

SPIDER-80SG

General Data Acquisition Device with Strain Gage Measurement

Spider Measurement Solution



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Introducing the Spider-80SG

Spider-80SG Modular Strain Gage Measurement System

The Spider-80SG is a high precision, general purpose data acquisition device featuring strain gage functionality. This device can be used in a variety of physical and measurement tests. The Spider-80SG can acquire data from a strain gage or a wide range of measurement quantities. A variety of general purpose and strain gage based sensors are supported. The Spider-80SG is built on the proven outstanding performance and reliability of Crystal Instruments' DSP-based hardware platform. It features the same form factor as other Spider-80X front-ends from Crystal Instruments and can be configured into one measurement system with excellent compatibility and scalability. This gives the Spider-80SG capabilities to reliably acquire data from multiple sensors and for multiple measurement quantities simultaneously.

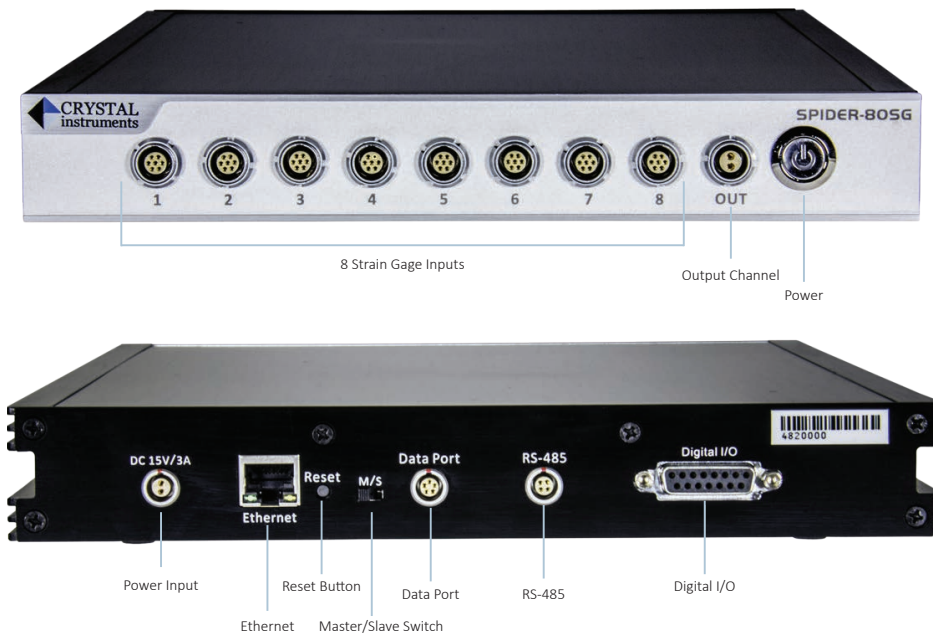
The Spider-80SG front-end connects to the network switch of a PC using an Ethernet connection. When used with a strain gage, it measures the strain based on arriving signals, measuring the changes in resistance when the strain gauge is stretched or compressed. It can also be used to measure Force, Torque, Pressure, Acceleration,

Velocity and Displacement. The Spider-80SG can be configured to output an excitation voltage to power up the sensors and measure a range of measurement quantities.

Pluggable front-ends provide the system with maximum flexibility of analog channel configuration, making it ideal for a range of measurement tests under various circumstances. The modular design allows configurations with 8 input channels of isolated analog inputs and one analog output.

With Crystal Instruments' unique Ethernet based time synchronization technology, multiple Spider-80SG front-ends can be chained together to construct a system with higher number of input channels. High channel systems scale up to 512 channels.

Each Spider-80SG front-end has its own mass storage media that houses the operating software and stores measurement data. This truly distributed system guarantees data recording at full speed without being subject to network speed limitations.



Product Applications

Dual Modes of Excitation

The Spider-80SG is equipped with dual excitation modes. There is an option for Precision Excitation Voltage of $\pm 2.5V$ or $\pm 5V$ that can be used to excite a strain gage or a strain gage based sensor and measure the minute change in resistance accurately. It is also equipped with a user configurable DC power supply of 2.5V, 5V and 10V which can be used as an excitation voltage for a wide variety of sensors.

Remote Sensing

The Spider-80SG has been tested to work on strain gages up to 1000 ft away from the analyzer using the remote sensing feature. Using an 18AWG 5 conductor cable to measure the excitation voltage using remote sensing and changes in output voltage, the error was measured to be less than 1.5% for up to signal frequencies of 10 KHz.

