System 8000 StrainSmart® Data Acquisition System

FEATURES

- Eight software-selectable input channels
- Supported inputs include:
  - ○ Strain gage (quarter-, half-, and full-bridges)
  - ○ Strain-gage-based transducer
  - ○ High-level voltage signal
  - ○ Thermocouples
- RJ45 input connectors for each input channel
- Scanning rates are 1000, 500, 200, 100, and 10 samples/second
- Compact size and ruggedized enclosure
- Ethernet network architecture
- Optional self-calibration functionality available

DESCRIPTION

System 8000 from Micro-Measurements is a versatile, precision data acquisition instrument system intended for static and dynamic test and measurement applications.

The system includes a scanner with 8 channels of data acquisition. A 10' crossover Ethernet cable is also included. The scanners may be used separately or up to 16 scanners can be used concurrently for a maximum of 128 channels.

Each channel can be configured, via software, to accept signals from strain gages or strain-gage-based transducers, thermocouples, or high level voltage sensors. Strain gage channels accept full-, half-, or quarter-bridge configurations and have the required bridge completion components for 120-, 350-, and 1000-ohm bridges. Each scanner operates independently; multiple scanners are not synchronized.

The data is processed in a modern 24-bit digital signal processor and filtering is performed using Finite Impulse Response (FIR), multi-stage filters. This provides excellent noise rejection and stability and unsurpassed measurement accuracy.

The Model 8000-8-SM Scanner communicates with a host personal computer (PC) via an Ethernet connection. Micro-Measurements StrainSmart® software is optimal for configuring, controlling, and acquiring data from the System 8000. A Programmer's Reference Kit provides documentation, programming examples, and instrument drivers to assist with custom software development.

SUPPORTED SENSORS

Each channel can be defined, via software, to be one of the following sensor types:

- Strain gage (quarter-, half-, and full-bridges)
- Strain-gage-based transducer
- High-level voltage signal
- Thermocouples

SAMPLING

All channels in each scanner are sampled simultaneously. Each channel's 24-bit analog-to-digital converter over-samples data at a rate of 128k samples/second, and provides high quality, low noise data (without the need for signal averaging) at rates up to 1000 samples/second/channel.

SCANNING RATES

The system provides numerous scan rates and Finite Impulse Response (FIR) filters are automatically selected to provide suitable filtering at each rate to avoid aliasing. Sampling rates for the Model 8000-8-SM are 1000, 500, 200, 100, and 10 samples/second.

COMPACT, RUGGEDIZED ENCLOSURE

The Model 8000-8-SM has 8 channels in a 1U (1.72 inch) height enclosure. The aluminum-alloy enclosure provides superior strength and durability. A rack mount kit is also available.

RJ45 INPUT CONNECTORS

Each channel input connector is an 8-pin TIA/EIA RJ45.

RELAY OUTPUT

A relay output is provided to control external hardware.

ETHERNET NETWORK ARCHITECTURE

The system communicates over an IEEE-802.3u 100Base-TX or an IEEE-802.3 10Base-T Ethernet Network. The firmware uses separate command and data ports and employs a reliable TCP-based protocol to prevent data loss.

DC OPERATION

Model 8000 operates on 10-32 VDC power. This can be from the included power supply or by using a separate AC-to-DC converter or DC supply such as a battery.

MODEL 8000-8-SM POWER SOURCE

The Model 8000 is a DC-powered instrument. The system accommodates DC input voltages from 10 to 32 volts. The included power supply provides the required AC-to-DC conversion and up to 30 watts of power to the system. An alternate DC power source can be used provided that it supplies enough power to meet the

System 8000 StrainSmart® Data Acquisition System

system and excitation power requirements. The total system power requirements are highly dependent upon the power requirements of the bridge excitation circuitry. At a minimum, the instrument requires approximately 17 watts of power. A fully loaded instrument employing the maximum excitation current requires up to 26 watts of power.

ENCLOSURE

The Model 8000-8-SM enclosure is constructed of aluminum alloy. The enclosure is designed to provide superior strength, durability, and to minimize RF emissions and susceptibility.

