

Model 9000 – High-Speed Data Acquisition System

FEATURES

- 12 Strain gage channels, supporting quarter, half, and full bridge strain gages and strain-gage-based transducers.
- 4 Plug-in card slots, available to support:
 - High-level voltage signal
 - Thermocouples
 - Piezoelectric transducers (charge mode and voltage mode)
- Sampling rates: 50,000, 25,000, 10,000 and 5,000 samples/second.
- Synchronized sampling of all channels.
- Expansion to a 48-channel system: Up to three scanners can be combined to provide 48 fully synchronized channels (36 strain gage plus 12 configurable).
- On-board Data Recording: Supports manual, time, and limits-based recording. Pre- and post-trigger data are available for limits-based recording and manually-triggered recording.
- Self-Calibrating (Optional) using NIST-traceable voltage calibration card (Model A123).
 - Provides a high-accuracy voltage source used to calibrate the gain and offset of each channel. A123 is removable and interchangeable and it only needs to be present in the Model 9000 during the self-calibration process.
- Optional analog outputs (Model 9000-16-SM-AO): Provide an analog output for each of the twelve strain gage channels. Bandwidth DC to 19.8 kHz.

DESCRIPTION

System 9000 from Micro-Measurements is a versatile, precision data acquisition instrument system intended for dynamic test and measurement applications.

The system includes a scanner with 12 channels of strain-gage-based input and 4 optional input slots (thermocouple, high level and piezoelectric).

The scanners may be used separately or up to 3 scanners can be used concurrently for a maximum of 48 fully synchronized channels.

Strain gage channels accept quarter, half, or bridge configurations and have the required bridge completion components for 120, 350, and 1000 Ω bridges. The data is processed in a 24-bit digital signal processor (DSP) and filtering is performed using Finite Impulse Response (FIR), multi-stage filters. This provides excellent noise rejection and stability.

The Model 9000-16-SM Scanner communicates with a host personal computer (PC) via a DHCP auto configured Ethernet connection (required router not included).

Micro-Measurements StrainSmart® software is optimal for configuring, controlling, and acquiring data from the System 9000.



SUPPORTED SENSORS

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

INPUT CONNECTIONS

Strain gage and high level inputs use RJ45 plugs. Shielded wires and shielded connectors are recommended. The thermocouple card accepts both 2- and 3-pin miniature plugs. The piezoelectric card connects through a BNC connector.

ETHERNET ARCHITECTURE

The Model 9000 communicates over an IEEE-802.3u 100Base-TX Network. Use of the Dynamic Host Configuration Protocol (DHCP) automates the IP address configuration.

DC OPERATION

The Model 9000 operates on 11-32 VDC power. Power can be sourced from the included power supply, a separate AC-to-DC converter, or a DC supply such as a battery.

DIGITAL I/O

A digital input and output are provided to interface with external hardware.

MOUNTING

The Model 9000 can be configured as a stand-alone desktop unit, stacked, or rack-mounted. A rack-mount kit is available from Micro-Measurements (9000-RM).

Model 9000 – High-Speed Data Acquisition System

SPECIFICATIONS

All specifications are nominal or typical at +23°C unless noted.

