

# EX1403A

16-CHANNEL STRAIN/BRIDGE,  
OHMS/RTD, VOLTS DIGITIZER



## FEATURES

- 16-Channel Strain/Bridge, Ohms/RTD & Voltage Measurements
- 24-bit, delta-sigma ADC, simultaneous sampling
- Programmable Sample Rate up to 128kSPS
- Full, Half & Quarter Bridge with 120 $\Omega$ , 350 $\Omega$  & 1k $\Omega$  bridge completion
- Voltage Excitation: 0.5V to 10V
- Current Excitation: 0.46mA
- 2-Wire & 4-Wire Ohms/RTD
- Bridge Zero Balancing
- Built-In-Self-Test (BIST)
- Strain Lead Wire Calibration
- Shunt Calibration: 50k $\Omega$ , 100k $\Omega$  & External provided by User
- TEDS Support
- LXI Ethernet Interface
- IEEE-1588 Synchronization
- Power over Ethernet (PoE) or 10-50 V DC input
- Built-in Parallel Data Streaming
- Full-featured Embedded Web Interface
- Compact 1U Half-rack Form Factor

## Overview

The EX1403A Precision Bridge and Strain Gauge Instrument sets a new standard for strain and bridge measurements, delivering the highest performance measurements possible while controlling overall test hardware costs.

Sixteen channels of strain or voltage, independent 24-bit ADCs per channel, extensive software-selectable filtering, and independent signal conditioning paths deliver exceptional accuracy and reliability.

Built-in signal conditioning, programmable excitation, and selectable bridge completion, all integrated into the instrument and configurable on a per-channel basis, greatly simplify setup and configuration. With unmatched performance, accuracy and reliability, the EX1403A is the “go-to” solution for the most complex structural test applications worldwide.

A single system that can provide high-quality static or high-speed strain measurements:

- Airframe structural and fatigue test
- Rocket and satellite structural test
- Wind tunnel flight load test
- General purpose bridge measurements
- Load frame materials testing

## Scalable for High-Speed Synchronized Data Acquisition

In addition to its core set of features, the EX1403A integrates Extended Functions as defined in the LXI specifications to provide box-to-box synchronization to correlate acquired data precisely. Time-stamping of data and LAN Event Messaging that simplify intermodule communication and flexible triggering options over Ethernet; this eliminates the overhead normally attributed to application software running on the host controller.

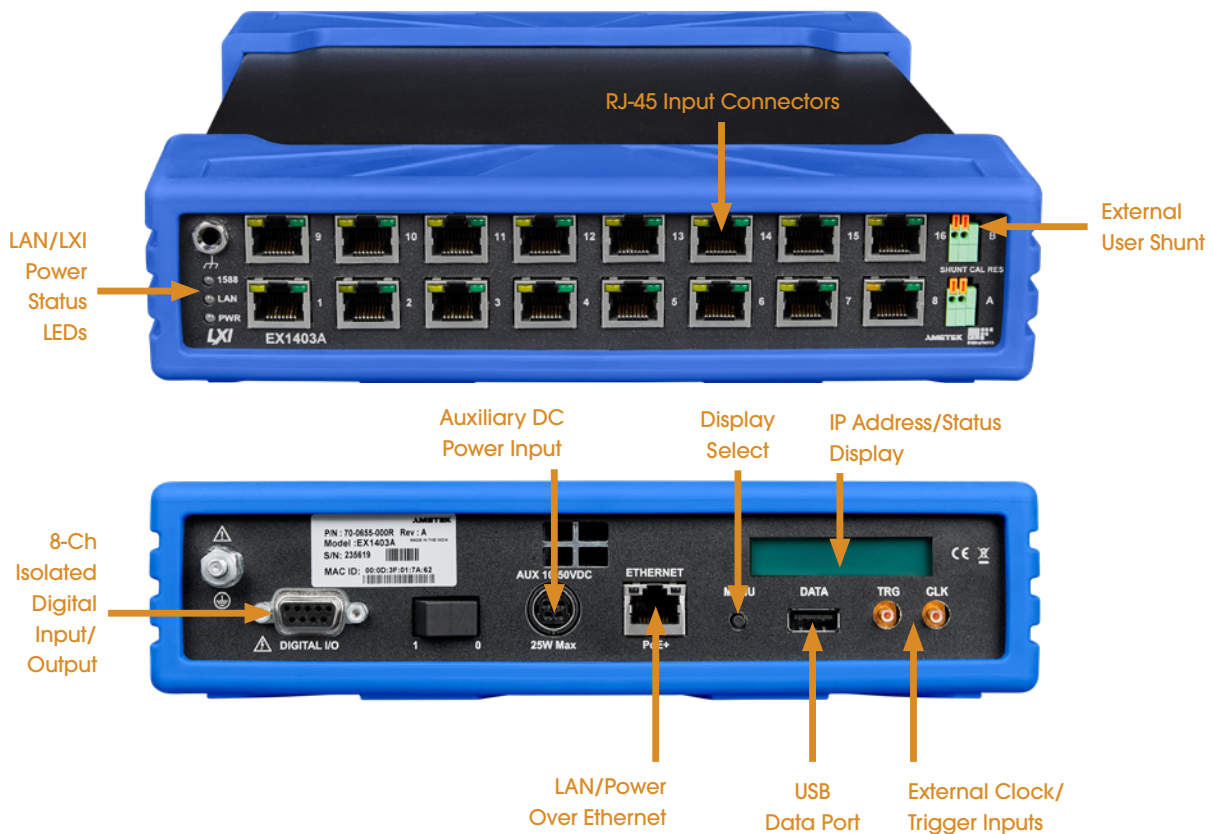
The EX1403A supports easy integration and synchronization of multiple devices through the IEEE-1588 v2 Precision Time Protocol standard for synchronization, providing an architecture that can be scaled from tens to thousands of channels. Multiple instruments can be easily distributed extremely close to the measurement points of interest, reducing the run length of analog cabling and minimizing errors induced by noisy environments.

