

StrainSmart® Data Acquisition System



FEATURES

- Stable, accurate, low-noise signal conditioning
- Measurement accuracy $\pm 0.05\%$
- Measurement resolution 0.5 microstrain
- Individual input cards for strain gage and strain-gage-based transducers (Model 7003-8-SG), thermocouples (Model 7003-8-TC), sensors with high-level voltage outputs (Model 7003-8-HL), and linear variable displacement transducers (Model 7003-8-LVDT)
- Electronically selectable, built-in bridge completion for 120-, 350-, and 1000-ohm strain gages
- Virtually unlimited number of channels in increments of 8 channels
- Maximum scan rate of 2048 samples per second
- Self calibration traceable to NIST standard
- Simultaneous sampling with anti-aliasing filter and analog-to-digital conversion for each channel
- Selectable digital filtering of measurement signals
- High-speed Ethernet network interface

DESCRIPTION

Vishay Micro-Measurements System 7000 builds upon the years of experience gained since the introduction of Systems 4000, 5000, and 6000 by continuing to provide a complete hardware/software approach to data acquisition, reduction, and presentation for strain gages and related sensors for stress analysis testing.

System 7000 hardware is designed to incorporate all the features required for precision strain measurement in a high channel density enclosure. Strain gages, strain-gage-based transducers, thermocouples, LVDTs, and other sensors with high level voltage outputs can be intermixed in groups of eight (8) by choosing the appropriate sensor card for up to 128 channels in a 4U height, 19-inch rack-mountable scanner (7000-128-SM). A 32-channel scanner is also available (7000-32-SM). The Ethernet interface allows flexible positioning of scanners, and multiple scanners can easily be synchronized using a single sync cable (maximum length 100 meters). A system can be configured with virtually an unlimited number of sensors.

System 7000 is a high performance data acquisition instrument with measurement accuracy of $\pm 0.05\%$ of full scale. Each sensor card employs a 24-bit analog-to-digital converter enabling 0.5 microstrain resolution. Scan rates up to 2048 samples per second are available for simultaneous reading of all sensor inputs. A combination of analog and flexible Finite Impulse Response (FIR) filters are available to provide adequate anti-alias filtering at all scanning rates.

Each sensor card has high-capacity nonvolatile data storage capability. Electronically selectable bridge completion resistors allow the user to choose between 120-, 350-, and 1000-ohm strain gages through software selection.

Several design features are provided to reduce total cost of ownership. System 7000 is capable of self-calibration with a removable calibration reference (7000-SM-VC). Calibration can be performed anywhere and there is no need to return the entire system to the factory for calibration. Down-time while waiting for calibration is essentially eliminated. Input connectors are RJ-45 type and assembly time is fast using simple cable crimping tools. Sensor input cards all use common Analog Input Cards (Model 7003-8-A-I), which thereby allow users to interchange sensor input cards with analog input cards. Individual scanners can be separated and located near sensors to reduce sensor cabling costs.

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MODEL 7000-128-SM SCANNER SPECIFICATIONS



The purpose of the Model 7000-128-SM Scanner is to house and retain the acquisition cards, regulate power to the cards, establish and maintain communication between the Ethernet interface and the input cards, synchronize the analog-to-digital converters in the system, and provide visual status information to the operator.

CAPACITY:

Up to 16 Input Cards. 128 channels maximum

CONFIGURATIONS:

Rack-mount (19-inch) or bench-top

LCD DISPLAY:

64 x 128 white LED-backlit display

LED PANEL:

128 individual red/green LEDs; one per channel

KEYPAD:

Membrane. 20-key; 12 key numeric keypad, 5 key navigation keypad, and three soft-keys

INPUT POWER:

11 - 32Vdc, 30A max

POWER INDICATION:

Green LED. Illuminated when power is on

ETHERNET INTERFACE:

IEEE 802.3, 802.3u 10Base-T, 100Base-TX, half- and full-duplex, auto-detect

COMPACT FLASH® CAPACITY:

1GB supplied. Removable

PROCESSOR:

250MHz floating point digital signal processor

MEMORY:

64MB SDRAM

INTERNAL COMMUNICATION:

