StrainSmart® Data Acquisition System

FEATURES

- From 1 to 1200 input channels
- Individual input cards for strain gage and strain-gage-based transducers (Model 6010A), thermocouples (Model 6020), sensors with high-level voltage outputs (Model 6030A), LVDTs (Model 6040A), piezoelectric sensors (Model 6050), and digital tachometer (Model 6095)
- Built-in bridge completion for 120-, 350-, and 1000-ohm strain gages
- Maximum scan rate of 10,000 samples per second per channel; maximum throughput of 200,000 samples per second
- Simultaneous sampling with anti-aliasing filter and analog-to-digital conversion for each channel
- Stable, accurate, low-noise signal conditioning
- Selectable digital filtering of measurement signals
- High-speed PCI or PCIe hardware interface (Model 6100) and Ethernet network interface (Model 6200A)
- Digital I/O for triggering external events

DESCRIPTION

System 6000 features data acquisition rates of up to 10,000 samples per second per channel. The hardware is designed to incorporate all the features required for precision strain measurement under a variety of loading conditions, while maintaining flexibility and ease of use. A system can be configured with 1 to 1200 sensors. Strain gages, strain-gage-based transducers, thermocouples, LVDTs, potentiometers, accelerometers, piezoelectric sensors and other transducers can be intermixed by choosing the appropriate sensor card.

All System 6000 components can be easily configured for each test requirement. Both the Model 6100 Scanner (holding up to 20 input cards) and the Model 6200A Scanner (holding up to 16 input cards) function independently. Additionally, the smaller, lighter, portable Model 6200A can operate from a variety of DC power sources, and can be configured to remotely perform data acquisition and storage.

Utilizing the benefits of individual analog-to-digital conversion on each channel and simultaneous sampling data acquisition for all channels, System 6000's Model 6100 Scanners record test data at rates of up to 10,000 samples per second per channel of instrumentation hardware. The PCI or PCIe hardware interface between the scanners and a PC running Strain-Smart software in the Windows XP/Vista/7 environment enables a combined throughput of up to 200,000 samples per second for all channels (for example, 20 channels at 10,000 samples per second per channel or 40 channels at 5000 samples per second per channel).

Selectable, digital FIR low-pass filtering is incorporated into each instrumentation channel to meet a variety of testing requirements. Custom filters are also available.

MODEL 6100 SCANNER SPECIFICATIONS

- AC powered
- 19-in rack-mountable, 3.5-in high package
- Accepts up to 20 plug-in input cards
- Supports high-speed data transfer and setup of the plug-in cards
- Supports local diagnostics
- Supports software identification and setup of each type of plug-in card

OPERATION
Direct software control

INPUTS
Accepts up to 20 cards (one channel per card and up to 20 channels per unit)

SYNC
Automatic

DATA STORAGE
None

INTERFACE
Proprietary PCI or PCIe

System 6000

◼ ◼ ◼ ◼ ◼ Micro-Measurements

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SIZE

3.5 H x 19 W x 16 D in (89 x 483 x 381 mm)

WEIGHT

17 lb (7.7 kg) empty
19.5 lb (8.8 kg) loaded with 20 plug-in cards

POWER

115 or 230 VAC user-selectable; ±10% of setting;
50/60 Hz; 200W max.

MODEL 6200A SCANNER SPECIFICATIONS

- DC powered (AC optional)
- Compact package
- Accepts up to 16 plug-in input cards
- Supports network communication via a 100BASE-T Ethernet connection
- Multiple units can be linked together to provide common control and synchronous sampling
- Offers user-selectable decimal-based (radix 10) and binary-based (radix 2) scanning rates
- On-board program and data storage
- Supports local diagnostics
- Supports software identification and setup of each type of plug-in card

OPERATION

Stand-alone or direct software control

INPUTS

Accepts up to 16 cards (one channel per card and up to 16 channels per unit)

