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EX1629

High-performance Remote Strain Gage Measurement Unit



Overview

The VXI Technology EX1629 Remote Strain Gage Measurement Unit simplifies stress and fatigue testing of large mechanical structures such as airframes and launch vehicles. Ethernet control allows for remote operation and easy connection to the host computer.

- A single system that can provide high-quality static or high speed strain measurements in one unit
- Airframe structural and fatigue test
- Rocket and satellite structural test
- Wind tunnel flight load test
- General purpose bridge measurements

The VXI Technology EX1629 is designed to simplify stress and fatigue testing for groups that test large mechanical products. The design of the EX1629 allows for the highest performance measurements possible while keeping overall test hardware costs down. The EX1629 also provides internal self-calibration without having to disconnect from the device under test.

48 programmable channels in a single unit

High-density design techniques and high-quality components combine 48 channels of strain conditioning and excitation into a single 19-inch rackmount enclosure that is only 3 1/2 inches high. The design of the EX1629 allows for full system flexibility with all bridge completion and excitation changes done programmatically. No more need to re-configure hardware to make measurement changes.

10,000+ channels can be combined and measured in an EX1629 system

The EX1629 can operate independently, or for large data acquisition applications multiple EX1629s can be synchronized together via an external trigger bus. This design allows for numerous units to be controlled by a single host computer by utilizing a programmable master slave relationship. The trigger input includes a D-Sub connector which accepts TTL logic level input and has programmable trigger polarity.

There has never been a strain measurement solution as simple and elegant as the EX1629. Easy strain gage wiring and conditioning for both static load and vibration testing simplifies the test engineer's job.

Features

Stand-alone 48-channel unit with built-in Ethernet controller

Built-in bridge completion and Excitation

24-bit A/D per channel for high resolution data

Up to 25 kSa/s per channel data rates

Simple, low-cost wiring using RJ-45 telecom connectors

Supports open TEDS transducer standard

On-The-Fly confidence mode detects transducer wiring errors and flags questionable data as it occurs

Closed loop end-to-end self-calibration assures maximum accuracy over time and temperature

Basic calibration requires only a precision DMM

Multiple gain ranges per channel supports sensitive bridge transducers and high output voltage devices

Output data is available in voltage or engineering units

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Key Attributes

- High confidence measurement mode allows users to make critical measurements such as excitation voltage, excitation current, and common mode voltage in parallel with standard bridge measurements for improved performance
- 24-bit A/D per channel with selectable sample rate up to 25 kSa/s.
- Built-in programmable bridge excitation, providing 14-bit resolution, current limited to 50 mA per channel. Each channel is individually regulated. The positive and negative excitation voltage is independently programmed with ranges of 0 V to +8V and 0 V to -8 V, allowing the common mode excitation voltage to be shifted away from ground
- Built-in solid state 64 MB data buffer.
- Built-in DSP's used for limit checking, averaging, peak detection, signal analysis, and digital filtering
- On board tri-filar input transformers are also provided on each channel to provide superior high-frequency common mode noise rejection in the 1 kHz to 1 MHz range
- High Impedance Voltage Input mode to accommodate direct measurements such as string-pots
- Input Voltage Protection. Each input channel has appropriate protection to prevent excessive input voltage from affecting an adjacent channel. Each channel is also individually protected against shorts to ground, across the gage, or to another gage and will not cause lockup of other channels, or invalidate their readings
- High accuracy time stamping available
- User selectable lead wire resistance compensation
- Ability to save user setups in non-volatile memory, complete with the ability to auto-load a user defined configuration
- Full data throughput via built-in Ethernet Controller, 48 channels each sampling at up to 10 kSa/s readings/channel.
- Supports Transducer Electronic Data Sheet transducers (Open TEDS Standard)
- Built-in Digital I/O for handshake and control

Reduced Cost for Strain Gage Field Wiring

Extensive testing has resulted in the qualification of the standard RJ-45 telecom connector as the ideal low-cost connector for strain gages. Not only are these connectors reliable, but also low-cost construction of custom length cables is readily available. Re-configuration or replacement of strain gage connections is as easy as connecting a telephone. For static load testing, there is an additional benefit. The design of the EX1629 allows it to be placed close to the device under test in order to minimize wire lengths.