Asynchronous command bus, synchronous data bus

SYSTEM SYNCHRONIZATION:

Connections: Sync In, Sync Out

Topology: Daisy-chain

Cable Connection: TIA/EIA RJ-45, Category 5

Max. Distance: 100m

SYSTEM CALIBRATION REFERENCE:

Firmware-controlled

Drift: 1.9ppm/°C ± 0.6µV/°C typical, 9.4ppm/°C ± 2.1µV/°C maximum

Resolution: 150µV nominal

Voltage Range: ±5V

DIMENSIONS:

7.5 H x 17.5 W x 13.5 D inches (190 x 445 x 343mm)

WEIGHT:

20lb (9.1kg)

MODEL 7000-32-SM SCANNER SPECIFICATIONS



The purpose of the Model 7000-32-SM Scanner is to house and retain the acquisition cards, regulate power to the cards, establish and maintain communication between the Ethernet interface and the input cards, synchronize the analog-to-digital converters in the system, and provide visual status information to the operator.

CAPACITY:

Up to 4 Input Cards. 32 channels maximum

CONFIGURATIONS:

Bench-top

LCD DISPLAY:

64 x 128 white LED-backlit display

LED PANEL:

32 individual red/green LEDs; one per channel

KEYPAD:

Membrane. 20-key; 12 key numeric keypad, 5 key navigation keypad, and three soft-keys

INPUT POWER:

11 - 32Vdc, 20A max

POWER INDICATION:

Green LED. Illuminated when power is on

ETHERNET INTERFACE:

IEEE 802.3, 802.3u 10Base-T, 100Base-TX, half- and full-duplex, auto-detect

COMPACT FLASH® CAPACITY:

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Firmware-controlled

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Resolution: 150µV nominal

Voltage Range: ±5V

DIMENSIONS:

7.5 H x 7.1 W x 13.5 D inches (190 x 180 x 343mm)

WEIGHT:

10.1lb (4.6kg)

MODEL 7003-8-SG STRAIN GAGE INPUT CARD



The Model 7003-8-SG Strain Gage Input Card is used in conjunction with the Model 7003-8-A-I Analog Input Card to perform bridge excitation, bridge completion, shunt calibration, and signal conditioning for eight quarter, half, and full bridges.

CHANNELS:

Eight per card

INPUTS:

Software selectable for S+/S-, Vcal+/Vcal-, or excitation Strain Gage: 120Ω, 350Ω, 1000Ω quarter-bridges; 60Ω to 5000Ω half- and full-bridges

Input Impedance: 220MΩ nominal each input

Source Current: ±5nA per volt excitation

MEASUREMENT RANGE AND RESOLUTION:

Total range depends upon excitation setting (see table).

Resolution: 0.5µε (GF=2)

INPUT CONNECTOR:

Eight-pin TIA/EIA RJ-45 (Amp type 554739 or equivalent)

AMPLIFIER:

Zero Temperature Stability: ±1µV/°C RTI, after 60-minute warm-up

DC Gain Accuracy and Stability: ±0.05%; ±50ppm/°C (1 year without periodic VCAL)

Analog Input (including full-scale balance):

Low Range: ±50mV

High Range: ±220mV

Linearity: ±0.02% of Full Scale

Common-Mode Rejection: >90dB (dc to 60Hz)

Common-Mode Voltage Range: ±12V typical

BALANCE:

Type: Software (mathematical)

Range: Full ADC Range

Excitation Volts	Measuring Range Includes Full Scale Imbalance	
	µε@GF=2	mV/V
0	48 000	24*
0.25	100 000	50
0.5	96 000	48
0.75	70 000	35
1	48 000	24
2	24 000	12
3	16 000	8
4	50 000	25
5	40 000	20
6	35 000	17.5
7	30 000	15
8	25 000	12.5
9	20 000	10
10	20 000	10

* Based on 1 volt excitation

EXCITATION:

Selection: Software controlled

Resolution: 1mV

Accuracy: ±4mV typical (Firmware measures excitation variations during arming process)

Current: 50mA max. per channel

Over-current limited

Over-current indication

Load Regulation: <0.05% of full scale for 10% to 100% of full scale load with remote sense

Temperature Stability: ±10ppm/°C

QUARTER-BRIDGE COMPLETION:

Selection: Firmware-controlled

Accuracy and drift:

120Ω and 350Ω: ±0.01%, 2.8ppm/°C max.

