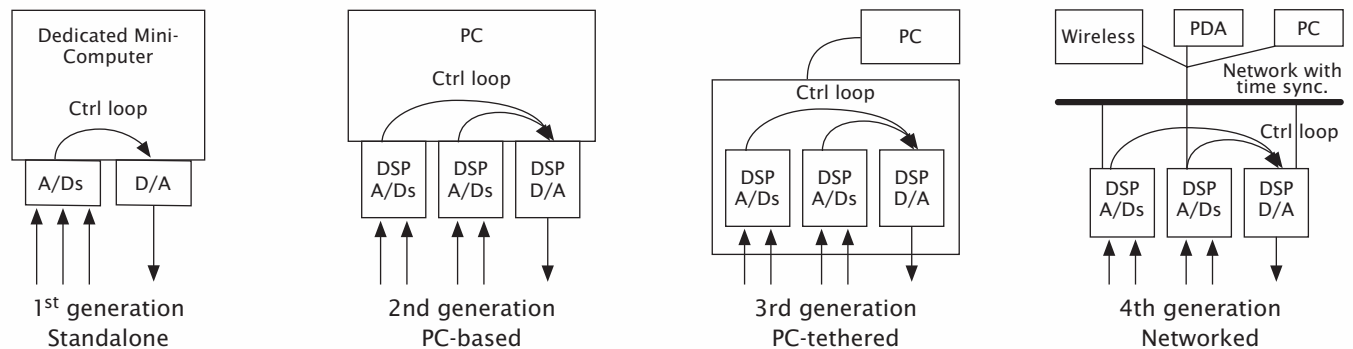
Architecture of four generations of VCS

Spider-81 is a highly modular, distributed, scalable vibration control system developed by Crystal Instruments. It represents the fourth generation of vibration control systems because its advanced technology is not seen in any other products. It includes a complete suite of vibration control modules including Sine, Random, Sine-on-Random, Random-on-Random, Classical Shock, SRS, Time Data Replication, and Dynamic Signal Analyzer functions.

◆ DSP Centralized Architecture

Unlike traditional controllers that rely heavily on an external computer for real-time operation, Spider is the first controller that directly integrates time-synchronized Ethernet connectivity with embedded DSP technology. This strategy greatly increases the control performance, system reliability, and failure protection of the controller. It also allows large numbers 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, acoustic, or general purpose voltage measurement. The internal flash memory stores test configuration and real-time analysis data for up to hundreds of channels simultaneously. Multiple output channels provide various signal output waveforms that are synchronized with the input sampling rate. The front panel has 5 function buttons and a bright LCD that displays test status information. Ten monitoring connections on each unit can be used to read the signals of analog inputs and outputs. There are built in isolated digital I/O and RS485 serial ports to interface with other hardware. There is a connection for an emergency abort button. Floating power design reduces ground loop problems in the controller installation.

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◆ Summary of Hardware Specifications

Analog Inputs	8 BNC connectors per Spider-81 module. Spider-81 and Spider-80 units can be networked to form up to 1024 inputs; charge, voltage or IEPE, single-ended or differential, AC or DC coupling, 130 dB dynamic range, 24 bit A/D converters, range ±20 volts, up to 102.4 kHz fs per channel
Analog Outputs	2 BNC connectors per unit, 100 dB dynamic range, 24 bit A/D converters. ±10 volts
Channel Phase Match	Better than ±1.0 degree up to 20 kHz among all channels
Peripherals	8 isolated DIO; 10 monitoring channels, LCD display with navigation buttons, RS-485, ground connection, abort contact switch, start and abort buttons
Dimensions	440 x 66 x 330 mm (WxHxD)
Weight	4.2 kg
Power	Up to 18 watts during operation. Powered from external DC power or internal backup battery source
PC Connections	100base-T, RJ-45 female connector supports connection to PC or network switch
Internal Memory	Flash memory for data storage: 4 GB per unit

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