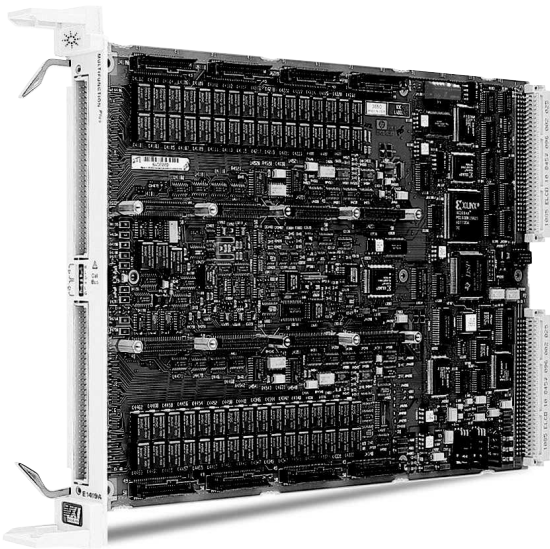


# Agilent E1419A Multifunction<sup>Plus</sup> Measurement and Control Module

## Data Sheet

- Comprehensive signal conditioning on board
- Wide choice of Input/Output signal types
- Powerful control capability
- On-board data reduction & engineering unit conversion
- Custom on-board DSP program development



Agilent E1419A

## Description

The Agilent Technologies E1419A Multifunction<sup>Plus</sup> Measurement and Control module is a **C-size, 1-slot, register-based VXI module**. It is ideal for mixed sensor and mixed signal data acquisition and control for design verification of electromechanical components and assemblies.

The flexibility in configuring with multiple Signal Conditioning Plug-ons (SCPs) allows for multiple test setups of mixed signals, both input and output, without adding extra VXI measurement modules. The integrated signal conditioning provides for more accurate and repeatable calibration and eliminates the need for separate signal conditioning carriers. The intelligent measurement and control allows for scaleable configurations, on-board Engineering Unit (EU) conversion, and real-time decision making.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.



## Compact Packaging with Signal Conditioning

The E1419A provides for configurable signal conditioned I/O with up to eight individual plug-ons for analog, digital, and frequency needs. The SCPs supported by the E1419A are:

- E1501A 8-Channel Direct Input SCP
- E1502A 8-Channel 7 Hz Low-pass Filter SCP
- E1503A 8-Channel Programmable Filter and Gain SCP
- E1505A 8-Channel Current Source SCP
- E1506A 8-Channel 120  $\Omega$  Strain Completion & Excitation SCP
- E1507A 8-Channel 350  $\Omega$  Strain Completion & Excitation SCP
- E1508A 8-Channel x16 Gain & 7 Hz Fixed Filter SCP
- E1509A 8-Channel x64 Gain & 7 Hz Fixed Filter SCP
- E1510A 4-Channel Sample & Hold Input SCP
- E1511A 4-Channel Transient Strain SCP
- E1512A 8-Channel 25 Hz Fixed Filter SCP
- E1513A 8-Channel Divide-by-16 Fixed Attenuator & 7 Hz Low-pass Filter SCP
- E1518A 4-Wire Resistance Measurement SCP
- E1531A 8-Channel Voltage Output SCP
- E1532A 8-Channel Current Output SCP
- E1533A 16-Bit Digital I/O SCP
- E1536A 8-Bit Isolated Digital I/O SCP
- E1538A Enhanced Frequency/Totalize/PWM SCP

## Wide Choice of Inputs/Outputs

The E1419A has a variety of signal conditioning plug-ons for making measurements of:

- Temperature, strain
- Voltage, current, resistance
- RPM, frequency, totalize
- Discrete levels, TTL, contact closures

In addition, the measured input values and the calculated output values can be stored in a 64,000-sample FIFO buffer and efficiently transferred to the controlling computer in blocks of data. A 500-element current value table is provided so user-written programs can post the latest reading or condition to the controlling computer. The result of any program calculation can be an input for use by another program or subsystem, or it can be a direct output of several different types. Among the choices of output are:

- Analog voltage
- Analog current
- Discrete levels (TTL)
- Programmable pulse width modulation (TTL)

As an example of output flexibility, the pulse width modulation output has several modes. In the PWM free-run mode, the frequency or pulse width output is independent of the update rate and can be changed once per loop update cycle. The square wave mode provides a variable frequency, fixed 50% duty cycle output signal. The pulse-per-update mode provides a variable width pulse synchronized to the update cycle.

## Powerful Decision Making Capability

The user-written programs are easily developed from a list of algebraic expressions and flow constructs such as IF-ELSE. Any variable (array or scalar) can be read or written on-the-fly. That is, new values are double-buffered so there is no need to stop scanning the inputs or halt the program execution.

The inputs to user programs can be measured values from multiple channels, operator input values, global variables from other programs, or values from other subsystems.

The on-board 40 MHz pipelined DSP provides highly deterministic execution, making it easy to accurately predict cycle times. Engineering unit conversions for temperature, strain, resistance, and voltage measurements are made automatically without slowing down the algorithm execution speed.

