Spider Front-End Hardware Specifications for Spider-80Xi Platform:
Spider-80Hi, Spider-80Ci, Spider-80SGi and Spider-80Ti

Patented technology allows each measurement channel to detect signals as small as 6 µV and as large as ±20 V.

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INTRODUCTION

The Spider-80Xi is a compact hardware platform that hosts a combination of front-end modules including the Spider-80Hi, Spider-80Ci, Spider-80SGi and Spider-80Ti front-ends to facilitate the measurement of various physical quantities. The efficient design of the Spider-80Xi chassis eliminates individual enclosures for each modular card to minimize the overall dimensions of the system. Its light weight makes it ideal for applications requiring portability and an efficient size without the need to exchange cards during operation.

The Spider-80Xi system provides two different chassis configurations: a large version hosts up to 8 front-end cards and a smaller version hosts up to 4 front-end cards. Each front-end card consists of 8 channels. Users can create a synchronized high channel count system with several types of inputs by combining Spider-80Hi, Spider-80SGi or Spider-80Ti front-end cards.

Multiple chassis can chain together to form a system with up to 1024 channels, all sampled simultaneously. Multiple Spider front-ends are accurately synchronized through the IEEE 1588v2 protocol, which ensures all measurement channels are on the same time base. Accurate time synchronization results in excellent phase match in the frequency domain between all channels, either on the same Spider front-end or across different front-ends. Channel phase match, even between separate Spider front-ends, is within 1.0 degree at 20 kHz which is suitable for high quality structural and acoustics applications requiring cross channel measurement.

The Spider-80Xi system with the 8 front-end slot chassis is powered by AC power, 100 to 240 VAC . The Spider-80Xi system with the 4 front-end slot chassis is powered by DC power, 12 – 30 VDC. The latter is easily used together with an external battery pack. With Spider-Battery, a special model of battery developed by Crystal Instruments, the 4 slot Spider-80Xi can run up to 4 hours without interruption.

The input channels of the Spider-80Hi front-ends are equipped with an IEPE power source to power IEPE sensors in addition to a standard voltage input which makes it ideal for shock, vibration, acoustic, or general purpose voltage measurements. For the charge input, users can select the Spider-80Ci. Spider-80SGi front-ends are designed for measuring strain using precision excitation and general purpose measurement quantities with a customizable power supply. The Spider-80Ti adds a temperature measurement capability to the Spider-80Xi system. The Spider product line performance is the best in class with the highest dynamic range of any similar product. With patented technology, each measurement channel can detect signals as small as 6 μV and as large as ±20 V. Proprietary hardware technology delivers more than 160 dBFS dynamic range. The extremely high dynamic range eliminates the need for multiple front-end gain settings.

The Spider-80Xi system is equipped with powerful and flexible data acquisition functions. Continuous time data recording up to 256 kHz and spectral analysis can be initiated by many events including user operation, pre-set run schedule, alarm limit trigger, input trigger or digital input trigger. A high-performance removable 2.5-inch hard disk is used as a storage media inside the Spider-80Xi. The default capacity of hard disk is 250 GB, which is expandable up to 2 TB. When recorded, data will be written in the NTFS file format. Data is extracted from the hard disk using Crystal Instruments PC software to transfer data to the PC, or the hard disk can be physically removed and connected to another PC.

SPIDER-80HI FRONT-END SPECIFICATIONS (S80HI – P08)