Use with Vibration Controller

The Spider-80SG's compatibility allows it to be chained together with Spider-80X front-end(s), extending the capabilities of the Spider-80SG to read and record general purpose measurements simultaneously while performing a vibration control test.

High Performance Hardware Capability

Since all the processing and data recording is executed locally inside the Spider-80SG, the front-end can be located far from the host PC and

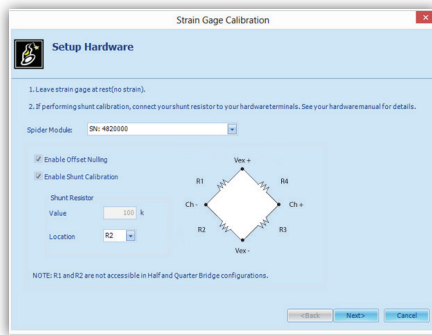
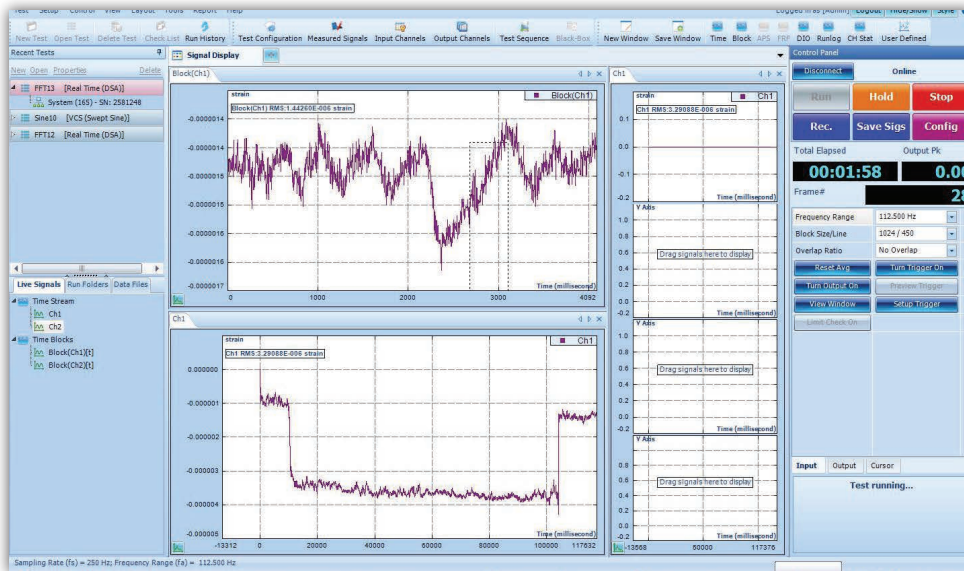
closer to the test article. This flexibility in location prevents the measurement results from being affected by the network connection limitations and other environmental errors. This decentralized and distributed structure greatly reduces the noise and electrical interference in the system. One PC can monitor and control multiple Spider-80SG front-ends over the network. With wireless network routers, the PC can easily connect to the Spider-80SG remotely via Wi-Fi.

Multiple Front-ends & Time Synchronization

The Spider-80SG is built on IEEE 1588 time synchronization technology. The Spider-80SG front-ends on the same network can be synchronized with up to 50 ns accuracy, which guarantees ± 1 degree cross channel phase match up to 20 KHz. With such unique technology and high-speed Ethernet data transfer capability, the distributed components on the network truly act as one integrated system.

Black Box Mode: Run without PC

The Spider-80SG can operate in Black Box mode, which allows the measurements to take place without a PC. In this mode, a PC is used only to configure the Spider-80SG system before the system starts operating and to download data after the test is complete. During the test, the system can operate according to a preset schedule or is controlled from a variety of external devices, such as a tablet or iPad.



On/Off	Location ID	Measurement Quantity	Bridge Type	Poisson Ratio	Gage Factor	Excitation Voltage (V)	Input Range	Shunt Resistance (Ω)	Nominal Gage Resistance (Ω)
On	CH1	Strain	Full	0	2.08	2.5	Full	100000	120
On	CH2	Strain	Full	0	2.08	2.5	Full	100000	120
On	CH3	Strain	Full	0	2.08	2.5	Full	100000	120
On	CH4	Strain	Full	0	2.08	2.5	Full	100000	120
On	CH5	Strain	Full	0	2.08	2.5	Full	100000	120
On	CH6	Strain	Full	0	2.08	2.5	Full	100000	120
On	CH7	Strain	Full	0	2.08	2.5	Full	100000	120
On	CH8	Strain	Full	0	2.08	2.5	Full	100000	120

Spider-80SG Features Overview

8 Strain Gage / General Purpose Inputs Per Front-end

24-bit ADC Channel

Supports Multiple Measurement Quantities

Supports a Variety of Strain Gages, Load Cells, Pressure Transducers, Torque Sensors, Accelerometers and Geophones

User Selectable Excitation Voltage

User Configurable Synchronized Sampling Rate

Remote sensing: Measures strain accurately from up to 1000 ft cable length with up to 10 KHz frequency.