PARAMETER	SPECIFICATION			
MODEL 9000-16-SM				
Environmental				
Temperature:	0° to +50°C			
Humidity:	Up to 90%, non-condensing			
CONFIGURATIONS	Bench-top, stackable, rack-mountable			
COMMUNICATION				
Ethernet interface:	100 Mbit			
Network protocol:	DHCP			
DATA RECORDING				
Storage type:	Internal SATA solid state drive			
Capacity:	≥16 GB, max file size is 2 GB			
SYNCHRONIZATION				
Channel count:	≤48 channels (3 devices)			
Configuration:	“Star” topology, max cable length ≤7 ft (~2 m)			
CHANNELS	12 Differential inputs 4 Configurable input slots			
A/D CONVERTER				
Architecture:	Delta-Sigma ($\Delta\Sigma$)			
Resolution:	24 bits			
Oversampling rate:	128 times the selected data rate			
Sampling mode:	Simultaneous			
DATA RATES	50,000, 25,000, 10,000 and 5,000 samples/second/ channel			
ANALOG ANTI-ALIAS FILTER				
Type:	Low-pass			
Frequency:	20 kHz @ -3 dB			
Number of poles:	One			
Topology:	Low-pass RC			
DIGITAL FILTERS				
Type:	Finite Impulse response (FIR), two selectable filters provided per sampling rate)			
	<i>f</i> _{user} (Hz)	<i>F</i> _{pass} (Hz)	Passband Peak-Peak Ripple (dB)	Stopband Attenuation (dB)
	50,000	12500	0.01	-80
	25,000	6250	0.01	-80
	10,000	2500	0.01	-80
	5,000	1250	0.01	-80
	Alternate Digital Filter Specifications			
	<i>f</i> _{user} (Hz)	<i>F</i> _{pass} (Hz)	Passband Peak-Peak Ripple (dB)	Stopband Attenuation (dB)
	50,000	6250	0.01	-80
	25,000	3125	0.01	-80
	10,000	1250	0.01	-80
	5,000	625	0.01	-80
POWER Input:	11-32 VDC, 10 A max			

Model 9000 – High-Speed Data Acquisition System

PARAMETER	SPECIFICATION		
ENCLOSURE			
Material:	A356-T6 aluminum casting		
SIZE	3.50 x 17.19 x 11.5 inch (88.9 x 436.7 x 292.1 mm) (H x W x D) Feet add 0.33" (9.35 mm) to the height. A123 VCAL module adds 1.47" (37.4 mm) to the depth		
WEIGHT	13.05 lbs (5.92 kg), without auxiliary plug in cards		
STRAIN GAGE INPUTS			
Quantity:	12		
INPUTS	Software-selectable for S+/S-, Vcal+/Vcal-, or excitation		
Supported Strain gage resistance	120 Ω , 350 Ω , 1000 Ω quarter bridges; 60 Ω to 5000 Ω half and full bridges		
Input impedance:	220 M Ω nominal each input		
Source current:	± 5 nA per volt excitation		
MEASUREMENT RANGE AND RESOLUTION			
Resolution:	0.5 μE @ GF=2 (0.25 $\mu\text{V/V}$)		
Range:	Depends upon excitation setting		
	Excitation (V)	Typical Measuring Range includes Imbalance	
		$\pm\mu\text{E}$ @ GF=2	$\pm\text{mV/V}$
	0	77500*	19*
	0.25	310000	155
	0.5	155000	77
	0.75	103000	51
	1	77000	38
	2	3800	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	RJ45		
AMPLIFIER			
Zero temperature stability:	± 1 $\mu\text{V}/^\circ\text{C}$ RTI, after 60-minute warm-up		
DC Gain accuracy and stability:	$\pm 0.05\%$; ± 50 ppm/ $^\circ\text{C}$ (1 year without periodic VCAL)		
Analog input (including full-scale balance):			
Low range:	± 38 mV		
High range:	± 155 mV		
Linearity:	$\pm 0.02\%$ of full scale		
Common-mode rejection:	> 90 dB (DC to 60 Hz)		
Common-mode voltage range:	± 12 V typical		

Model 9000 – High-Speed Data Acquisition System

PARAMETER	SPECIFICATION	
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:	120 Ω and 350 Ω: ±0.01%, 5 ppm/°C max 1 kΩ: ±0.01%, 4.5 ppm/°C max (socketed)	
SHUNT CALIBRATION		
Selection:	Firmware controlled	
Configuration:	Shunt calibration across each dummy resistor to simulate 10000 µε (±0.1%).	
External:	Switched shunt at input connector (Ra, Rb)	
Resistor sockets:	Tin-plated	
DIGITAL INPUT/OUTPUT		
Quantity:	1 input and 1 output	
Configuration:	5 V TTL, Isolated	
ANALOG OUTPUTS	(MODEL 9000-16-SM-AO)	
Quantity:	12 (one per strain gage input channel)	
Connectors:	Female BNC Jack (50 Ω)	
Range:	±10 V (min.)	
Load:	2000 Ω min.	
Bandwidth:	DC to 19.8 KHz (-3 dB ±0.25 dB)	
Gain accuracy:	±1%	
Gain:	Not selectable, depends upon excitation setting	
	Excitation Selection (Volts)	Gain (Volts/Volt)
	0-3	257.05
	4-10	64.262
	NOTE: Software gage factor settings or balance settings have no effect on Analog Output response.	
MODULE 9000-TC	THERMOCOUPLE INPUT CARD (OPTIONAL)	
CHANNELS:	1 channel per card; 4 cards max	