Input Channel Specifications

- **Input Channels:** 8 channels per front-end
- **Max Input Channels:** 1024
- **Connector Type:** BNC
- **TEDS:** IEEE 1451.4 compliant
- **Coupling:** AC, DC, IEPE (ICP®)
- **IEPE Power:** 4.2 mA at 21 V
- **Input Type:** differential or single-ended
- **Input Range:** +/- 20 V
- **Input Range Selection:** auto, ±20 V, ±5 V, ±0.2 V
- **Input Impedance:** 444 kΩ for differential; 222 kΩ for single-End
- **Input Protection Voltage:** ±220 V
- **AC Coupling:** analog high-pass filter (-3 dB @ 0.375 Hz; -0.1 dB @ 2.45 Hz)
- **A/D Resolutions:** 2 x 24-bit (patented dual A/D technology per input channel)
- **Anti-Aliasing Filter:** analog anti-aliasing filters plus digital decimation technique
- **Digital Filter:** high-pass filters (user programmable)
- **Dynamic Range:** 160 dBFS
- **Sampling Rate:** 0.48 Hz to 256 kHz, with 58 stages
- **Maximum Bandwidth:** 115.2 kHz
- **Continuous Data Recording Speed:** up to 256 kHz/ channel
- **THD:**
  - -90 dB at 1 kHz, 17.83 V (-1 dBFS)
  - -96 dB at 1 kHz, 5 V (-12 dBFS)
- **Amplitude Accuracy (1 kHz, 1 V):** ± 0.04 dB
- **Amplitude Channel Match (1 kHz, 1 V):** < 0.04 dB

- **Channel Phase Match:** better than ±1.0 degree, up to 20 kHz
- **Crosstalk:** less than -100 dB
- **Frequency Accuracy:** ±25 ppm (typically ±0.025 Hz margin at 1 kHz)
- **Common Mode Range:** ±20 V
- **Common Mode Rejection:** better than 70 dB (typical)
- **LED Indicator:** displays the status of each channel in red or green

Tachometer Input Specifications

- **Number of Tachometers:** 2
- **Connector Type:** BNC
- **Configuration:** software configures the port as either output or tacho input
- **Input Voltage Range of Rotating Pulses:** zero to ±10 V
- **Sampling Rate:** up to 256 kHz, synchronized with input channels
- **Maximum RPM:** 300,000
- **Tacho channel 1** can be used for both pulse counting and order tracking measurement.
- **Tacho channel 2** has 50 MHz ultra-high counter resolution and is only used for pulse counting.

Output Channel Specifications

- **Channels:** 2 channels
- **Connector Type:** BNC
- **D/A Resolution:** 24-bits
- **Maximum Output Sampling Rate:** 102.4 kHz, synchronized with input channels
- **Dynamic Range:** 120 dB
- **Output Impedance:** 50 Ω
- **Maximum Output Current:** 250 mA
- **Amplitude Accuracy:**
  - ±0.2 dB at 1 kHz for 200 μV to 10 V
  - ±1.0 dB at 1 kHz for 10 μV to 200 μV
- **Anti-Imaging Filtering:** 160 dB/oct digital plus analog filters
- **Source Waveforms:** sine, triangle, square, white noise, pink 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 V

SPIDER-80CI FRONT-END SPECIFICATIONS (S80CI – P08)

Input Channel Specifications

- **Input Channels:** 8 channels per front-end
- **Maximum Input Channels:** 1024
- **Connector Type:** BNC
- **TEDS:** IEEE 1451.4 compliant
- **Coupling:** AC, DC, charge and IEPE (ICP®)
- **IEPE Power:** 4.2 mA at 21 V
- **Input Type:** single-ended
- **Input Range:** +/- 20 V
- **Input Range Selection:** auto, ±20 V, ±5 V, ±0.2 V
- **Input Impedance (Voltage Mode):** 222 kΩ
- **Charge Input Range:** 1,000 pC and 10,000 pC
- **Input Impedance (Charge Mode):** 100 MΩ
- **Input Protection Voltage:** ±220 V
- **AC Coupling:** analog high-pass filter (-3 dB @ 0.375 Hz; -0.1 dB @ 2.45 Hz)
- **A/D Resolutions:** 2 x 24-bit (patented dual A/D technology per input channel)
- **Anti-Aliasing Filter:** analog anti-aliasing filters plus digital decimation technique
- **Digital Filter:** high-pass filters (user programmable)
- **Dynamic Range:** 160 dBFS
- **Sampling Rate:** 0.48 Hz to 256 kHz, with 58 stages
- **Maximum Bandwidth:** 115.2 kHz
- **Continuous Data Recording Speed:** up to 256 kHz/ channel
- **THD:** -90 dB at 1 kHz, 5 V
- **Amplitude Accuracy (1 kHz, 1 V):** ±0.04 dB
- **Amplitude Channel Match (1 kHz, 1 V):** < 0.04 dB
- **Channel Phase Match:** < ±1.0 degree up to 20 kHz
- **Crosstalk:** less than -100 dB
- **Frequency Accuracy:** ±25 ppm (typically ±0.025 Hz margin at 1 kHz)
- **Common Mode Range:** ±20 V
- **Common Mode Rejection:** better than 70 dB (typical)
- **LED Indicator:** displays the status of each channel in red or green