Additionally, Power Over Ethernet (PoE) enables a single cable to be used for both power and data capture. All measurement data is returned with IEEE-1588 timestamp codes with typical accuracies of <200nS, ensuring that acquired data is tightly correlated across the test article.

## Confidence

Manufacturing and test environments of today are dynamic, dictating minimal downtime of test systems in order to meet increasing product throughput demands. Ensuring that acquired data is reliable and that instrument calibration can be turned around quickly are keys to the success of any production team. VTI embeds intelligence into the EX1403A to facilitate maximum system "uptime" and increase manufacturing efficiency.

Built-In-Self-Test (BIST), Self-CAL, Lead-Wire CAL, or Shunt CAL can be executed prior to a critical test to have confidence that digitizer and connections to transducers are OK.



## Connectivity

Created in 2004 and adopted by the test and measurement industry in 2005, LXI (LAN Extensions for Instrumentation) defines a core set of capabilities that ensure compliant devices interact consistently in an instrumentation network. As an LXI-certified device, the EX1403A provides the convenience of LAN communications and control with features such as an embedded web page for monitoring and control and a consistent means of identification on the network. Connect the device directly to your network using industry-standard cables with the assurance that it will be a trusted and proven "network citizen."

## Input Specifications

Parameter	Specification
No. of Channels	16 channels
Input Connector	RJ45 connector (8 wire), pinout compatible with EX1629
Input Type	Differential
Input Range	Volts: $\pm 10V$ , $\pm 1V$ , $\pm 0.1V$ Strain: $\sim \pm 40\mu\epsilon$ ; Range= $0.1V$ , Exc.= $5V$ , GF= $2$ Ohms: $20k\Omega$ , $2k\Omega$ , $200\Omega$
Accuracy (Tcal $\pm 3^\circ C$ )	Volts: 0.1V Range: $\pm ((0.10\%+53PPM/^\circ C) Rdng + 9\mu V + 1\mu V/^\circ C)$ 1V Range: $\pm ((0.10\%+63PPM/^\circ C) Rdng + 53\mu V + 5\mu V/^\circ C)$ 10V Range: $\pm ((0.10\%+28PPM/^\circ C) Rdng + 442\mu V + 50\mu V/^\circ C)$ Strain (Range= $0.1V$ , VExc= $5V$ , GF= $2$ , 100SPS): $\frac{1}{4}$ Bridge $120\Omega$ : $\pm ((0.10\%+53PPM/^\circ C) Rdng + 15\mu\epsilon + 14\mu\epsilon/^\circ C)$ $\frac{1}{2}$ & $\frac{1}{4}$ Bridge $350\Omega$ & $1k\Omega$ : $\pm ((0.10\%+53PPM/^\circ C) Rdng + 15\mu\epsilon + 6\mu\epsilon/^\circ C)$ Full Bridge: $\pm ((0.10\%+53PPM/^\circ C) Rdng + 2\mu\epsilon + 0.5\mu\epsilon/^\circ C)$ Note: excluding errors from lead wire resistance. Excitation to be applied to gage for >30min before zero balancing bridge (measure Vunstrained) 2/4Wire-Ohms & RTD( $\Omega$ ): $\pm ((0.05\%+60PPM/^\circ C) Rdng + (0.01\%+0.001\%/^\circ C) Rng)$
Maximum Input, no damage	$\pm 12V$ . ESD protected to $\pm 10kV$
Input Ground Isolation	No channel to channel Ground Isolation
Input Coupling	DC
Input Impedance	>100 M $\Omega$ each input to ground
Slew Rate: 10% to 90% FS	30 V/ $\mu s$ Typical
Common Mode Rejection	-120dB Typical, <100 Hz   -100dB Typical, 100Hz - 1kHz   -90dB Typical, 1kHz - 10kHz
Channel-to-Channel Crosstalk	-120dB Typical, <1kHz: Overdriving 1 channel does not affect performance of other channels
