

SPIDER-81

HARDWARE SPECIFICATIONS (VERSION 4.2)



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APPLICABLE HARDWARE VERSION

This document applies to hardware version 7.4 of the Spider-81 and the Spider-81B. Hardware with version 7.3 or lower may have reduced functions and/or performance.

INTRODUCTION

The Spider-81 series 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, the Spider-81 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 a large number of channels to be configured without sacrificing system performance.

LATEST HARDWARE DESIGN

The Spider-81 hardware 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 are used to read signals of analog input and output. The front panel has intuitive function buttons. There is a built-in isolated digital I/O to interface with other hardware.

SIMPLE NETWORK CONNECTION

Ethernet connectivity allows the Spider-81 to be located far from the host PC. This distributed structure greatly reduces noise and electrical interference in the system. One PC monitors and controls 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, a PC connects easily to the Spider-81 remotely via Wi-Fi.

TIME SYNCHRONIZATION BETWEEN MULTIPLE HARDWARE MODULES

The Spider-81 is built on IEEE 1588 PTP time synchronization technology (PTP-Precision Time Protocol). Spider-81 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 act as one integrated system.

BLACK BOX MODE: OPERATE WITHOUT PC

The Spider-81 in Black Box mode enables operation 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 completed. During the test, the controller operates according to a preset schedule or from a connected iPad. Black Box mode is included with every Spider-81/81B.

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

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 is instantly viewed on the LCD.

DESIGNED FOR HIGH RELIABILITY

The 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. All Spider-81 hardware passes 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. A power-backup circuitry based on super-capacitor is installed to prevent the unexpected power loss.

DESIGNED FOR HIGH ACCURACY

Using a patented dual parallel A/D design, the Spider-81 is the first vibration control system that achieves 150 dBFS input dynamic range. Each measurement channel can detect signals as small as 6 μ V 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 graphical guidance, wizards, and tools are available to simplify setup. The interface has been reformatted to be more intuitive. 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 supported by more than 150 companies in the test and measurement industry. The 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 the Spider-81 are all governed by the ASAM standard. The Spider-81 data is read by the software of LMS, Bruel & Kjaer, BBM, and many other providers.

INTEGRATED WITH DYNAMIC SIGNAL ANALYSIS AND DATA RECORDING

The 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 work together to form one integrated system. Long waveform data recording is a built-in function.

IPAD CONTROL

The iPad app is available from the Apple App Store. The software runs on the iPad and accesses the Spider-81 hardware when operating in 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, TWR, and RSTD testing bundles.

SPIDER-81, 16-INPUT VERSION

The Spider-81 16-input version is designed to be a compact system. It integrates two Spider-81 modules and a switch. However, the system cannot be expanded beyond 16 inputs and does not support Black Box mode or Spider-NAS.

HARDWARE SPECIFICATIONS | ANALOG INPUT CHANNELS

Input Channels per Spider-81 Front-End: 4 – 8 or 16

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 4.2 mA

Charge Input: 10,000 pC and 49,000 pC

Input Range: ± 20 Vpk

Input Impedance: 500 k Ω

Input Protection Voltage: ± 40 Vpk

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 filters (user programmable)

Input Dynamic Range: 150 dBFS

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: ± 20 Vpk

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-bits

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: $\pm 1\%$ (0.34 dB) at 1 kHz for 0.1 Vpk to 5 Vpk

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 VDC ($\pm 10\%$)

External Circuit Power Supply: 3.3 – 12 VDC ($\pm 10\%$)
Internal Power: 3.3 VDC 350 mA, 12 VDC 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 k Ω
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 VDC max, output current 100 mA per channel max

Residual Voltage with Output On: 1.0 V or less (Output current < 100 mA)
Pulse Width: 47 ms
Rise Time: 250 μ s
Fall Time: 50 μ s

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 VDC max, 25 mA per channel max

HIGH SPEED DATA PORT INTERFACING TO SPIDER-NAS

Not available on Spider-81B, Spider-81 16-input

Connector Type: 5-pin LEMO
Maximum distance of Cable: 2 meters
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 the Spider-NAS at rate of 102.4kHz per channel)

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-81 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 at 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 VAC (47 – 440 Hz), DC power 15 V ($\pm 10\%$)

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)

Spider-81, 16-input, Dimension: 440 x 104 x 291 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