SYNC

Multiple scanners synchronized with synchronization cable links

DATA STORAGE

Can be configured:

Internal: 1 GB solid state

Removable: ATA form factor removable storage devices, solid state

INTERFACE

Type: Ethernet
Topology: 100Base-T
Protocol: TCP/IP (HTTP)

OPERATING VIBRATION

6G peak in all three axes, sweep to 10 Hz (solid state media)

OPERATING SHOCK

20G peak in all three axes, 5 shocks in each axis (solid state media)
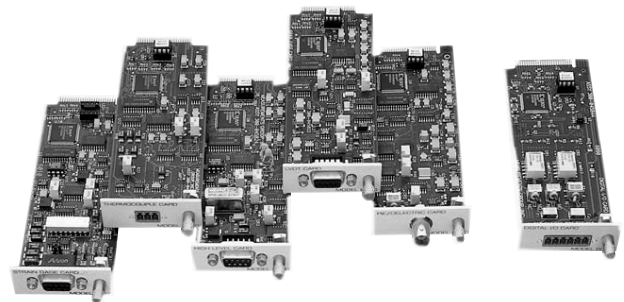
SIZE

4 H x 10 W x 12.3 D in (102 x 254 x 312 mm)

WEIGHT

9.1 lb (4.1 kg) empty, 11.1 lb (5.0 kg) loaded with 16 plug-in cards

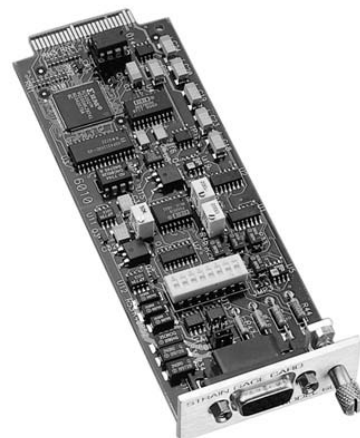**POWER**

Designed for use with DC power; 9–32 VDC, 100W max
Optional power adapter (Model 6207); 120/240 VAC

SENSOR CARD SPECIFICATIONS

MODEL 6010A STRAIN GAGE CARD

StrainSmart® Data Acquisition System

- Supports software identification and setup of each type of plug-in card
- Complete strain gage signal conditioner with 16-bit analog-to-digital converter
- Programmable digital filter
- Programmable excitation supply per channel. The supply is settable to 0, 0.5, 1, 2, 5, and 10V. Up to 50 mA of excitation current is available on each channel. Remote sense is provided for full-bridge transducers.
- Programmable gain to complement the excitation steps of 1, 2, 5, and 10V. Full-scale input range will be ±16,383 με. An excitation setting of 0.5V will use the 1V gain range, but with one-half the resolution. Gain settings are independent per channel.
- Internal bridge completion resistors: 120Ω, 350Ω, and 1000Ω dummy resistors (jumper selectable); 1000 internal half bridge
- Programmable coarse balance range of ±16,300 με (4096 με steps)
- Fixed low-pass anti-aliasing filter (six-pole)
- Two programmable shunt calibration circuits
- Input connections to user's strain gage via nine-pin D-sub connector

CHANNELS
One per card

INPUTS

Strain Gages
120Ω, 350Ω,1000Ω quarter bridges; 60Ω to 5000Ω half and full bridges

Jumper-selectable completion resistors (0.01% ±2.5 ppm/°C typical)

Measurement Range
Normal range mode: ±16,380 με
High range mode: ±163,800 με
Low range mode: ±1638 με

Resolution
Normal range mode: 0.5 με
High range mode: 5 με
Low range mode: 0.05 με

Strain Gage Based Transducers
60Ω to 5000Ω impedance

Measurement Range
Normal range mode: ±8 mV/V
High range mode: ±80 mV/V
Low range mode: ±0.8 mV/V

Resolution
Normal range mode: 0.25 µV/V
High range mode: 2.5 µV/V
Low range mode: 0.025 µV/V

Input Impedance
220 MΩ each input

Source Current
±25 nA max.