1kΩ: ±0.01%, 1.6ppm/°C max. (socketed)

SHUNT CALIBRATION:

Selection: Firmware-controlled

Configuration:

Internal: P- to D120, P- to D350, P- to D1000

Remote: RcalA to RcalB

Sockets: Tin-plated

Levels: Simulates 10000µε @GF = 2.0

Values:

P- to D120: 5940Ω ±0.1%

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P- to D350: $17325\Omega \pm 0.1\%$
 P- to D1000: $49500\Omega \pm 0.1\%$

SYSTEM CALIBRATION:

Firmware-controlled
 Calibration voltage: Supplied by Model 7000-SM-VC voltage calibration card

Type: Ten point calibration

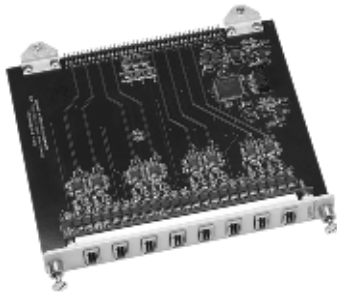
SIZE:

6.5 L x 6.5 W x 0.9 H in (165 x 165 x 23mm)

WEIGHT:

0.45lb (0.2kg)

MODEL 7003-8-TC THERMOCOUPLE INPUT CARD



The Model 7003-8-TC Thermocouple Input Card is used in conjunction with the Model 7003-8-A-I Analog Input Card to perform signal conditioning and cold-junction compensation for thermocouple types J, K, T, E, N, R, S, and B.

CHANNELS:

Eight per card

INPUTS:

Supported thermocouple types: J, K, T, E, N, R, S, B
 Cold-junction compensation, software-selectable

Open-sensor detection

Input Impedance: $220M\Omega$ nominal each input

Input Connectors:

Five-position connector with screw terminals

AMPLIFIER:

Zero Temperature Stability: $\pm 2\mu V/^{\circ}C$ RTI, $\pm 10\mu V/^{\circ}C$ RTO, after 60-minute warm-up

DC Gain Accuracy and Stability: $\pm 0.1\%$; $\pm 30ppm/^{\circ}C$

Linearity: $\pm 0.02\%$ of Full Scale

Common Mode Rejection (dc to 60Hz): $>90dB$

Common Mode Voltage range: $\pm 12V$ typical

MEASUREMENT RANGE AND RESOLUTION:

Range: $\pm 81.9mV$

Resolution: $1^{\circ}C$ minimum

ACCURACY:

$\pm 3^{\circ}C$

SIZE:

6.5 L x 6.5 W x 0.9 H in (165 x 165 x 23mm)

WEIGHT:

0.45lb (0.2kg)

MODEL 7003-8-HL HIGH LEVEL INPUT CARD



The Model 7003-8-HL High Level Input Card is used in conjunction with the Model 7003-8-A-I Analog Input Card to perform signal conditioning and excitation for high level ($\pm 10V$) inputs.

CHANNELS:

Eight per card

INPUTS:

Differential

Input Impedance: $220M\Omega$ nominal each input

Input Bias Current: $\pm 0.5nA$ typical ($\pm 2nA$ max.)

INPUT CONNECTOR:

Eight-pin RJ-45

AMPLIFIER:

Zero Temperature Stability: $\pm 2\mu V/^{\circ}C$ RTI, typical, $\pm 10\mu V/^{\circ}C$ RTO, after 60-minute warm-up

DC Gain Accuracy and Stability: $\pm 0.1\%$; $\pm 30ppm/^{\circ}C$

Linearity: $\pm 0.02\%$ of Full Scale

Common-Mode Rejection (dc to 60 Hz): $>90dB$

Common-Mode Voltage Range: $\pm 12V$ typical

MEASUREMENT RANGES AND RESOLUTION:

Range: $\pm 10V$

Resolution: $100\mu V$ effective

EXCITATION:

Selection: Software controlled

Bipolar range: 0 to $\pm 12Vdc$ (24Vdc total)