Get Results with High-level Programming

Programming the EX1629 is done through the built-in Ethernet controller, with Plug and Play Function calls similar to previous models from VXI Technology. This simplifies the programming task and greatly reduces development time. High-level commands also let users quickly configure the bridge, list the parameters of the strain gage, program the excitation voltage, and initiate a scan that produces measurement results in the correct engineering units. The programming language also can handle more difficult measurement and analysis situations. For example, users can write programs using unique constants for the mx+b linearization, or save raw bridge output voltages needed for post processing purposes.

Testing Flexibility

Tailoring a solution to the exact needs of the application is easy with the broad choice of available configurations in the EX1629. Users can select, under program control, the appropriate bridge completion circuitry on a per-channel basis: full, half, quarter-120 Ω, quarter-350 Ω, and quarter-user-specified configurations. Programmable DSP based low-pass filters let users control system noise on a per-channel basis. The built-in digital filtering of the EX1629 allows users to define filter type (Bessel or Butterworth), cutoff frequency and order. A fixed single pole analog 60 kHz filter provides alias free data. Each channel has programmable gain of 1, 10, or 100.

On-board Calibration Ensures Confidence

The EX1629 employs several techniques to ensure highly reliable and accurate measurements for the entire signal path. A 5-point internal calibration technique is used to reduce measurement uncertainty and provide improved accuracy for all system gains. Reference voltages of 14 V, 7 V, 0 V, -7 V, and -14 V are used to calibrate each channel. Each of these five voltages is then scaled by a factor of 0.1 and 0.01 to provide equivalent calibration points for the ±1.5 V and ±0.15 V input ranges. Gain errors are recorded in memory for measurement compensation at run time. To further minimize error, the offset in each channel is measured by the system, with the inputs to each amplifier grounded.

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The traditional shunt calibration process is also available to ensure reliable bridge performance. Users may program the EX1629 to select either the internal 55 kΩ shunt calibration resistor or an external user-selected resistor connected to the front-panel terminals.

Combined Conditioning for Static-load and Vibration Measurements

Each channel of the EX1629 provides a buffered analog output designed to provide wideband outputs for use with external high speed digitizers or recording equipment.

Specifications

General Functionality

Channels: 48 differential inputs

Functions (Strain): Quarter120, Quarter350, QuarterUser Halfbending, Halfpoisson, Fullbending, Fullpoisson, Fullbendingpoisson

Functions (Non-strain): Voltage, Ratiometric, Linear

Sampling Rate: 1 Sa/s to 25000 Sa/s per channel

A/D Converter: 24-bit ΔΣ converter per channel

Gains: 1, 10, or 100, software selectable

Network Connection: 10/100 Base-T Ethernet

Input Connector: RJ-45

Bridge Excitation

Regulation: Independent high side and low side control on a per channel basis

High Side Range: 0 to +8 V

Low Side Range: 0 to -8 V

Resolution: 14-bit (500 V)

Sense: Local or remote

Current Output: 50 mA per channel, short circuit limited to 60 mA

Bridge Completion

Resistor Values: 120Ω , 350Ω , and user, software selectable. User selectable value available as a factory installed option

Resistor Stability: 5 ppm/°C

Back Half Resistors: 10 kΩ /10 kΩ , 0.1%, 2 ppm/°C

Shunt Calibration

Internal Resistor: 55 kΩ , 0.1%, 25 ppm/°C per channel (0.05%, 5 ppm/°C optional)

External Resistor: Front panel connection shared among groups of 16 channels

Resistor Connection: Software selectable: local (across completion resistor) or remote

Quarter Bridge Strain Measurement

Excitation	Gain	Range[1]	Gain Accy[2]	Gain TC[3]
10 V	100	+31000με/-29000με	±0.12%	±50 ppm/°C
5 V	100	+64000με/-56500με	±0.12%	±50 ppm/°C

Notes:

1: Nominal for balanced bridge.