Input Connector
Nine-pin D-sub style

AMPLIFIER

Zero Temperature Stability
±1.5 µV/°C RTI, ±100 µV/°C RTO, after 30-minute warm-up

DC Gain Accuracy and Stability
(±0.1% at 23°C) ±50 ppm/°C

Common-Mode Rejection (DC to 60 Hz)
100 dB typical

Common-Mode Voltage
±6V typical

AC Accuracy (Typical)

Input Frequency/Bandwidth	500/3000	50/200
Spurious Free Dynamic Range	100 dB	110 dB
Signal to Noise	90 dB	95 dB
Signal to Distortion	100 dB	110 dB

Coarse Balance Range
±99% of measurement range (typically ±16 300 με)

CALIBRATION
Two shunt calibration points are available on each channel
Switch-selectable
Calibration switches, A and B, are software selectable

EXCITATION
0.0, 0.5, 1.0, 2.0, 5.0, and 10.0 VDC. Software programmable.

Accuracy
±3 mV typical

Current
50 mA max; over-current protected

Load Regulation
<0.05% of full scale for a load variation of 10% to 100% of full load

Temperature Stability
Better than ±0.005%/°C

Remote Sense
15Ω maximum lead resistance

System 6000

StrainSmart® Data Acquisition System

A/D CONVERTER

Type

16-bit successive approximation with integrated sample and hold

Integral Linearity Error

±2 LSB

FILTERS

Linear phase, analog, 6-pole anti-aliasing filter, and 256-tap, programmable, FIR digital filter (lowpass)

Passband Frequency

User-selectable 1 Hz to 4 kHz

ANALOG OUTPUT (6010A Version Only)

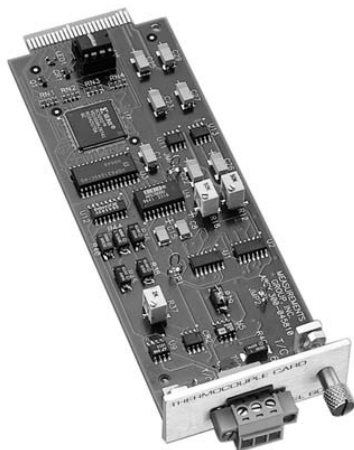### Type

±5.00V max for typical full-scale input of ±16,380 με

Output Load

2000Ω min

Bandwidth

DC to 15 kHz (–0.5 dB typical)

MODEL 6020 THERMOCOUPLE CARD

- Complete thermocouple signal conditioner with 16-bit analog-to-digital converter
- Programmable digital filter
- Programmable common cold-junction reference
- Compensation is provided for J, K, T, N, E, R, S, and B thermocouple types
- Fixed low-pass anti-aliasing filter (six-pole)
- Connections to user's thermocouple circuit via a removable three-terminal screw connector

CHANNELS

One per card

INPUTS

Thermocouple types J, K, T, E, N, R, S, B. Built-in electronic cold-junction compensation. Software-selectable.

Open sensor detection

Input Impedance

10 MΩ differential, 100 KΩ common mode

Source Current

±0.5 nA typical; ±5 nA max.

Input Connector

Three-position screw terminal

AMPLIFIER

Zero Temperature Stability

±1.5 µV/°C RTI, ±100 µV/°C RTO, after 30-minute warm-up

DC Gain Accuracy and Stability

0.05% at 23°C ± 50 ppm/°C

Common-Mode Rejection (DC to 60 Hz)

100 dB typical

Common-Mode Voltage

±6V typical

AC Accuracy (Typical)

Input Frequency/Bandwidth	500/3000	50/200
Spurious Free Dynamic Range	100 dB	110 dB
Signal to Noise	90 dB	95 dB
Signal to Distortion	100 dB	110 dB

