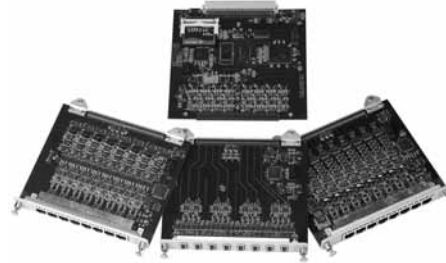


StrainSmart® Data Acquisition System

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, thermocouples, sensors with high-level voltage outputs, and LVDTs
- 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
- Remote Utility includes capability for acquiring data without connection to a computer (field upgradeable)



DESCRIPTION

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.

A feature for acquiring data without a connection to a computer has been added. This Remote Utility Feature is field upgradeable on units purchased prior to the introduction of this feature. With this feature, data can be collected then exported to other applications for analysis.

StrainSmart® Data Acquisition System

**SCANNER SPECIFICATIONS
(128 CHANNEL VERSION)**



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 3 soft-keys

INPUT POWER

11–32 VDC, 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

1 GB supplied (removable)

PROCESSOR

250 MHz floating point digital signal processor

MEMORY

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

Resolution: 150 µV nominal

Voltage Range: ±5V

DIMENSIONS

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

WEIGHT

20 lb (9.1 kg)

**SCANNER SPECIFICATIONS
(32-CHANNEL VERSION)**



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

StrainSmart® Data Acquisition System

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

11–32 VDC, 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

1 GB supplied (removable)

PROCESSOR

250 MHz floating point digital signal processor

MEMORY

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

Resolution: 150 µV nominal

Voltage Range: ±5V

DIMENSIONS

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

WEIGHT

10.1 lb (4.6 kg)

STRAIN GAGE INPUT CARDS



A choice of two Strain Gage Input Cards (7003-8-SG or 7003-8-SG-A) are 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. Note that the 7003-8-SG-A Strain Gage Input Card with Analog Output has an analog output which provides an amplified representation of the input source.

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: 220 MΩ nominal each input

Source Current: ±5 nA per volt excitation

ANALOG OUTPUT (MODEL 7003-8-SG-A ONLY)

Fixed Gain: 50.3 V/V ±1%

Output Range: ±10V min

Output Load: 2000Ω min

Bandwidth: DC to 4.2 kHz (–3 dB ±0.25 dB)

MEASUREMENT RANGE AND RESOLUTION

Total range depends upon excitation setting (see table).

Resolution: 0.5 µε (GF=2)

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

StrainSmart® Data Acquisition System

INPUT CONNECTOR

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

AMPLIFIER

Zero Temperature Stability: $\pm 1 \mu\text{V}/^\circ\text{C}$ RTI, after 60-minute warm-up

DC Gain Accuracy and Stability: $\pm 0.05\%$; $\pm 50 \text{ ppm}/^\circ\text{C}$ (1 year without periodic VCAL)

Analog Input (Including Full-Scale Balance):

Low Range: $\pm 50 \text{ mV}$

High Range: $\pm 220 \text{ mV}$

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

Common-Mode Rejection: $>90 \text{ dB}$ (DC to 60 Hz)

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

BALANCE

Type: Software (mathematical)

Range: Full ADC range

EXCITATION

Selection: Software controlled

Resolution: 1 mV

Accuracy: $\pm 4 \text{ mV}$ typical (Firmware measures excitation variations during arming process)

Current: 50 mA 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: $\pm 10 \text{ ppm}/^\circ\text{C}$

QUARTER-BRIDGE COMPLETION

Selection: Firmware controlled

Accuracy and Drift:

120 Ω and 350 Ω : $\pm 0.01\%$, 2.8 ppm/ $^\circ\text{C}$ max.

1 k Ω : $\pm 0.01\%$, 1.6 ppm/ $^\circ\text{C}$ 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 10,000 $\mu\epsilon$ @ GF = 2.0

Values:

P- to D120: 5940 Ω $\pm 0.1\%$

P- to D350: 17,325 Ω $\pm 0.1\%$

P- to D1000: 49,500 Ω $\pm 0.1\%$

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 23 mm)

WEIGHT

0.45 lb (0.2 kg)

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: 220 M Ω nominal each input

INPUT CONNECTORS

Five-position connector with screw terminals

AMPLIFIER

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

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

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

Common Mode Rejection (DC to 60 Hz): $>90 \text{ dB}$

Common Mode Voltage Range: $\pm 12\text{V}$ typical

StrainSmart® Data Acquisition System

MEASUREMENT RANGE AND RESOLUTION

Range: ± 81.9 mV
Resolution: 1°C minimum

ACCURACY

$\pm 2^\circ\text{C}$

SIZE

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

WEIGHT

0.45 lb (0.2 kg)

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 ($\pm 10\text{V}$) inputs.