Tachometer Input Specifications

- **Number of Tachometers:** 2
- **Connector Type:** BNC
- **Configuration:** software configures the port as either output or tacho input

- **Input Voltage Range of Rotating Pulses:** zero to ±10 V
- **Sampling Rate:** up to 256 kHz, synchronized with input channels
- **Maximum RPM:** 300,000
- **Tacho Channel 1 (Analog Input Channel)** can be used for both pulse counting and order tracking measurement.
- **Tacho Channel 2 (has 50 MHz ultra-high counter resolution)** can be used for both pulse counting and order tracking measurement.

Output Channel Specifications

- **Channels:** 2 channels
- **Connector Type:** BNC
- **D/A Resolution:** 24-bit
- **Maximum Output Sampling Rate:** 102.4 kHz, synchronized with input channels
- **Dynamic Range:** 120 dB
- **Output Impedance:** 50 Ω
- **Maximum Output Current:** 250 mA
- **Amplitude Accuracy:**
  - ±0.2 dB at 1 kHz for 200 μV to 10 V
  - ±1.0 dB at 1 kHz for 10 μV to 200 μV
- **Anti-Imaging Filtering:** 160 dB/oct digital plus analog filters
- **Source Waveforms:** sine, triangle, square, white noise, pink 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 V

SPIDER-80SGI FRONT-END SPECIFICATIONS (S80SGI – P08)

Measurement Channel Specifications

- **Input Channels:** 8 channels per front-end
- **Maximum Input Channels:** 1024
- **Connector Type:** 14-pin LEMO
- **Coupling:** DC Differential, AC Differential and IEPE (ICP®)
- **Excitation Voltage/Power Supply:** +2.5 V, +5 V, 10 V
- **AC Coupling Cutoff Freq. @ -3dB:** 0.375 Hz
- **Input Impedance:** 1 MΩ
- **A/D Resolution:** 24-bit
- **Input Protection Voltage:** ±40 V
- **Input Range:** ±10 mV, ±100 mV, ±1V, ±10 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 -100 dB
- **Frequency Accuracy:** ±25 ppm (typically ±0.025 Hz margin at 1 kHz)
- **Amplitude Accuracy:** 0.1% typical
- **Amplitude Accuracy (Extended Cable Length):** less than 1.5% (up to 10 kHz), cable length up to 1000 ft (18 AWG)
- **Noise Floor:** 0.5 μV/V (10 mV Range)
- **DC Drift:** 1.5 μV/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
- **THD:** -90 dBFS (DC to 1 kHz)
- **Amplitude Channel Match:** < 0.1 dB
- **Phase Channel Match:** better than 0.3 degrees up to 20 kHz
- **Common Mode Range:** 100% input range
- **Common Mode Rejection:** better than 90 dB (typical)
- **Shunt Calibration:** internal 100 kΩ (0.05%, 10 ppm/°C)
- **Excitation Sense:** local sensing and remote sensing