Remote Sensing

Precision Excitation Voltage of $\pm 2.5V$ and $\pm 5V$

Power Supply Voltage of 2.5V, 5V and 10V for Sensor Excitation

Shunt Calibration

Offset Nulling for any Measurement Quantity

Multiple Trigger Modes

Compact, Portable Design

Scale up to 512 channels using Multiple Front-ends



Hardware Specifications

Measurement Channel Specifications

- Input Channels: 8 channels per front-end, expandable to 512 channels in a system
- Connector Type: 7-pin LEMO
- Coupling: DC Differential, AC Differential
- Excitation Voltage / Power Supply: 2.5V, 5V, 10V
- AC Coupling Cutoff Freq. @ -3dB: 0.375Hz
- Input Type: Differential
- Input Impedance: 1M Ω
- A/D Resolution: 24 bit
- Input Protection Voltage: +/-40Vpk
- Input Range: $\pm 10\text{mV}$, $\pm 100\text{mV}$, $\pm 10\text{V}$
- Sampling Rate per Channel: 0.48 Hz to 102.4 kHz, with 54 stages
- Maximum Useful Bandwidth: 46% of sampling rate
- Crosstalk: less than -130 dB
- Frequency Accuracy: better than 1/100,000
- Amplitude Accuracy: 0.1% typical
- Amplitude Accuracy (Extended Cable Length): Less than 1.5% (up to 10 KHz), cable length up to 1000 ft (18AWG)
- Noise Floor: 0.5 $\mu\text{V/V}$ (10mV Range)
- DC Drift: 1.5 $\mu\text{V/V}$ in 48 Hours
- Anti-Aliasing Filter: analog anti-aliasing filters
- Max Sampling rate: 102.4 kHz
- Digital Filter: digital high-pass and low-pass filters
- Total THD + Noise: -90dBfs (DC to 1 kHz)
- Amplitude Channel Match: 0.1dB
- Phase Channel Match: better than 0.3 degrees up to 20 kHz
- Common Mode Range: 100% input range
- Common Mode Rejection: better than 85 dB
- Shunt Calibration: Internal 100K Ω (0.1%, 25 ppm/c)
- Excitation Sense: local sensing and remote sensing

Strain functions:

- Quarter-120, Quarter-350
- Half bridge
- Full bridge

Bridge Completion:

- 120 Ω : 0.1%, 25 ppm/c
- Back Half resistor: 120 Ω /120 Ω , 0.1% 25 ppm/c

Excitation Voltage for Strain Gauge

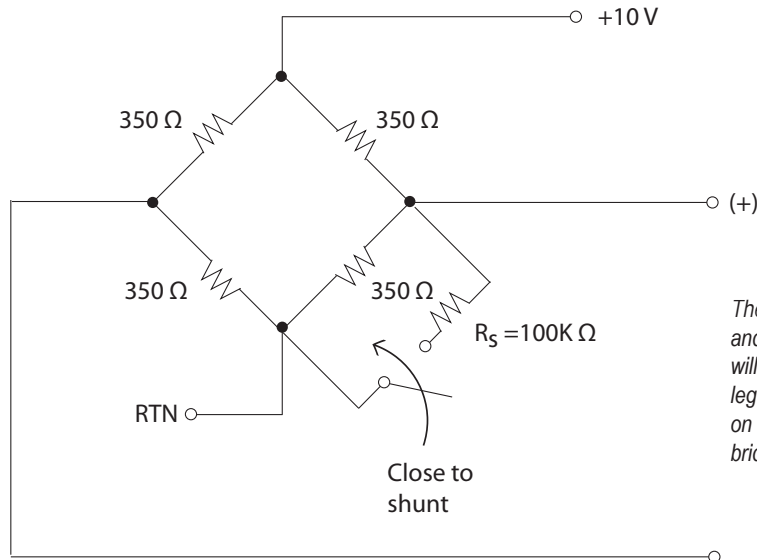
- $\pm 2.5\text{V}$, $\pm 5\text{V}$
- Current: 30mA max/channel