Unipolar range: 0 to $+12Vdc$

Accuracy: $\pm 0.1\%$ of full scale using remote sense

Current: 50mA max. Over-current/over-temperature protected
 Load Regulation: $<0.05\%$ of full scale (bipolar mode) for a load variation of 10% to 100% of full scale load (with remote sense)

Temperature Stability: Better than $\pm 30ppm/^{\circ}C$

DIMENSIONS:

6.5 L x 6.5 W x 0.9 H in (165 x 165 x 23mm)

WEIGHT:

0.45lb (0.2kg)

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MODEL 7003-8-LVDT LINEAR VARIABLE DISPLACEMENT TRANSDUCER INPUT CARD



The Model 7003-8-LVDT Linear Variable Displacement Transducer Input Card is used in conjunction with the Model 7003-8-A-I Analog Input Card to perform signal conditioning, polarity demodulation and AC excitation for transformer type transducers.

CHANNELS: Eight per card

INPUTS:

Six-, five-, four- and six-wire transducers
 Input Impedance: 220MΩ nominal each input with 0.001μF parallel to both inputs
 Input Bias Current: ±0.5nA typical (±2nA max.)

INPUT CONNECTOR:

Eight-pin RJ-45

AMPLIFIER:

Zero Temperature Stability: ±2μV/°C RTI, typical, ±10μV/°C RTO, after 60-minute warm-up
 DC Gain Accuracy and Stability: ±0.25%, ±30ppm /°C
 Common-Mode Rejection (dc to 60 Hz): >90dB
 Common-Mode Voltage Range: ±12V typical

POST DEMODULATOR FILTER:

Type: Low-Pass
 Frequency: 1.0kHz @ -3dB
 Number of Poles: Six
 Topology: Butterworth

MEASUREMENT RANGE AND RESOLUTION:

Range: ±5Vrms
 Resolution: 50μVrms effective

EXCITATION:

Selection: Software controlled
 Frequency: 2500, 5000, or 10000Hz sine wave
 Amplitude: 3Vrms
 Accuracy: ±0.5% of full scale typical
 Current: 50mA max. Over-current/over-temperature protected
 Load Regulation: <0.1% of full scale for a load variation of 10% to 100% of full scale load
 Temperature Stability: Better than ±0.05%/°C

SIZE:

6.5 L x 6.5 W x 0.9 H in (165 x 165 x 23mm)

WEIGHT:

0.45lb (0.2kg)

MODEL 7003-8-A-I ANALOG INPUT CARD



The Model 7003-8-A-I Analog Input Card performs the analog anti-alias filtering, analog-to-digital conversion and data storage for the System. The Model 7003-8-A-I is used in conjunction with a Sensor Input Card, which performs the sensor-specific analog conditioning.

The Model 7003-8-A-I consists of eight dedicated 3-pole constant delay analog anti-alias filters, eight fully synchronized, 24 bit analog-to-digital converters operating at 40k samples/second/channel, a dedicated digital signal processor to perform scaling and digital filtering, a pretrigger buffer with a capacity of over one-half million samples per channel, and 1GB of CompactFlash® memory for data storage.

CHANNELS:

Eight per card

A/D CONVERTER:

Quantity: Eight (one per channel)
 Architecture: Sigma-delta

Resolution: 24 bits

Conversion Rate:

Radix-10: 40k samples/second/channel

Radix-2: 40.96k samples/second/channel

DATA RECORDING RATES:

2048, 1024, 512, 256, 128, or 64 samples/second/channel (radix-2)

2000, 1000, 500, 200, 100, or 10 samples/second/channel (radix-10)

PRE-TRIGGER BUFFER:

Type: SDRAM, firmware-controlled

Depth: 645,276 samples/channel

ANALOG ANTI-ALIAS FILTER:

Type: Low-pass

Frequency: 3.5kHz @ -3dB

Number of Poles: Three

Topology: GIC, constant delay

PROCESSOR:

Type: 32-bit floating point digital signal processor

250MHz operating frequency

RAM:

Type: SDRAM

Size: 64MB

PROGRAM AND CALIBRATION DATA STORAGE:

Type: Flash Memory

Size: 1MB