Strain Gage Functions:

- **120Ω, 350Ω Quarter Bridges (Type I,II, 3 – Wire Quarter Bridge)**
- **Half bridge (Type I,II)**
- **Full bridge (Type I,II)**
- **Bridge Completion:** 120 Ω - 0.05%, 5 ppm/°C, 350 Ω: 0.1%, 25 ppm/°C
- **Back Half Resistor:** 120 Ω - 0.05%, 5 ppm/°C, 350 Ω: 0.1%, 25 ppm/°C
- **Excitation Voltage for Strain Gauge:** ±2.5 V, ±5 V
- **Current:** 30 mA max/channel
- **Zero Suppression/Auto Balancing/Offset Nulling**
- **Power Supply (excitation voltage for other kind of sensors):** 2.5 V, 5 V, 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
- **Maximum Output Sampling Rate:** 102.4 kHz, synchronized with input channels
- **Dynamic Range:** 120 dB

- **Output Impedance:** 50 Ω
- **Maximum Output Current:** 25 mA
- **Sine Amplitude Accuracy:**
  - ±0.2 dB at 1 kHz for 200 µV to 10 V
  - ±1.0 dB at 1 kHz for 10 µV to 200 µV
- **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, pink 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 V

SPIDER-80TI FRONT-END SPECIFICATIONS (S80TI – P08)

Temperature Input Channel

RTDs:

- **Number of Input Channels:** 16 channels per front-end (Expandable up to 1024 channels)
- **Connector Type:** six pins Pluggable Terminal Blocks (Each block connects two input channels)
- **ADC:** 24-Bit Sigma - Delta
- **Temperature Measurement Range:** -200°C to 850°C (-328°F to 1562°F)
- **Resistance Measurement Range:** 0 to 400 Ohm
- **RTD Excitation Current Source:** 10 µA to 1.5 mA programable source
- **Operating Temperature:** -10°C to 55°C (14°F to 131°F)
- **Normal-mode Rejection Ratio (50/60 Hz):** 105 dB
- **Common Mode Rejection Ratio (CMRR):** 115 dB
- **Differential Input Impedance:** 2 MΩ
- **Channel-to-COM:** ±3 V
- **Sampling Rate:** 0.3125, 0.625, 1.25, 2.5 S/sec (user selectable)
- **Average Number and Mode:** selectable moving linear average from 1 – 128

Thermocouples:

- **Number of Input Channels:** 16 channels per front-end (Expandable up to 1024 channels)
- **Connector Type:** six pins Pluggable Terminal Blocks (Each block connects two input channels)
- **ADC:** 24-Bit sigma – delta
- **Temperature Measurement Range:** -250°C to 1350°C (-454°F to 2462°F)
- **Voltage Measurement Range:** ±80 mV
- **Operating Temperature:** -10°C to 55°C (14°F to 131°F)
- **Cold Junction Compensation Accuracy:**
  - +/- 0.25°C (0°C to 70°C)
  - +/- 0.75°C (-40°C to 70°C)
- **Normal Mode Rejection Ratio (50/60 Hz):** 105 dB
- **Common Mode Rejection Ratio (CMRR):** 115 dB
- **Differential Input Impedance:** 2 MΩ
- **Channel-to-COM:** ±3 V
- **Sampling Rate:** 0.3125, 0.625, 1.25, 2.5 S/sec (user selectable)
- **Average Number and Mode:** selectable moving linear average from 1 – 128

SPIDER-80XI CHASSIS SPECIFICATIONS (S80XI-A35-8N/S80XI-A35-4N)

Input Channels

- **Number of Input Channels per Chassis:** 16, 24, 32, 48, 56 or 64 when ordered with S80Xi-A35-8N, the 8 slot chassis; 16, 24, 32 when ordered with S80Xi-A35-4N, the 4 slot chassis. This is only factory configurable.
- **Maximum Number of Input Channels in a Complete System:** 1024

Isolated Digital Input and Output

Total 4 bits digital channels that can be configurable by the software to either input or output type.