Model 9000 – High-Speed Data Acquisition System

PARAMETER	SPECIFICATION
INPUTS	
Supported types:	J, K, T, E, N, R, S, B
Cold-junction compensation, software-selectable	
Open-sensor detection	
Input impedance:	22 M Ω nominal each input
INPUT CONNECTORS:	Mini-TC with optional earth connection
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:	$\pm 0.1\%$; $\pm 30 \text{ ppm}/^\circ\text{C}$
Zero accuracy and linearity:	$\pm 0.02\%$ of full scale
Common mode rejection (DC to 60 Hz):	>90 dB Common mode
Common-mode Voltage range:	$\pm 12 \text{ V}$ typical
MEASUREMENT RANGE AND RESOLUTION	
Range:	$\pm 77.5 \text{ mV}$
Resolution:	1 $^\circ\text{C}$ min.
Measurement Accuracy:	$\pm 2^\circ\text{C}$ (nominal)
MODULE 9000-HL	
HIGH-LEVEL INPUT CARD (OPTIONAL)	
CHANNELS:	1 channel per card; 4 cards max
INPUTS	
Input impedance:	220 M Ω nominal each input
Input bias current:	$\pm 0.5 \text{ nA}$ typical ($\pm 2 \text{ nA}$ max)
Input connector:	RJ45
AMPLIFIER	
Zero temperature stability:	$\pm 2 \mu\text{V}/^\circ\text{C}$ RTI typical, $\pm 10 \mu\text{V}/^\circ\text{C}$ RTO, after 60-minute warm-up
DC Gain accuracy and stability:	$\pm 0.1\%$; $\pm 30 \text{ ppm}/^\circ\text{C}$
Zero accuracy and 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
Unipolar mode:	
Range:	0 to +11.997 VDC
Accuracy:	$\pm 10 \text{ mV}$ 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 $\pm 30 \text{ ppm}/^\circ\text{C}$

Model 9000 – High-Speed Data Acquisition System

PARAMETER	SPECIFICATION
Bipolar mode:	
Range:	±12 VDC (24 VDC total)
Accuracy:	±5% of full scale
MODEL 9000-PE	PIEZOELECTRIC INPUT CARD (OPTIONAL)
CHANNELS:	1 channel per card; 4 cards max
INPUTS	VM or CM piezoelectric type transducers (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	
Gain Accuracy @1KHz:	±0.5%
Secondary stage DC gain accuracy and stability:	±0.1% at +23°C; ±25 ppm/°C
MEASUREMENT RANGES AND RESOLUTION	
VM Type transducers range:	0.5 to 29.5 VDC input with measurement ranges of ±14.5 V, ±9.5 V, ±4.7 V, and ±2.3 V
Resolution:	1µV
Charge type transducers range:	±225,000 pC, ±56,000 pC, ±14, 000 pC, ±3,500 pC, ±875 pC
Resolution:	0.1 pC
EXCITATION	
Selection:	Software controlled
Range:	0, 1, 2, 4, 5, 10 and 20 mA for VM type transducers
Accuracy:	±3% + (±30 µA) typical at 1 to 20 mA
Voltage compliance:	0 to 28 V
Temperature stability:	±100 ppm/°C
A123 VOLTAGE CALIBRATION CARD (OPTIONAL)	
ACCURACY	±100 ppm repeatability typical; ±250 ppm repeatability, max.
DRIFT	1.9 ppm/°C ±0.6 µV/°C typical; 9.4 ppm/°C ±2.1 µV/°C max
RESOLUTION	150 µV nominal
VOLTAGE RANGE	±5 V
INSTRUMENT CALIBRATION	Firmware controlled
Calibration voltage:	Supplied by the optional A123 voltage calibration card
Type:	Multi-point, ≥100 samples per point