APPENDIX 1: SPIDER-81 AND SPIDER-81B COMPARISON

	Spider-81	Spider-81B	Spider-81 (16-Channel)
Number of Input Channels	4, 6, 8 and expandable	2, 4	16 not-expandable
Number of Output Channels	2	1	2
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	Charge TEDS IEPE AC-Differential DC-Differential AC-Single End DC-Single End
Digital I/O	8 in/out, isolated	4 in/out, isolated	8 in/out, isolated
Backup Super Capacitor	Yes	Yes	Yes
Available Software Bundles	Silver, Gold	Bronze, Silver, Gold	Silver, Gold
Front Panel LCD	Yes	No	Yes
High Speed Data Port for direct recording to Spider-NAS	Yes	No	No
Analog Monitor Channels	Yes	No	Yes

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 switch 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 is either wired or wireless.

PC TETHERED WITH ONE SPIDER FRONT-END

One Spider-81 is 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.

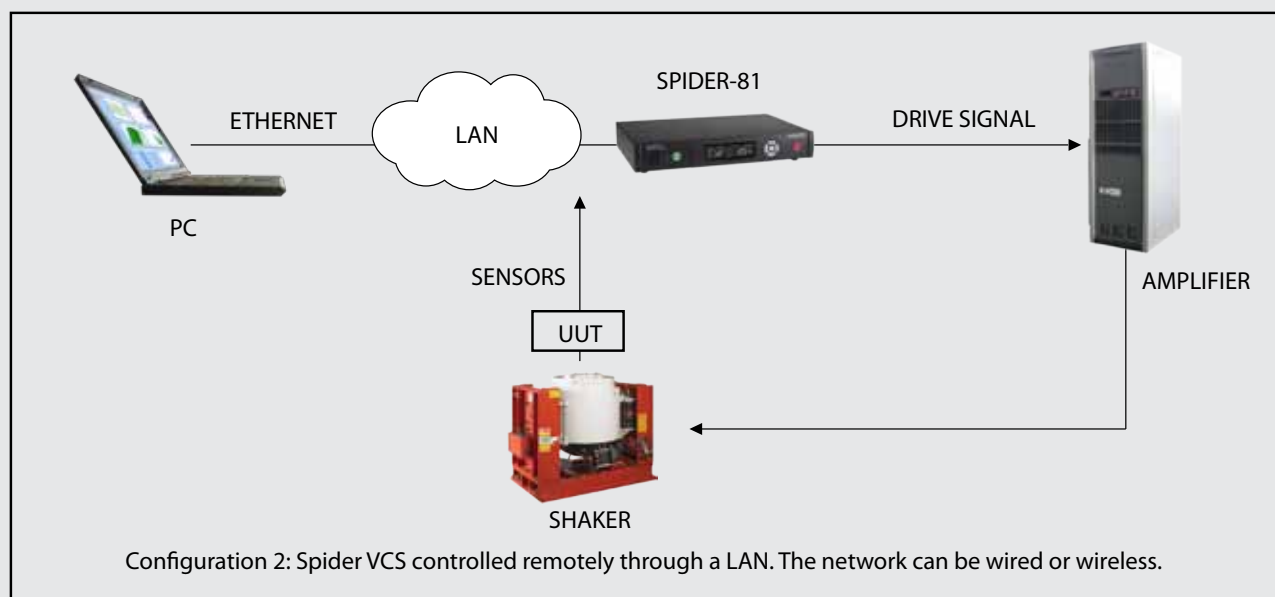
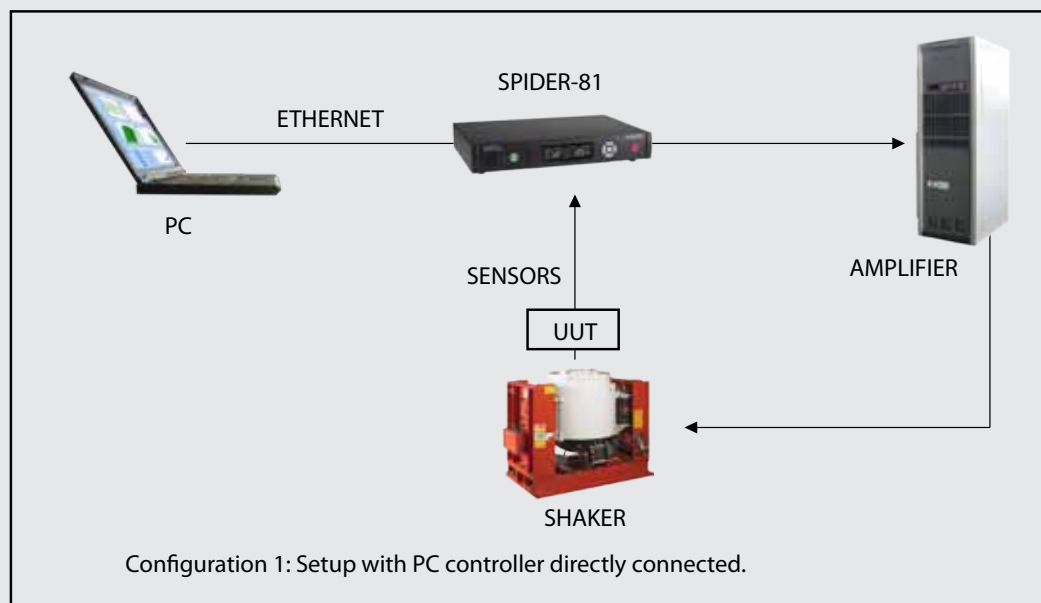
PC TETHERED WITH MULTIPLE SPIDER FRONT-ENDS