- **Connector:** 9-pin female D-SUB
- **External Circuit Power Supply:** 12 V_{DC} (±10%)
- **Internal Power:** 12 V_{DC} 400 mA
- **Maximum Allowable Distance of Signal Extension:** 50 meters

Digital Inputs

- **Input Format:** opto-isolated input (compatible with current-sink output)
- **Number of Channels:** 2
- **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).

Digital Outputs

- **Output Format:** opto-isolated input (current sink output)
- **Number of Channels:** 2

- **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)
- **Pulse Width:** 47 ms
- **Rise Time:** 250 µs
- **Fall Time:** 50 µs

Mass Storage

A high-performance removable Serial ATA (SATA) 2.5-inch hard disk is used as storage media. When recorded, data will be written in NTFS file format. Data is extracted from the Spider-NAS using Crystal Instruments software to transfer data to the PC. Alternatively, the SATA hard disk can be physically removed and connected to extract data to the PC.

When the system is shipped, it includes an internally installed solid-state hard drive with a 250 GB capacity that can expand up to 2 TB. The solid-state drive performs very well in the high shock and vibration environment. A special error-checking algorithm developed by Crystal Instruments detects and avoids any errors that may occur during data transfer and storage.

Time Synchronization

Through the Ethernet connection, multiple Spider-80Xi front-ends can synchronize through the IEEE 1588v2 protocol. The synchronization accuracy is better than ±100 ns when the Spider-HUB switch is used. The data acquired by all the measurement channels will be on the same time base. Phase match between channels across different Spider front-ends is within 1.0 degree at 20 kHz.

Environmental and General Specifications

- **Ethernet:** RJ 45 connector
- **Digital Input and Output:** 2 digital inputs and 2 digital outputs
- **Hard Buttons:** Power, Fan On/Off, Start measurement, Stop measurement
- **LCD Display:** display the IP address, connection status and input status of the system
- **LCD:** 128 x 64 dot; monochrome; display size: 61 x 31.3 mm.
- **Cooling Fan:** manually controlled
- **Grounding:** 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
- **Hardware Abort:** hardware Abort 2 pin port is provided which can be connected to a switch to force turn off the output of the front-end.
- **Connector Type:** 2-pin LEMO
- **Safety Standard:** electromagnetic compatibility and sensitivity: EN 61326:1997+A1:1998+A2:2001, EN61000-3-2: 2000, EN61000-3-3: 1995+A1:2001
- **Operational 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_{rms}, tested at 3 sides, operational test
- **Vibration:** 5 – 500 Hz, 2.42 g_{rms}, tested at 3 sides, non-operational test

8 SLOT CHASSIS (S80XI-A35-8N)

- **Enclosure:** rugged sealed metal box, electrical safety compliant, and internal EMI shielding
- **Power Supply:** 100 – 240 V_{AC} (50 / 60 Hz),
- **Power Consumption:** less than 90 W when 64 channels are configured
- **Ethernet:** 1000BASE-T Ethernet. RJ45 connector
- **Size:** 278.4 X 257 X 304 mm (W x H x L)
- **Total Weight:** 12.06 kg when 64 channels configured
- **The 8-slot chassis supports:**
  - 8 Spider-80Xi/SGi/Ti front-ends
  - Spider-NASi for mass storage
  - Spider-HUBi for communication and time sync

4 SLOT CHASSIS (S80XI-A35-4N)

- **Enclosure:** rugged sealed metal box, electrical safety compliant, and internal EMI shielding
- **Power Supply:** 12 – 30 V_{DC}
- **Power Consumption:** less than 50 W when 32 channels are configured
- **Ethernet:** 1000BASE-T Ethernet. RJ45 connector
- **Size:** 193.8 X 257 X 304 mm (W x H x L)
- **Total Weight:** 8.2 kg when 32 channels configured
- **Battery Hours:** 4 hours with Spider-Battery provided
- **The 4-slot chassis supports:**
  - 4 Spider-80Xi/SGi/Ti front-ends
  - Spider-NASi for mass storage
  - Spider-HUBi for communication and time sync