Bridge Zero Balance	Software nulling: Excitation to be applied to strain gage for >30min before zero balancing bridge to ensure gage & completion resistors have thermally stabilized
Bridge Types	Full, Half ( $\frac{1}{2}$ ), Quarter ( $\frac{1}{4}$ )
Bridge Completion	$\frac{1}{4}$ Bridge Completion Software Selectable: OFF, $120\Omega$ , $350\Omega$ , $1000\Omega$ Accuracy: 0.1% $\pm 5$ ppm/ $^\circ C$ typical Bridge completion resistance measured within $\pm 0.05\%$ and stored in memory for use during internal shunt calibration $\frac{1}{2}$ Bridge Completion: 10k-10k thin film resistor network, 0.1% $\pm 2$ ppm/ $^\circ C$ Typical

## Self Calibration & Self-Test (BIST)

Strain Shunt Calibration	Unit can shunt the strain gage RG or the internal $\frac{1}{4}$ bridge completion with either an internal 50k $\Omega$ or 100k $\Omega$ (12PPM/ $^\circ C$ measured with 0.05% accuracy and stored in memory) or an external resistor connected on the front panel provided by the user. Unit can compute a gain correction factor that compensates for errors due to lead wire, excitation, internal gain errors, and temperature.
Strain Lead Wire Calibration	Unit can measure lead wire resistance and verify connections to the gage are ok. The unit can compute a gain correction factor that compensates for errors due to lead wire.
Built-In Self-Test (BIST)	Unit verifies that all internal critical voltages are within specified limits: power source (POE vs. AUX), power supply voltages, calibration reference voltages, excitation voltages, calibration date, internal PCB temperature, fan speed.



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### Excitation Specifications

Channel-to-Channel Isolation	All channels share the same ground. Each channel provides separate excitation circuitry
Voltage Excitation	<p>Software Selectable per channel: +0.5V, +1V, +2V, +5V, +10V with Sense lines            Measured with <math>\pm 0.05\%</math> accuracy and saved in memory to convert voltage to strain units  <math>\pm 10</math> ppm/<math>^{\circ}</math>C for +5V &amp; +10V; <math>\pm 30</math> ppm/<math>^{\circ}</math>C for +0.5V, +1V &amp; +2V; <math>\pm 50</math>ppm/year            Current Limit: 35mA            Load regulation: &lt;0.05% for load change &lt; 32mA            Crosstalk: &lt;0.03% effect on other channels from load changes            Noise: 20 <math>\mu</math>V RMS Typical, 50kHz bandwidth            Excitation Sensing: Max. Voltage at <math>\pm</math>P: 11V            Voltage Excitation Monitoring: every ~1 second when all 16 channels enabled for dynamic excitation</p>
Current Excitation	<p>EX1403A: 0.46mA            Stability: <math>\pm 230</math> ppm/<math>^{\circ}</math>C <math>\pm 50</math>ppm/year            Measured with <math>\pm 0.05\%</math> accuracy and saved in memory to convert voltage to ohms units            Compliance Voltage: &gt;10V; Output Impedance: &gt;10M<math>\Omega</math></p>
Excitation Protection	<p>Protected if driven by external voltage source: -0.3V to +12V            Crosstalk: A short does not affect Excitation accuracy in other channels <math>\pm 10</math>kV ESD protection</p>