MEASUREMENT RANGE

±81.9 mV

RESOLUTION

2.5 µV

A/D CONVERTER

Type

16-bit successive approximation with integrated sample and hold

Integral Linearity Error

±2 LSB

FILTERS

Linear phase, analog, 6-pole anti-aliasing filter, and 256-tap, programmable, FIR digital filter (lowpass)

Passband Frequency

User-selectable 1 Hz to 4 kHz

StrainSmart® Data Acquisition System

MODEL 6030A HIGH-LEVEL INPUT CARD

- Complete high-level signal conditioner with 16-bit analog-to-digital converter
- Programmable gain
- Programmable digital filter
- Programmable excitation supply. The supply is settable to 0, 0.5, 1, 2, 5, 10, 15, 20, 24, and 30V. Up to 50 mA of current is available on each channel
- Fixed low-pass anti-aliasing filter (six-pole)
- Input connections to user's voltage source via nine-pin D-sub connector
- Analog output

CHANNELS
One per card

INPUTS
DC volts (differential)

Input Impedance
22 MΩ each input

Source Current
±2 nA typical

±100 nA max

Input Connector
Nine-pin D-sub style

AMPLIFIER

Zero Temperature Stability
±2 µV/°C RTI, typical. ±100 µV/°C RTO, after 30-minute warm-up

DC Gain Accuracy and Stability
±0.05% at 23°C ± 20 ppm/°C

Common-Mode Rejection (DC to 60 Hz)
86 dB typical at X1 gain

94 dB typical at X10 gain

Common-Mode Voltage
±12V typical

AC Accuracy (Typical)

Input Frequency/Bandwidth	500/3000	50/200
Spurious Free Dynamic Range	100 dB	110 dB
Signal to Noise	90 dB	95 dB
Signal to Distortion	100 dB	110 dB

MEASUREMENT RANGES
±1, ±2, ±5, ±10 VDC

RESOLUTION
30.5, 61, 152.5, 305 µV

EXCITATION
0, 0.5, 1.0, 2.0, 5.0, 10.0, 15.0, 20.0, 24.0, 30.0 VDC

Accuracy
±10 mV typical at 0 to 24 VDC; ±5% at 30 VDC

Current
50 mA max. Over-current protected

Load Regulation
<±0.05% of full scale for a load variation of 10% to 100% of full load

Temperature Stability
Better than ±0.005%/°C

A/D CONVERTER

Type
16-bit successive approximation with integrated sample and hold

Integral Linearity Error
±2 LSB

FILTERS
Linear phase, analog, 6-pole anti-aliasing filter, and 256-tap, programmable, FIR digital filter (lowpass)

Passband Frequency
User-selectable 1 Hz to 4 kHz

ANALOG OUTPUT (6030A Version Only)

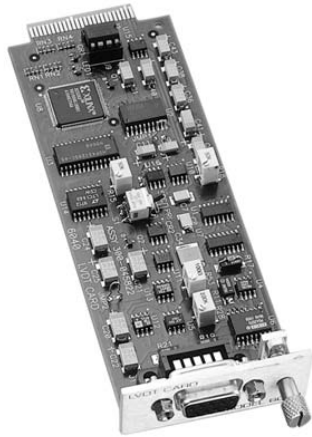### Type
±5.00V max for typical full-scale input of ±32,767 µε

Output Load
2000Ω min

Bandwidth
DC to 15 kHz (–0.5 dB typical)

StrainSmart® Data Acquisition System

MODEL 6040A LVDT CARD

- Complete LVDT signal conditioner with 16-bit analog-to-digital converter
- Programmable digital filter
- Independent AC excitation supply
- Programmable gain steps of 1, 2, 5, and 10
- Supports six-, five-, four-, and three-wire transducers
- Fixed low-pass anti-aliasing filter (six-pole)
- Excitation reference provided for calibration
- Input connections to user's transducer via nine-pin D-sub connector