SOFTWARE APPLICATIONS FOR SPIDER-80XI PLATFORM

- EDM Vibration Controller (VCS) Mode Software (PC-based)
- EDM Dynamic Signal Analyzer (DSA) Mode Software (PC-based)
- EDM – Modal (experimental Modal Analysis) (PC-based)
- EDM Remote Condition Monitoring Software (PC-based) (DSA-40)
- EDM – Time Data Acquisition (PC-based) (TDA-10)
- Post Analyzer (PC-based post processing software)
- EDM Cloud support (Cloud based Monitoring)
- LabVIEW Driver
- Python API (Cross platform utility)
- EDM App - DSA mode in iOS (DSA-37) (iPad-based)

HARDWARE PART NUMBERS

Part Number	Short Description
S80Hi-P08	Spider-80Hi front-end card: 8 Inputs
S80SGi-P08	Spider-80SGi front-end card: 8 Inputs
S80Ti-P08	Spider-80Ti front-end card: 16 Inputs
S80Xi-A35-4N	4-slot chassis with HUB and NAS
S80Xi-A35-8N	8-slot chassis with HUB and NAS

PC Requirements for EDM Software

- **Operating System Support:** Windows 7 or higher
- **Operating System Type:** 32-bit or 64-bit
- **Minimum Processor Speed:** 1.5 GHz Dual-Core x86
- **Minimum RAM:** 8 GB
- **Minimum Free Disk Space:** 10 GB

THE FRONT-ENDS OF THE SPIDER-80XI AND SPIDER-80M PLATFORM					
Front-end Types	**Spider-80Xi**	**Spider-80Hi**	**Spider-80Ci**	**Spider-80SGi**	**Spider-80Ti**
Max Sampling Rate	102.4 kHz	256 kHz	256 kHz	102.4 kHz	2 kHz
Number of Inputs Per Front-end	8	8	8	8	16
Connector Type	BNC	BNC	BNC	LEMO	3-pin screwed terminal
Input Type	IEPE Voltage TEDS	IEPE Voltage TEDS	IEPE Voltage TEDS Charge Inputs	Voltage strain gage Strain gage-based sensors MEMS DC-based sensors	3-wire RTD K type thermocouple
Input Coupling	AC Differential DC Differential AC Single-ended DC Single-ended	AC Differential DC Differential AC Single-ended DC Single-ended	AC Differential DC Differential AC Single-ended DC Single-ended	AC Differential DC Differential	-------
Sensor Excitation	4.2 mA at 21 V for IEPE	4.2 mA at 21 V for IEPE	4.2 mA at 21 V for IEPE	2.5 V, 5 V, 10 V	-------
Strain Gage Type	-------	-------	-------	Quarter Bridge Type I, II Half Bridge Type I, II Full Bridge Type I, II Excitation voltage: ±2.5, ±5	
Max Input Range	±20 V	±20 V	±20 V	±10 V	-------
Input Protection Voltage	±220 V	±220 V	±220 V	±40 V	-------
Analog to Digital Converter Per Channel	Dual 24-bit ADC	Dual 24-bit ADC	Dual 24-bit ADC	24-bit ADC	-------
Cross Talk	< -100 dB	< -100 dB	< -100 dB	< -130 dB	-------
Amplitude Accuracy	±0.1% at 1 kHz 1 V	±0.1% at 1 kHz 1 V	±0.1% at 1 kHz 1 V	±0.1%	-------
Phase Match	< 1° up to 20 kHz	< 1° up to 20 kHz	< 1° up to 20 kHz	< 1° up to 20 kHz	-------

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