### Analog-to-Digital Converter (ADC)

ADC	24-bit, delta-sigma ( $\Delta\Sigma$ ) simultaneous sampling
ADC Data Rate (SPS) (f <sub>DATA</sub> )	Programmable up to 128kSPS with filtered Decimation from 128k, 102.4k, 100k, 78.125k, 65.536k, 64k, 51.2k, 50k, 39.0625k, 32.768k & 19.53125k SPS. Additional up to 65536 unfiltered (blind) decimation Accuracy: $\pm 100$ PPM
ADC Digital Filter Passband ( $\pm 0.05\%$ ripple)	$0.417 * f_{DATA}$
ADC -3dB Bandwidth	$0.424 * f_{DATA}$
Group Delay	$39 / f_{DATA}$
Settling Time (Latency)	$78 / f_{DATA}$

### TEDS (Transducer Electronic Data Sheet)

Protocol	MicroLAN
Baud Rate	9600 Baud (default)
Electrical Specifications	5V
Driver type	Maxim Integrated DS2480B
Capacitance Loading (1-Wire input)	<2000pF

### Engineering Units (EU) Conversion

Unit can convert raw ADC counts to Engineering Units (EU): Volts, Ohms ( $\Omega$ ), Strain ( $\epsilon$ ). Linearization formulas are used for  $\frac{1}{4}$  bridge and Half/Full bridge with Poisson effect. User can provide linear scaling factors (gain & offset) to convert to EU any other transducer type, i.e. volts to pressure or force, Ohms to temperature  $^{\circ}$ C or  $^{\circ}$ F

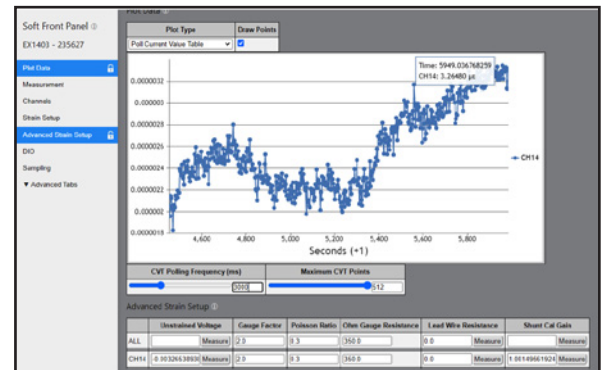


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## Software and Drivers

Built-in GUI available via a standard Web Browser.

Enabled	Function	Range	Offset	Mode	Record Size	Transducer Conversion	Auto Cal	Current Value
ALL	Strain	0.0	Auto Zero	Differential	1024	0.1	Auto Cal	
CH01	Strain	1V	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH02	Strain	10V	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH03	Strain	100mV	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH04	Strain	100mV	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH05	Strain	100mV	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH06	Strain	100mV	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH07	Strain	100mV	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH08	Strain	100mV	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH09	Resistance	10k	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH10	Resistance	100k	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH11	Strain	100mV	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH12	Strain	100mV	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH13	Strain	100mV	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH14	Unbridge	100mV	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH15	Unbridge	1V	0.0	Auto Zero	Differential	1024	0.1	Auto Cal
CH16	Unbridge	10V	0.0	Auto Zero	Differential	1024	0.1	Auto Cal



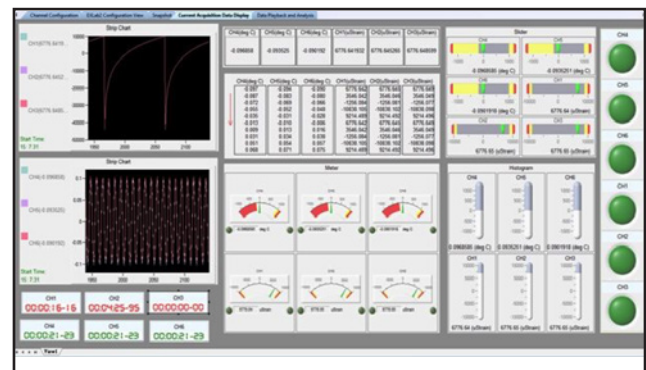
Driver support for operation in Windows, Linux, MATLAB and LabVIEW.