CHANNELS
One per card

INPUTS
3- to 6-wire transducers

Input Impedance
10 MΩ each input

Source Current
±2 nA typical; ±100 nA max

Input Connector
Nine-pin D-sub style

AMPLIFIER

Zero Temperature Stability
±2 µV/°C RTI, typical. ±100 µV/°C RTO, after 30-minute warm-up

Gain Accuracy and Stability
±0.25% typical

Common-Mode Rejection (DC to 60 Hz)
86 dB typical at X1 gain
94 dB typical at X10 gain

Common-Mode Voltage
±12V typical

MEASUREMENT RANGES
±0.5, ±1, ±2.5, ±5 VRMS

RESOLUTION
15.25, 30.5, 76.2, 152.5 µVRMS

CALIBRATION
Excitation sample

EXCITATION
3.0 VRMS at 2500, 5000, or 10000 Hz sine wave
Software-selectable

Accuracy
±5 mVRMS typical

Current
±50 mA max. Over-current protected

Load Regulation
<±0.1% of full scale for a load variation of 10% to 100% of full load

Temperature Stability
Better than ±0.05%/°C

A/D COVERTER

Type
16-bit successive approximation with integrated sample and hold

Integral Linearity Error
±2 LSB

FILTERS
Butterworth, six-pole anti-aliasing analog filter, and 256-tap, programmable, FIR digital filter (lowpass)

Passband Frequency
User-selectable 1 Hz to 4 kHz
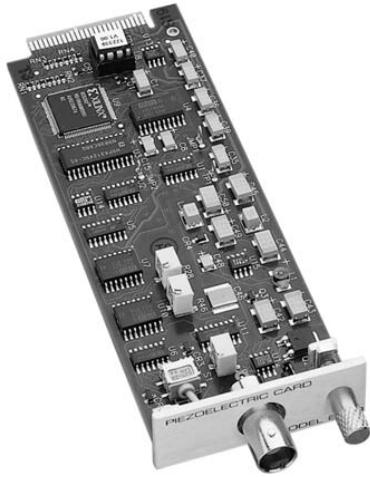
ANALOG OUTPUT (6040A Version Only)
Linear Output: ± 5.00V for typical full-scale input
Output Load: 2000Ω min
Bandwidth: DC to 1 kHz (–3 dB typical)

StrainSmart® Data Acquisition System

MODEL 6050 PIEZOELECTRIC CARD

- Complete piezoelectric signal conditioner with 16-bit analog-to-digital converter
- Supports both VM (voltage mode, low impedance) and CM (charge mode, high impedance) type piezoelectric transducers
- Programmable constant current excitation supply for VM transducers is software settable to 1, 2, 4, 5, 10 and 20 mA
- Programmable gain steps of 1, 2, 5, and 10 for VM transducers and steps of 1, 2, 5, 10, 20, 50 and 100 for CM transducers
- Programmable digital filter
- Fixed low-pass anti-aliasing filter (six-pole)
- Input connections to user's transducer via BNC connector

CHANNELS
One per card

INPUTS
Voltage mode (VM) or charge mode (CM) piezoelectric type transducers (type is switch-selectable)

Coupling
CM Type: Charge amplifier with software-selectable time constants of 0.5 and 5 seconds

VM Type: AC coupling to remove DC bias voltage with high pass response of 0.1 Hz (-3 dB)

Input Connector
Female BNC

AMPLIFIER
Zero Temperature Stability
±10 µV/°C RTI, typical, after 30-minute warm-up

Charge Amplifier Zero Stability
±1.2 pC/°C RTI typical at 0.5 second time constant

DC Gain Accuracy and Stability
±0.1% at +23°C; ±25 ppm/°C

AC Accuracy (Typical at X2 Gain Step)