8000-SM-VC SYSTEM VOLTAGE CALIBRATION CARD (OPTIONAL)

The 8000-SM-VC System voltage Calibration Card is available as an accessory and provides the ability to perform a system-level calibration of the entire measurement circuit without the need to return the system to the manufacturer or metrology lab. The gain and offset of each channel can be calibrated. The 8000-SM-VC is calibrated at the factory to NIST-traceable standards and does not need to be present in the system during normal operation. A benefit of on-board system calibration is the ability to calibrate the system under the actual operating conditions, thereby minimizing errors due to environmental conditions.

SPECIFICATIONS — GENERAL

All specifications are nominal or typical at +23°C unless noted. Performance may be degraded in the presence of high-level electromagnetic fields. For CE compliance, Micro-Measurements recommends that all cables be limited to 30 meters in length.

Environmental

> **Temperature:** 0° to +50°C
>
> **Humidity:** Up to 90%, non-condensing

Enclosure

> **Material:** A356-T6 aluminum casting
>
> **Dimensions (all dimensions are nominal):**
> 1.72 H (1.96 with feet) x 11.0 W x 10.18 D (10.55 including power connector) inches (43.68 x 279.4 x 258.66 mm)
>
> **Configurations:**
> Bench-top, stackable, rack-mountable.

Weight

> 3.85 lbs (1.75 kg)

Power

> **Input:** 10-32 VDC, 5A max.
>
> **Fuse:**
> 5A Fast-acting blade terminal. (Littlefuse FUN MINI® PN 125.6785.4502 or equivalent)
>
> **Power Switch:**
> Rocker switch with green LED to indicate power on.

Relay

> **Quantity:** One
>
> **Configuration:** NO and NC, 500 mA relay contact

Communication

> Ethernet Interface: IEEE 802.3 10Base-T, 802.3u 100Base-TX, half- and full-duplex, auto-detect. RJ45 connection, green LINK/ACT LED

8000-SM-VC Voltage Calibration Card

> **Accuracy:**
> ±100 ppm repeatability, typical
> ±250 ppm repeatability, maximum
>
> **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

ANALOG CHANNELS

Channels

> Eight, differential inputs

A/D Converter

> **Quantity:** Eight (one per channel)
>
> **Architecture:** Delta-Sigma ($\Delta\Sigma$)
>
> **Resolution:** 24 bits
>
> **Oversampling Rate:**
> 128k samples/second/channel (max)

Data Rates

> 1000, 500, 200, 100, or 10 samples/second/channel

Analog Anti-Alias Filter

> **Type:** Low-pass
>
> **Frequency:** 500 Hz @ –3 dB
>
> **Number of Poles:** One
>
> **Topology:** Lowpass RC

Processor

> **Type:** 32-bit floating point Digital Signal Processor 300 MHz operating frequency

RAM

> **Type:** SDRAM
>
> **Size:** 32 MB

Flash

> **Type:** Serial NOR
>
> **Size:** 1MB (user)

System 8000 StrainSmart® Data Acquisition System

Digital Filters

Type: Two-stage Finite Impulse Response (FIR)

Table 1. Digital Filter Specifications			
f_{user} (Hz)	f_{pass} (Hz)	Passband Peak-Peak Ripple (dB)	Stopband Attenuation (dB)
1000	360	0.01	–70
500	200	0.01	–80
200	80	0.01	–80
100	35	0.01	–70
10	3.5	0.01	–66

System Calibration

Firmware-controlled

Calibration Voltage
Supplied by Model 8000-SM-VC voltage calibration card

Type: Multi-point, ≥100 samples per point

STRAIN GAGE INPUTS

Channels

Up to 8 per scanner

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

Measurement Range and Resolution

Range: Depends upon excitation setting (see Table 2)

Resolution: 0.5 με @ GF=2 (0.25 µV/V)

Table 2— Strain Gage Measurement Range and Resolution		
Excitation Volts	Typical Measuring Range includes Imbalance	
	±με @ GF=2	±mV/V
0	77500*	19*
0.25	310000	155
0.5	155000	77
0.75	103000	51
1	77000	38
2	38000	19
3	25000	12
4	77000	38
5	62000	31
6	51000	25
7	44000	22
8	38000	19
9	34000	17
10	31000	15

* NOTE: Range calculations at zero volts excitation are based upon 1 volt excitation, and are typically used for the quantification of self-generating noise.