## EXlab Turnkey Solution

- Easy to use spreadsheet configuration
- Flexible real-time data displays
- Data can be viewed and exported in a number of data formats
- Provides extended features such as "snapshot," calculated channels and Rosette support, event handling and alarms
- Multiple configurations and options

Chan	Chan Name	Chan Type	Chan Range	Chan Offset	Chan Mode	Chan Record Size	Chan Transducer Conversion	Chan Auto Cal	Chan Current Value
1	CH01	Strain	1V	0.0	Differential	1024	0.1	Auto Cal	
2	CH02	Strain	10V	0.0	Differential	1024	0.1	Auto Cal	
3	CH03	Strain	100mV	0.0	Differential	1024	0.1	Auto Cal	
4	CH04	Strain	100mV	0.0	Differential	1024	0.1	Auto Cal	
5	CH05	Strain	100mV	0.0	Differential	1024	0.1	Auto Cal	
6	CH06	Strain	100mV	0.0	Differential	1024	0.1	Auto Cal	
7	CH07	Strain	100mV	0.0	Differential	1024	0.1	Auto Cal	
8	CH08	Strain	100mV	0.0	Differential	1024	0.1	Auto Cal	
9	CH09	Resistance	10k	0.0	Differential	1024	0.1	Auto Cal	
10	CH10	Resistance	100k	0.0	Differential	1024	0.1	Auto Cal	
11	CH11	Strain	100mV	0.0	Differential	1024	0.1	Auto Cal	
12	CH12	Strain	100mV	0.0	Differential	1024	0.1	Auto Cal	
13	CH13	Strain	100mV	0.0	Differential	1024	0.1	Auto Cal	
14	CH14	Unbridge	100mV	0.0	Differential	1024	0.1	Auto Cal	
15	CH15	Unbridge	1V	0.0	Differential	1024	0.1	Auto Cal	
16	CH16	Unbridge	10V	0.0	Differential	1024	0.1	Auto Cal	



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### Trigger Input/Output Specifications

Trigger Input	Maximum Input Voltage: -0.5V to 5V, ESD protected VIL: < 0.5V; VIH: > 2.5V
Trigger Input Impedance	Signal is pulled high by a 4.7k Ohm resistor
Minimum Trigger Input Pulse Width Detection	1 $\mu$ s
Trigger Output Swing	0V to 5V
Output Pulse Width for trigger event	1 $\mu$ s
Output Drive	Can drive 50 Ohm coax. Source series termination for 50 Ohms

### Clock Input/Output Specifications

Output Swing	0V to 3V
Duty Cycle	40% to 60%
Frequency	10 MHz phase locked to the ADC sample rate
Enable/Disable	Software control

### Network / Data Port

Connection	10/100 Base-T (auto MDI-X)
Connector	RJ-45
USB Interface	USB 2.0 high speed (480Mbps)
Connector	USB type A

### Power

POE+	IEEE 802.3at
Auxiliary Power	+12VDC to +50VDC The auxiliary power source supplies the power even if PoE power is already present. The unit may reboot if auxiliary power is applied after it had already been powered from a POE+ compliant PSE
Max. Input Power Requirements	25 Watt (includes 5W maximum to bridge transducer)
Power Input Protection	Reverse polarity protection
Power Control	The unit can identify if the unit is operating from a POE+ type 2 PSE or from AUX power, and whether power is good.
Ripple to Meet All Specs	<1% pk-pk



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### Environmental

Temperature	Operating Temperature: 0°C to +50°C Storage Temperature: -40°C to +80°C MIL-PRF-28800 Class 3
Relative Humidity, non-condensing	Operating: 10%-90% Storage: 5% to 95% MIL-PRF-28800 Class 3
Vibration & Shock	MIL-PRF-28800 Class 3
Altitude	4600M, MIL-PRF-28800 Class 3
CE Compliance	YES
MTBF	200k Operational Hours
Service Life	> 10 Years

### Physical

Dimensions	Half Rack 1U: 8.70" x 1.68" x 9.81"; 220.6mm x 42.7mm x 249.2mm
Weight	6.6 Lbs or 3kg
Material	Steel
Color	Powder Coating Black Texture Semi-Gloss

### Ordering Information

Model	Description
70-0655-100R	EX1403A, 16-Channel Strain/Bridge, Ohms/RTD Digitizer
56-0739-120R	EX14XX AC/DC Power Supply, 120W, PSE Certified
56-0739-000R	EX14XX AC/DC Power Supply 60W
70-0626-900R	EX14XX-RK001, Rack Mount Kit
41-0620-015R	EX14XX Rack Mount Filler Panel



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