Zero Suppression/Auto Balancing/Offset Nulling

Power Supply (Excitation Voltage for other kind of sensors): 2.5V, 5V, 10 V

Output Channel Specifications

- Channels: 1 output channel per front-end
- Configuration: Output for voltage calibration
- Connector Type: 2-pin LEMO
- D/A Resolution: 24 bit
- Max Output Frequency: 46 kHz
- Dynamic Range: 100 dB
- Output Impedance: 50 Ω
- Maximum Output Current: 25 mA
- Sine Amplitude Accuracy: $\pm 1\%$ (0.34 dB) for 0.1 to 5 Vpk, at 1 kHz
- Anti-Imaging Filtering: 160 dB/oct digital plus analog filters
- Digital Filter: high-pass and low-pass digital filters
- Source Waveforms: sine, triangle, square, white noise, DC, chirp, swept sine, arbitrary waveform
- Arbitrary Waveform Size Limit: 16,000 points typical. Special configuration allows up to 128,000 points.
- Output Range: ± 10 Volts



The Spider-80SG features an easy-to-use and flexible Shunt calibration wizard. This will allow the user to select any available leg of the strain gage bridge, depending on the bridge type (i.e. quarter, half, full bridge,) for shunt calibration.

Isolated Digital Input and Output

- Connector: 25-pin female D-SUB
- External Circuit Power Supply: 3.3 – 12 VDC ($\pm 10\%$)
- Internal Power: 12 VDC 400 mA
- Maximum Allowable Distance of Signal Extension: 50 meters

Inputs

- Input Format: opto-isolated input (compatible with current-sink output)
- Number of 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)
- Number of 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

High Speed Data Port interfacing to Spider-NAS

- Connector Type: 5-pin LEMO
- Maximum distance of cable: 2 meters
- Data Transfer Speed: Higher than 819.2 K Sample/second

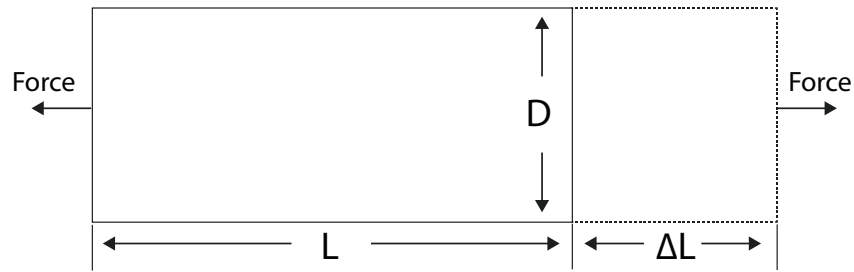
System Specifications

- On-Board Memory: 4 GB non-volatile flash memory, 32 MB DRAM
- Power Management: active and sleep mode
- Ethernet: 100Base-T, RJ45 female connector supports connection to PC or network switch
- Internal Clock: maintains date and time
- System Disaster Recovery: dedicated reset pin. Watch-dog based recovery can be enabled.
- Cooling: no cooling fan required

Network Protocols & IEEE 1588 Time Synchronization

Multiple Spider front-ends are synchronized through IEEE 1588 protocol. The synchronization accuracy is better than ± 50 ns with a certified network switch. The data acquired by all the measurement channels will be synchronized. The phase match between channels across different Spider-Strain front-ends 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



$$\epsilon = \frac{\Delta L}{L}$$

Poisson Ratio Parameter

The Poisson ratio is also included as a measurement parameter in Spider-80SG system. The user will have the option of using a Poisson ratio value, or to not use it at all depending on the unit under test or test configurations.

Power Specifications

- Power Supply: external DC power
- External DC Power: AC adaptor accepts 100 to 240 VAC (50/60 Hz), DC power 15 V ($\pm 10\%$)/3 A
- Power Consumption: less than 15 watts

Environmental & General Specifications

Enclosure: sealed metal box, electrical safety compliant, rugged metal design, shock proof with integrated protective holster and internal EMI shielding.

- Size : 240 x 35 x 310 mm (w x h x l)
- Weight: 1.87 kg
- Electromagnetic Compatibility and Sensitivity: EN 61326:1997+A1:1998+A2:2001, EN61000-3-2: 2000, EN61000-3-3: 1995+A1:2001
- Operating Temperature:-10 to +55 °C
- Storage Temperature -20 to +70 °C
- Shock: 50 g's, 315 in/sec, tested at 6 sides, non-operational test
- Vibration: 5 - 500 Hz, 0.3 gRMS, tested at 3 sides, operational test
- Vibration: 5 - 500 Hz, 2.42 gRMS, tested at 3 sides, non-operational test

Compatible Measurement Quantities & Suggested Sensors

Multiple sensors of various measurement quantities are supported with the Spider-80SG. The following list gives an overview of measurement quantities with sample sensors that are supported. The actual list of compatible sensors contains much more than specified here.