CHANNELS

Eight per card

INPUTS

Differential

Input Impedance: 220 M Ω nominal each input

Input Bias Current: ± 0.5 nA typical (± 2 nA max.)

INPUT CONNECTOR

Eight-pin RJ-45

AMPLIFIER

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

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

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

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

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

MEASUREMENT RANGES AND RESOLUTION

Range: $\pm 10\text{V}$

Resolution: 100 μV effective

EXCITATION

Selection: Software controlled

Bipolar Range: 0 to ± 12 VDC (24 VDC total)

Unipolar Range: 0 to +12 VDC

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

Current: 50 mA 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 ± 30 ppm/ $^\circ\text{C}$

DIMENSIONS

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

WEIGHT

0.45 lb (0.2 kg)

LVDT CARD



The Model 7003-8-LVDT 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 three-wire transducers

Input Impedance: 220 M Ω nominal each input with 0.001 μF parallel to both inputs

Input Bias Current: ± 0.5 nA typical (± 2 nA max.)

INPUT CONNECTOR

Eight-pin RJ-45

AMPLIFIER

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

DC Gain Accuracy and Stability: $\pm 0.25\%$;
 ± 30 ppm/ $^\circ\text{C}$

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

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

StrainSmart® Data Acquisition System

POST DEMODULAR FILTER

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

MEASUREMENT RANGE AND RESOLUTION

Range: ±5 VRMS
Resolution: 50 µVRMS effective

EXCITATION

Selection: Software controlled
Frequency: 2500, 5000, or 10000 Hz sine wave
Amplitude: 3 VRMS
Accuracy: ±0.5% of full scale typical
Current: 50 mA 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

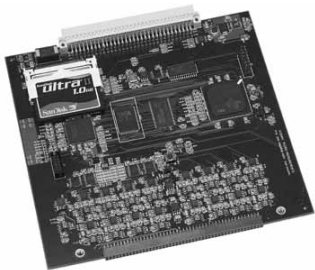
SIZE

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

WEIGHT

0.45 lb (0.2 kg)

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 1 GB 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: 3.5 kHz @ -3 dB
Number of Poles: Three
Topology: GIC, constant delay

PROCESSOR

Type: 32-bit floating point digital signal processor
250 MHz operating frequency

RAM

Type: SDRAM
Size: 64 MB

PROGRAM AND CALIBRATION DATA STORAGE

Type: Flash Memory
Size: 1 MB

DATA STORAGE

Type: Sandisk Ultra-Series II® CompactFlash
Quantity: One per card
Capacity: 1 GB supplied. Removable

SIZE

6.8 L x 6.5 W x 0.7 H in (173 x 165 x 18 mm)

WEIGHT

0.35 lb (0.16 kg)

StrainSmart® Data Acquisition System

CONFIGURATIONS

StrainSmart® Data Systems can be configured in a variety of ways to meet the specific requirements of each user. Each system consists of (1) software, (2) instrumentation hardware, and (3) personal computer.

SOFTWARE

It is strongly recommended that StrainSmart Software be installed on a Windows-based personal computer for data acquisition, reduction, display, and storage.

While the hardware for StrainSmart Data Systems may be used with third-party data acquisition software, total system operation becomes the user's responsibility when third-party software is used.

INSTRUMENTATION HARDWARE

In addition to a one-time purchase of StrainSmart Software, the initial purchase for each system would normally include one of the following:

System 7000 with Ethernet Interface—At least one Model 7000-128-SM Scanner or Model 7000-32-SM Scanner, and at least one Model 7003-8-SG, 7003-8-SG-A, 7003-8-HL, or 7003-8-TC Input Card, each connected to a Model 7003-8-A-I Analog Input Card

PERSONAL COMPUTER REQUIREMENTS

In addition to StrainSmart Software and Hardware purchased from Micro-Measurements, the system requires access to a properly configured personal computer. The hardware requirements for StrainSmart are:

- Fast Intel Core-2 Duo or better
- 4 GB of memory or better
- 20 GB of available free space or better
- XGA (1024 x 768) or better

STRAINSMART SOFTWARE

StrainSmart Software is designed to function with all System 5000, 6000, and 7000 hardware. It contains everything needed to acquire, reduce, display, and store measurement data, including:

- StrainSmart Main Operating Program
- Offline Data Presentation Program
- Interactive Help System

All components are supplied on CD-ROM along with a utility for installing them.

An unlimited number of installations can be made within your facility with the one-time purchase of a single copy of StrainSmart.

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