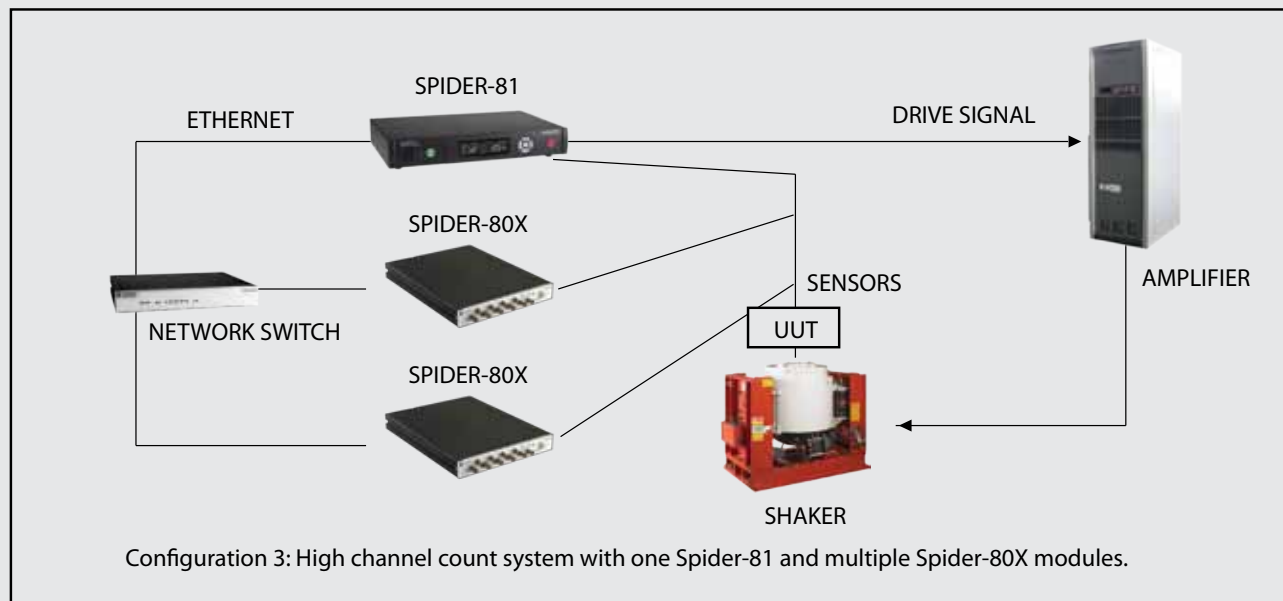
Multiple Spider modules are connected to form a high channel count system. Multiple switches are cascaded to extend the number of modules. For example, to make a 64 channel system, a Spider-81 and 7 Spider-80X's are used. The PC is used as a control and monitoring terminal via the EDM software.

BLACK BOX MODE WITH ONE SPIDER FRONT-END

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.

The figures below illustrate some of the many configurations that are possible with the Spider system:





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