Front-End Hardware Specifications for Spider-80Xi Platform: Spider-80Hi

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CRYSTAL INSTRUMENTS

INTRODUCTION

The Spider-80Hi front-end, integrated into the Spider-80Xi platform, delivers a high sampling rate of up to 512 kHz, making it ideal for dynamic signal analysis and data acquisition. By incorporating the Spider-80Hi module into a Spider-80Xi chassis, users can build a portable and modular solution tailored to their specific needs. This advanced platform leverages state-of-the-art high-speed analog-to-digital converters, real-time digital signal processing, and intuitive software, enabling precise measurement of a wide range of physical parameters.

In 2025, the Spider-80Hi front-end underwent a major upgrade, enhancing its performance and expanding its capabilities to meet evolving demands.

The Spider-80Xi is a compact and versatile hardware platform designed to host various front-ends, including the Spider-80Hi, Spider-80Ci, Spider-80SGi, and Spider-80Ti. It is available in two chassis configurations: a large version accommodating up to eight front-end cards and a smaller version supporting up to four. The Spider-80Xi chassis is engineered for maximum efficiency, eliminating the need for separate enclosures for each modular card in an effort to reduce the system's overall size. Its lightweight and compact design make it an excellent choice for portable applications, while its modular nature ensures continuous operation without the need to swap cards.

Multiple Spider-80Xi chassis can be interconnected to create systems with up to 1024 channels, all sampled simultaneously. Precise synchronization between multiple Spider front-ends is achieved using the IEEE 1588v2 protocol, ensuring that all measurement channels share the same time base. This precise synchronization delivers exceptional phase matching across all channels, with a phase match accuracy of within 1.0 degree at 20 kHz.

The Spider-80Xi platform is available in two power configurations: the 8-slot chassis operates on AC power (100–240 VAC), while the 4-slot chassis is powered by DC power (12–30 VDC).

The Spider-80Hi input channels are equipped with an IEPE power source to support IEPE sensors, alongside standard voltage input functionality. This makes the Spider-80Hi particularly suited for applications such as shock, vibration, acoustic, or general-purpose voltage measurements. The Spider product line delivers best-in-class performance, boasting the highest dynamic range among similar products. Patented dual-ADC technology allows each channel to detect signals ranging from as small as sub-µV to as large as ±20 V. With a dynamic range exceeding 175 dBFS, the need for multiple front-end gain settings is eliminated.

The Spider-80Xi system offers robust and flexible data acquisition capabilities, including continuous time data recording at up to 512 kHz, shaker vibration control and spectral analysis. Data recording can be triggered by various events, such as user actions, preset schedules, alarm limits, input triggers, or digital input triggers. A high-performance, removable 2.5-inch hard disk serves as the primary storage medium, with a default capacity of 250 GB that can be expanded to 2 TB. This combination of advanced features ensures the Spider-80Xi system is a powerful and reliable solution for complex measurement and analysis tasks.