A123 Voltage Calibration Card
(Optional)



Model 9000 – High-Speed Data Acquisition System

SYSTEM 9000 OPTIONAL ACCESSORIES		
MM Part Number	Item Description	Notes
COMMUNICATION		
MM120-001623	MMA128 Ethernet router (with cable)	Required for communication between your PC and the 9000 ⁽¹⁾
MM120-001624	MMA129 7', Cat6, shielded, straight-through Ethernet cable	Used for synchronization cabling between multiple instruments. May also be used for Ethernet communication.
MM120-001625	MMA131 2', Cat6, shielded, straight-through Ethernet cable	Used for synchronization cabling between multiple instruments. May also be used for Ethernet communication.
MM120-001580	10', Cat5e, unshielded, straight-through Ethernet cable	Used for Ethernet communication (1) (should not be used for synchronization cabling)
OPTION MODULES		
MM120-001608	9000-HL High Level Input Card	High-level voltage signals ± 10 VDC
MM120-001609	9000-TC Thermocouple Input Card	Supported J, K, T, E, N, R, S, B types
MM120-001610	9000-PZ Piezoelectric Input Card	Charge and voltage mode capable
MM120-001579	A123 Calibration (VCAL) card	Required for on-site calibration
MM120-001606	Rack-mount kit	Brackets for mounting into an instrumentation rack
INPUT CONNECTION		
MM120-001620	MMA114 - RJ45(8) modular plug, shielded	Recommended connector for strain gage and high level inputs. May be used for digital I/O.
MM120-001581	MMA106 RJ45(8) modular plug, unshielded	Connector for digital input/output
MM120-001622	MMA115 RJ45(8), shielded modular plug crimping	Tool used to crimp wires to connector MMA114
MM120-001582	MMA108 RJ45(8), unshielded modular plug crimping	Tool used to crimp wires to connector MMA106
MM120-001627	MMA134 2-Pin miniature plug for type J	No shield present
MM12X300830	MMA135 3-Pin miniature plug for type J	Shield present
MM120-001629	MMA136 2-Pin miniature plug for type	No shield present
MM120-001630	MMA137 3-Pin miniature plug for type K	Shield present
MM120-001626	MMA141 Wire Clamp Bracket For Mini TC Plug	

Note 1: The 9000 requires a DHCP-enabled router for communication with a PC. Part number MMA128 provides a router and a single cable which may be connected to your PC. Each 9000 instrument will require an additional Ethernet cable (MMA90, MMA129, or MMA131).



Disclaimer

ALL PRODUCTS, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE.

Vishay Precision Group, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "VPG"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained herein or in any other disclosure relating to any product.

The product specifications do not expand or otherwise modify VPG's terms and conditions of purchase, including but not limited to, the warranty expressed therein.

VPG makes no warranty, representation or guarantee other than as set forth in the terms and conditions of purchase. **To the maximum extent permitted by applicable law, VPG disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.**

Information provided in datasheets and/or specifications may vary from actual results in different applications and performance may vary over time. Statements regarding the suitability of products for certain types of applications are based on VPG's knowledge of typical requirements that are often placed on VPG products. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. You should ensure you have the current version of the relevant information by contacting VPG prior to performing installation or use of the product, such as on our website at vpgsensors.com.

No license, express, implied, or otherwise, to any intellectual property rights is granted by this document, or by any conduct of VPG.

The products shown herein are not designed for use in life-saving or life-sustaining applications unless otherwise expressly indicated. Customers using or selling VPG products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify VPG for any damages arising or resulting from such use or sale. Please contact authorized VPG personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.

Copyright Vishay Precision Group, Inc., 2014. All rights reserved.