- Acceleration – Dytran 7603B, 7503, 7523A2,

Endevco 7264C, Kistler Type 8395A, DTS 6DX PRO Series

- Force – Omega LCM 901, Futek FFP350
- Torque – Omega TQ-130 Series, Futek TDD400, Futek TRS300, Futek TAT200, TAT420
- Pressure – Omega PX309 series, Measurement Spec EB100, Futek PMP927
- Angular Velocity – DTS ARS Pro-300, ARS Pro-1500, ARS Pro-8K, ARS Pro-18k
- Displacement – Omega E2E-3DC Series
- Magnetic Field – Analog Devices AD22151
- Sound Pressure – InvenSense ICS40618
- Strain – Configurable as Quarter, Half or Full Bridge

Hardware/Software Compatibility Specifications

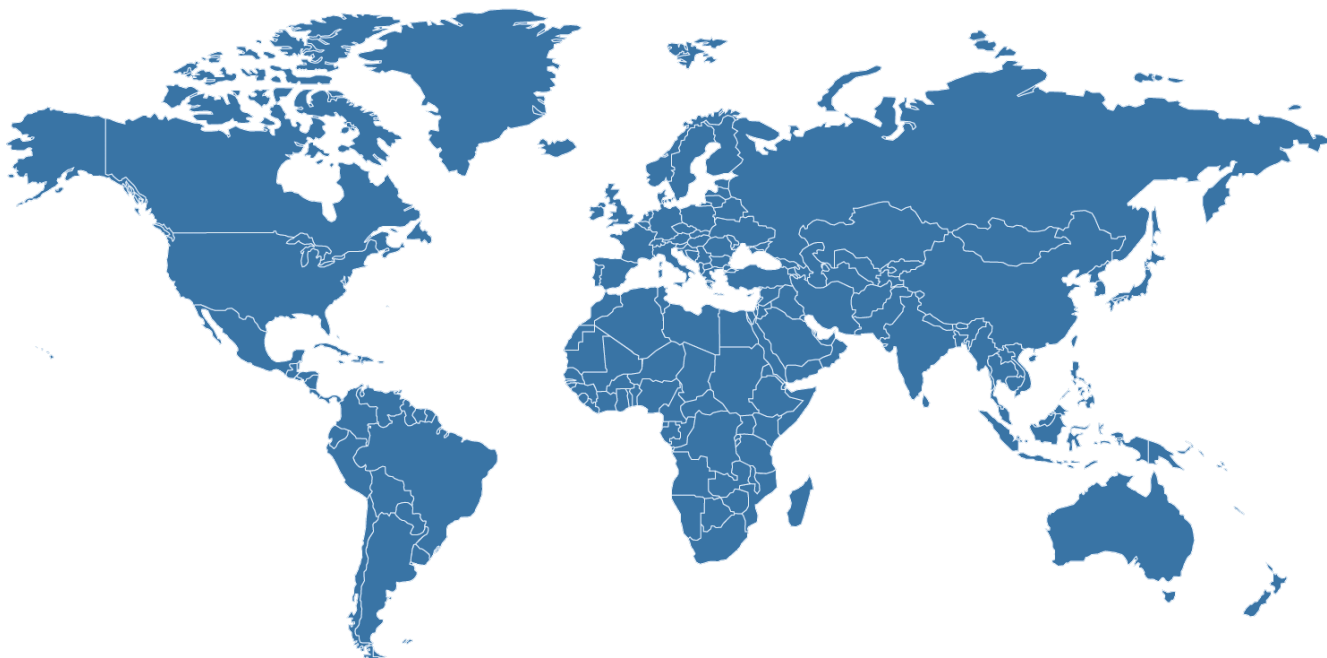
The Spider-80SG can be used with the following devices:

1. Spider-80X
2. Spider-81
3. Spider-NAS
4. Spider-HUB

Modes of Operation:

1. Standalone mode as a General Purpose Data acquisition device
2. In conjunction with Spider-80X for General purpose Data Acquisition
3. In conjunction with Spider-80X for general data acquisition during vibration control.

For further software specifications related to the Spider-80SG, please refer to the EDM DSA or EDM VCS specification documents by Crystal Instruments.



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CRYSTAL INSTRUMENTS

2370 OWEN STREET
SANTA CLARA, CA 95054 (USA)

PHONE: +1-408-986-8880
FAX: +1-408-834-7818

EMAIL: INFO@GO-CI.COM
WWW.CRYSTALINSTRUMENTS.COM

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