Input Frequency/Bandwidth	500/3000	50/200
Spurious Free Dynamic Range	100 dB	110 dB
Signal to Noise	90 dB	95 dB
Signal to Distortion	100 dB	110 dB

MEASUREMENT RANGES
VM Type Transducers
±10.5V, ±5.25V, ±2.1V, and ±1.05V

CM Type Transducers
±200 000 pC, ±100 000 pC, ±40 000 pC, ±20 000 pC, ±10 000 pC, ±4000 pC, and ±2000 pC

RESOLUTION
0.0015% of range

CALIBRATION
Excitation sample

EXCITATION
0, 1, 2, 4, 5, 10 and 20 mA selections for VM type transducers

Accuracy
±1% + (±30 µA) typical at 1 to 20 mA

Voltage Compliance
0 to 28V

Temperature Stability
±50 ppm/°C

A/D CONVERTER
Type
16-bit successive approximation with integrated sample and hold
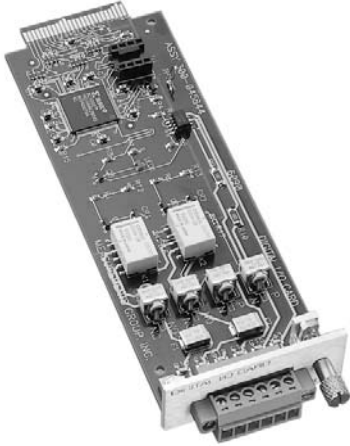
Integral Linearity Error
±2 LSB

FILTERS
Linear phase, analog, 6-pole anti-aliasing filter, and 256-tap, programmable, FIR digital filter (lowpass)

Passband Frequency
User-selectable 1 Hz to 4 kHz

EMEME Micro-Measurements

StrainSmart® Data Acquisition System

MODEL 6095 DIGITAL/TACHOMETER CARD

- Multi-function digital input card
- Relay output for control functions
- Compatible with all System 6000 hardware
- Supported by StrainSmart software

When used in conjunction with Micro-Measurements StrainSmart® Software, the Model 6095 Digital/ Tachometer Card enables the user to capture and reduce data in any one of five operating modes:

- Tachometer Mode
- Interval Mode
- Quadrature Mode
- Counter Mode
- Digital Input Mode

Depending upon the mode selected, data can be reduced as a digital input; counts; interval counts; pulses; rate; shaft angle; RPM; radians or degrees per second; elapsed time (milliseconds, seconds or minutes); or calculated values.

Multiple Model 6095 Cards can be used in each system, and each card in a system can be configured individually to any operating mode. However, the relay provides one distinct control function (on/off control for testing machines, etc.) per system when using a Model 6100 Scanner, or one per scanner when using multiple Model 6200 Scanners.

The Model 6095 is compatible with all Model 6100 and 6200 Scanners. It is supported by Version 3.0, and later, StrainSmart Software; no-charge upgrades are available upon request.

INPUT CONNECTOR

Nine-pin, D-sub style

RELAY OUTPUTS

Quantity

One

Configuration

NO and NC, 500 mA contact at 30 VAC or 30 VDC into resistive load

DIGITAL INPUTS

Quantity

Four

Configuration

Optically isolated. TTL Schmitt-trigger input thresholds accept up to 28 VDC without damage. 2.23Ω pull-up resistors can be selected for each input.

Impedance

50 kΩ

Data Rate

DC to 200 kHz

Accessory Supply

5 Volt ± 5%, 75 mA

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 6000 with PCI or PCIe Interface**—Model 6101PCI or Model 6101PCIe Interface Card, at least one Model 6100 Scanner, and at least one Model 6010, 6020, 6030, 6040, 6050, or 6095 Input Card
- **System 6000 with Ethernet Interface**—At least one Model 6200 Scanner and at least one Model 6010, 6020, 6030, 6040, 6050, or 6095 Input Card

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StrainSmart® Data Acquisition System

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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