INPUT CHANNEL SPECIFICATIONS

Number of input channels	8		
Max number of input channels per system	1024		
Connector type	BNC		
TEDS (Transducer Electronic Data Sheet)	IEEE 1451.4 compliant		
Coupling	AC, DC, IEPE (ICP®)		
IEPE power	4.2 mA at 21 V		
Input type and impedance	Single-End: 222 kΩ Differential: 444 kΩ		
Input voltage protection	±220 V		
Input voltage range and dynamic range	**Channel Mode**	**Range**	
	Auto	±20 V	
	Full	±20 V	
	1/100 of Full	±200 mV	
Dynamic Range (dBFS)	Better than 175 dB		
Sampling rate (f_s)	0.48 Hz to 512 kHz with 81 stages		
Max Bandwidth*	230 kHz (0.45 f_s)		
Continuous data recording speed	up to 512 kHz per channel (3 channels) up to 204.8 kHz (all channels)		
Frequency accuracy of oscillator	8 PPM		
A/D resolution	2 x 24-bit dual Σ-Δ A/D converters		
AC coupling	-3 dB @ ~0.31 Hz & user programmable digital high-pass filters		
Spectral flatness	Better than -0.01 dB (0 – 10 kHz) -0.2 dB (0 Hz – 45 kHz)		
Alias-free bandwidth	DC to 0.45 f_s		
Alias rejection	> -110 dB		
Amplitude accuracy at 1 kHz, 1 V	<1%		
Amplitude linearity (-120 dBFs - -1 dBFs)	0.05 dB		
Channel-to-channel match	Gain match <0.04 dB Phase match @ 20 kHz <0.15° Phase match @ 46 kHz <0.30°		
THD (Total Harmonic Distortion - up to 10th harmonic)	-105 dB @ 1 kHz, -20 dBFS (2 V) -97 dB @ 8 kHz, -20 dBFS (2 V)		
Crosstalk	better than 120 dB		
Noise *Audio BW is defined as 20 Hz to 20 kHz.* *Full BW high frequency is 0.45 f_s. Lower frequency is 6.25 Hz (fs = 102.4 kHz) and 15.625 Hz (fs = 512 kHz).* *All noise specs are maximums, channel mode on Auto.*	**fs = 102.4 kHz**		**fs = 256 kHz**
	Audio BW	10 – 40 kHz	0 – 100 kHz
	3.51 µVrms	5.28 µVrms	31.0 µVrms
	23.9 nV/√Hz at 1 kHz		
DC offset	less than 1 mV		
Common mode range *Input Type = Differential, Range = Full*	±20 V		
Common mode rejection at 1 kHz	better than 120 dB		
LED indicators (one per channel)	displays channel status in off, green, or red		
Overload detection	LED indicators turn red when input is above 20 V or below -20 V		

**Spider-80Hi supports 512 kHz sampling on up to 3 channels and 256 kHz sampling on all 8 channels*

TIME SYNCHRONIZATION (BETWEEN MODULES)

Multiple Spider-80Hi front-ends synchronize according to the IEEE 1588v2 protocol through an Ethernet connection.

Supported technologies	IEEE 1588
Protocol	PTPv2
Phase match	Less than ±1° at 40 kHz
Synchronization accuracy	Better than 100 ns (When Spider-HUB is used)
Maximum distance	Up to 328 ft. (100 m) between front-end to Spider-HUB.
Supported modules	Spider-80Hi Spider-80X Spider-20HE

TIME STAMPING (CI'S PATENTED TECHNOLOGY)

Multiple Spider-80Hi front-ends can be run without any physical connection between them and cross-spectral calculations including FRF can be calculated between the modules using patented time stamping technology.

Time stamp sources	GPS (through GPS antenna), GPS (through Indoor GPS repeater), PTP Grandmaster Clock
Time stamp accuracy	Better than 100 ns
Phase match	Less than ±1° at 40 kHz
Maximum distance	No limitation
Supported modules*	Spider-80Hi Spider-80X Spider-81 Spider-20HE CoCo-80X GRS

**Spider-80Hi supports both GPS and PTP Grandmaster Clock, CoCo-80X and GRS supports GPS only, Spider-80X, Spider-81 and Spider-20HE supports PTP Grandmaster clock only.*

TACHOMETER CHANNEL SPECIFICATIONS

Number of tachometers	1
Connector type	BNC
Configuration	software configures the port as either output or tachometer input
Input voltage range of rotating pulses	±10 V
Tachometer 1 – Pulse Counting & Order Tracking	
Sampling rate	up to 512 kHz (synched with analog input channels)
Frequency accuracy	0.1% at 1 kHz
Maximum RPM	100,000