Input Connector

8-pin TIA/EIA RJ45 (MM Part No. A106, Tyco AMP type 554739 or equivalent)

Use of a crimping tool is recommended (MM Part No. A108, Tyco AMP Model No. 3-23-1652-0, or equivalent). Crimping tool can be used on both shielded and non-shielded connectors.

Amplifier

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

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

Analog Input (including Full-Scale balance):

Low Range: ±38 mV

High Range: ±155 mV

Linearity: ±0.02% of Full Scale

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

Common-Mode Voltage Range: ±12V typical

Balance

Type: Software (mathematical)

Range:
Full ADC Range (actual balance level shifts dynamic measurement range 1:1)

Excitation

Selection: Software controlled

Unipolar: 0 to +10 VDC

Resolution: 3 mV

Accuracy: ±10 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 loads with remote sense

Temperature Stability: ±10 ppm/°C

Quarter-Bridge Completion

Selection: Firmware-controlled

Accuracy and drift:

120Ω and 350Ω: ±0.01%, 2.8 ppm/°C max.

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

Shunt Calibration

Selection: Firmware-controlled

Configuration:

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

Sockets: Tin-plated

Levels: Simulates 10000 με @ GF = 2.0

System 8000

System 8000 StrainSmart® Data Acquisition System

Values:

P– to D120: 5940Ω ±0.1%

P– to D350: 17325Ω ±0.1%

P– to D1000: 49500Ω ±0.1%

THERMOCOUPLE INPUTS

Channels:

Up to 8 per scanner

Inputs

Supported thermocouple types:
J, K, T, E, N, R, S, B

Cold-junction compensation, software-selectable

Open-sensor detection

Input Impedance: 22 MΩ nominal each input

Input Connectors

Eight-pin TIA/EIA RJ45

Amplifier

Zero Temperature Stability:
±2 µV/°C RTI, ±10 µV/°C RTO, after
60-minute warm-up

DC Gain Accuracy and Stability:
±0.1%; ±30 ppm /°C

Linearity: ±0.02% of Full Scale

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

Common Mode Voltage Range: ±12V typical

Measurement Range and Resolution

Range: ±77.5 mV

Resolution: 1°C minimum

Accuracy

±2°C (nominal)

HIGH-LEVEL INPUT

Channels

Up to 8 per scanner

Inputs

Differential

Input Impedance: 220 MΩ nominal each input

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

Input Connector

8-pin TIA/EIA RJ45 (MM Part No. A106, Tyco AMP
type 554739 or equivalent)

Use of a crimping tool is recommended (MM Part
No. A108, Tyco AMP Model No. 3-23-1652-0, or
equivalent). Crimping tool can be used on both
shielded and non-shielded connectors.

Amplifier

Zero Temperature Stability:
±2 µV/°C RTI, typical, ±10 µV/°C RTO, after
60-minute warm-up

DC Gain Accuracy and Stability:
±0.1%; ±30 ppm /°C

Linearity: ±0.02% of Full Scale

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

Common-Mode Voltage Range: ±12V typical

Measurement Ranges and Resolution

Range: ±10V

Resolution: 100 µV effective

Excitation

Selection: Software controlled

Unipolar Mode:

Range: 0 to +11.997 VDC

Accuracy: ±10 mV typical

Current:
50 mA max. Over-current/over-temperature
protected

Load Regulation:
<0.05% of Full Scale (unipolar mode) for a load
variation of 10% to 100% of Full Scale loads (with
remote sense)

Temperature Stability: Better than ±30 ppm/°C

Bipolar Mode:

Range: ±12 VDC (24 VDC total)

Accuracy: ±5% of Full Scale