2: Conditions:

- GF = 2.0, Rcomp = 350 Ω, balanced excitation
- <30 days, ±5°C from last self calibration
- 15°C to 35°C, 1 year from full calibration
- Assumes the excitation voltage is measured and used in the conversion. Valid for 30 days, ±5°C.
- Includes the stability effects of the excitation source.
- 60 minute warm-up
- Exclusive of lead wire desensitization errors
- Exclusive of gage errors
- Exclusive of noise

3: Only applies outside of self calibration window.

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Full Bridge Strain Measurement

Excitation	Gain	Range[1]	Gain Accy[2]	Gain TC[3]
5 V	100	±15000με	±0.05%	±50 ppm/°C
2.5 V	100	±30000με	±0.06%	±60 ppm/°C

Notes:
1: Nominal for balanced bridge.

2: Conditions:
- GF = 2.0, balanced excitation, remote sense
- <30 days, ±5°C from last self calibration
- 15°C to 35°C, 1 year from full calibration
- Assumes the excitation voltage is measured and used in the conversion. Valid for 30 days, ±5°C
- Includes the stability effects of the excitation source.
- 60 minute warm-up
- Exclusive of gage errors
- Exclusive of noise

3: Only applies outside of self calibration window.

Confidence Measurements

Total Excitation Voltage: ±(0.012% + 500 μV)

±Excitation Voltage: ±(0.012% + 2.5 mV)

±Excitation Current: ±(0.1% + 50 μA)

Common Mode Voltage: ±(0.1% + 2.5 mV)

Sampling Rate: 500 Samples/sec

Voltage Measurement

Gain	Range	Gain Accy[1]	Gain TC[2]
100	±150mV	±0.025%	±30 ppm/°C
10	±1.5V	±0.025%	±30 ppm/°C
1	±15V	±0.025%	±30 ppm/°C

Notes:
1: Conditions:
- <30 days, ±5°C from last self calibration
- 15°C to 35°C, 1 year from full calibration
- 60 minute warm-up
- Exclusive of noise

2: Only applies outside of self calibration window.

Input Characteristics

Input Impedance (dc): 10 GΩ

Input Bias Current: 10 nA max

Input Protection: ±25 V

Common Mode Input Range: ±15 V

CMRR: 120 dB typ, 110 dB min (Gain = 100) (dc to 60hz)

Filtering

Analog Anti-Alias LPF: 60 kHz 1-pole per channel

Digital IIR Filtering: Configuration options per channel:
- Type (Bessel, Butterworth, None)
- Cut-off frequency
- Transform
- Order (1-10)

Wideband Outputs

Channels: 1 per input channel

Connectors: DSUB-44 male (3 total)

Maximum Output Voltage: ±15 V

Output Impedance: 150 Ω

Gain	Gain Accy	Offset Accy (RTI)	Bandwidth (-3dB)
100	±0.15%	±150 μV	> 100 kHz
10	±0.15%	±500 μV	> 150 kHz
1	±0.15%	±5 mV	> 150 kHz

Digital I/O

Channels: 16

Connector: DSUB-44 female

Electrical

V_{INPUT}:	-0.5 V to 5.5 V
V_{IH}:	2 V min
V_{IL}:	0.8 V max
V_{OH} (IOH = -5.2 mA):	2.5 V min
V_{OL} (IOL = 48 mA):	0.5 V max

Acquisition

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Trigger Bus

Channels: 8

Connector: Micro DB-25

Electrical

Logic Type:	M-LVDS Type 2
V_{IT+}:	150 mV max
V_{IT-}:	50 mV min
V_{OS}:	1 V typical

Power Requirements

Line Voltage: (90-264) Vac, (47-440) Hz

Input Power: 200 VA max

Environmental

Operating Temperature: -5°C to +55°C

Relative Humidity: 5% to 85%

Mechanical

Height:	3.5 in (8.89 cm)
Width:	19 in (48.26 cm)
Depth:	22 in (55.88 cm)

ORDERING INFORMATION

EX1629	**48-Channel Remote Strain Conditioning and Acquisition Unit**
Option 33	**Calibration Block Set**

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