OUTPUT CHANNEL SPECIFICATIONS

Number of channels	2
Connector type	BNC
Coupling	DC
D/A resolution	24-bit
Dynamic range (voltage range)	145 dB (±10 µV to ±10 V)
Output impedance	50 Ω
DC offset (DC value set to 0 V in EDM)	< 1 mV
Output voltage range (DC)	±10 V
Max output current	250 mA
Max output sampling rate	512 kHz, synchronized with input channels
Frequency range	0 to 230 kHz
Spectral flatness	-1.5 dB max at 45 kHz
Phase resolution *Smallest possible increment in EDM software*	0.1 degrees
Phase deviation between channels	< 0.5 degrees
Amplitude precision @ 1 kHz, 1 V	±0.04 dB
Amplitude accuracy @ 1 kHz	±0.04 dB, 200 µV to 10 V (-94 dBFS to 0 dBFS) ±0.2 dB, 10 µV to 200 µV (-120 dBFS to -94 dBFS)
DC Amplitude accuracy	0.01 dB at 10 V
Anti-imaging and reconstruction filter	160 dB/octave digital plus 3rd order analog filter
Total Harmonic distortion	97 dB @ 1 kHz, 1 V (-26 dBFs) 94 dB @ 8 kHz, 1 V (-26 dBFs)
Crosstalk *Between outputs and any input with 50 Ω short*	better than 132 dB
Classical waveforms	Sine, Triangle, Square, White Noise, Pink Noise, DC, Chirp, Swept Sine, Arbitrary Waveform, Playback Waveform
Arbitrary waveform size limit	16,000 points typical. Special configuration allows up to 128,000 points.
Playback waveform size limit	up to available memory on internal storage

INTERNAL STORAGE

Internal storage capacity	4 GB
Type of storage	non removable secure digital card

**Each Spider front-end is equipped with a 4GB internal memory. A Spider chassis with 8 modules provides a total of 32 GB of internal memory.*

GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) RECEIVER (GPS) (IF EQUIPPED)

Type	Global navigation satellite system (GNSS) Non-removable Integrated Receiver module
Supported satellite systems	GPS, BeiDou, GLONASS and Galileo
Time accuracy	Better than 100 ns
Antenna type	1575 MHz with SMA-M connector
Maximum length of antenna cable	150 ft

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 the 8-slot chassis; 16, 24, 32 when ordered with the 4-slot chassis. Only factory configurable.
- **Maximum number of input channels in a complete system:** 1024

Isolated Digital Input and Output

- **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 2.5-inch solid-state drive is used as an external storage media. When recorded, data will be written in the NTFS file format. Data is extracted from the Spider-NAS using EDM software to transfer data to a computer. Alternatively, the solid-state drive can be physically removed and connected to extract data to a computer.

The shipped system 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 in the data transfer and storage.

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:** displays 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:** automatically 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:** provided hardware abort 2-pin port can connect to a switch to force turn-off of a front-end output.
  - **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

- **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
- **GPS Connector:** SMA-F
- **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-80Hi/SGi/Ti front-ends
  - Spider-NASi for mass storage
  - Spider-HUBi for communication and time sync

4-SLOT CHASSIS

- **Enclosure:** rugged sealed metal box, electrical safety compliant, and internal EMI shielding
- **Power supply:** 12 – 30 V_{DC} (Includes power adapter for 100 – 240 V_{AC} (50/60 Hz) to DC)
- **Power consumption:** less than 50 W when 32 channels are configured
- **Ethernet:** 1000BASE-T Ethernet. RJ45 connector
- **GPS Connector:** SMA-F
- **Size:** 193.8 X 257 X 304 mm (W x H x L)
- **Total weight:** 8.2 kg when 32 channels configured
- **The 4-slot chassis supports:**
  - 4 Spider-80Hi/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 (computer-based)
- EDM Dynamic Signal Analyzer (DSA) Mode Software (computer-based)
- EDM Modal (Experimental Modal Analysis) (computer-based)
- EDM Remote Condition Monitoring Software (computer-based) (DSA-40)
- EDM Time Data Acquisition (computer-based) (TDA-10)
- Post Analyzer (computer-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

COMPUTER REQUIREMENTS FOR EDM SOFTWARE

- **Operating system support:** Windows 10 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

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