## Custom Program Development

**Language:** subset of C, programming language including if-then-else, most math and comparison operations.

**Variable types:** scalar local and global variables, array local and global variables.

**Intrinsic functions:** interrupt ( ), writefifo ( ), writecvt ( ), writeboth ( ), min ( ), max ( ), abs ( ).

**Other functions:** create your own custom functions to handle transcendental operations.

## Automated Calibration for Better Measurements

The E1419A offers superior calibration capabilities that provide more accurate measurements. Periodic calibration of the measurement and control module's measurement inputs is accomplished by connecting an external voltage measurement standard (such as a highly accurate multimeter) to the inputs of the measurement and control module. This external standard first calibrates the on-board calibration source. Then built-in calibration routines use the on-board calibration source and on-board switching to calibrate the entire signal path from the measurement and control module's input, through the signal conditioning plug-ons (SCPs) and FET MUX, to the A/D itself. Subsequent daily or short-term calibrations of this same signal path can be quickly and automatically done using the internal calibration source to eliminate errors introduced by the signal path through the SCPs and FET MUX, or by ambient temperature changes. All input channels can be quickly and productively calibrated to assure continued high-accuracy measurements.

In addition to the calibration of the signal path within the measurement and control module, the E1419A allows you to perform a "Tare Cal" to reduce the effects of voltage offsets and IR voltage drops in your signal wiring that is external to the measurement and control module. The Tare Cal uses an on-board D/A to eliminate these voltage offsets. By placing a short circuit across the signal or transducer being measured, the residual offset can be automatically measured and eliminated by the D/A. Tare Cal should not be used to eliminate the thermoelectric voltage of thermocouple wire on thermocouple channels.

## Signal Conditioning Plug-Ons

A Signal Conditioning Plug-on (SCP) is a small daughter board that mounts on Agilent's VXI scanning measurement and control modules. These SCPs provide a number of input and output functions. Several include gain and filtered analog inputs for measuring electrical and sensor-based signals, as well as frequency, total event count, pulse-width modulation, toothed-wheel velocity, and digital state. Output functions include analog voltage and current D/As, 8- or 16-bit digital outputs, pulse output with variable frequency and PWM, and stepper motor control.

Refer to the information on each individual SCP for more details.

## Voltage Measurements

Use any of the following SCPs with the E1419A to make voltage measurements: E1501A, E1502A, E1503A, E1508A, E1509A, E1512A or E1513A.

## Temperature Measurements

Any of the input SCPs can be used to make temperature measurements with thermocouples, thermistors, or RTDs, but the E1503A/E1508A/E1509A SCPs provide higher accuracy with thermocouples.

## Resistance Measurements

Resistance is measured using either the E1505A 8-Channel Current Source SCP or an input SCP or the E1518A 4-Wire Resistance Measurement SCP. Measurements are made by applying a dc current to the unknown and measuring the voltage drop across the unknown.

## Static Strain Measurements

The E1506A and E1507A SCPs provide a convenient way to measure a few channels of static strain. When using the E1506A/E1507A for bridge completion, a second SCP is required to make the measurement connection. You can use the following SCPs for this type of static strain measurements:

- E1503A 8-Channel Programmable Filter/Gain SCP
- E1506A 8-Channel 120  $\Omega$  Strain Completion & Excitation SCP
- E1507A 8-Channel 350  $\Omega$  Strain Completion & Excitation SCP
- E1508A 8-Channel 7 Hz Fixed Filter & x16 Gain SCP
- E1509A 8-Channel 7 Hz Fixed Filter & x64 Gain SCP

For applications requiring more than eight channels of strain measurement, the combination of the Agilent E1422A/E1529A/E1539A provide a more cost effective approach to static (and dynamic) strain measurements.

## Transient Measurements

When making higher speed measurements, a vital issue often is the time skew between channels. Ideally, in many applications, the sampled data is needed at essentially the same instant in time. The intrinsic design of the E1419A provides scanning of 64 channels with maximum skew of 640  $\mu$ S between the first and last channel, far less than most sampled data systems.

## Transient Voltage Measurements

The E1510A provides basic sample-and-hold capabilities on four channels. Six-pole Bessel filters provide alias and alias-based noise reduction while giving excellent transient response without overshoot or ringing. The E1510A can be used in strain applications primarily where the bridge is external.

## Transient Strain Measurements

The E1511A, a double-wide SCP, has all the capabilities of the E1510A but adds on-board bridge excitation and completion functions. The four direct input channels are used for monitoring the bridge excitation. A maximum of two SCPs (8 channels) can be installed on an E1419A.

**Note:** For field wiring, the use of shielded twisted pair wiring is highly recommended.

## Analog Output

Use the E1531A for voltage outputs and the E1532A for current outputs. The E1531A and E1532A have eight (8) output channels available on each SCP.

## Digital I/O

Use the E1533A Digital I/O SCP to provide two 8-bit input/output words. Use the E1536A Digital I/O SCP to provide one isolated 8-bit input/output word.

## Frequency/Totalize/PWM

The E1538A Enhanced Frequency/Totalize/PWM SCP provides eight (8) channels which can be individually configured as a frequency or totalizer input, or as a pulse width modulated output.

## Product Specifications

### Timing Signals

<b>Timing:</b>	Scan-to-scan timing and sample-to-sample timing can be set independently.
<b>Scan triggers:</b>	Can be derived from a software command or a TTL level from other VXI modules, internal timer, or external hardware. Typical latency 17.5 $\mu$ s.
<b>Synchronization:</b>	Multiple E1419A modules can be synchronized at the same rate using the TTL trigger output from one E1419A to trigger the others.
<b>Alternate synchronization:</b>	Multiple E1419A modules can be synchronized at different integer-related rates using the ALG:SCAN:RATIO command and the TTL trigger output from one E1419A module to trigger the others.

### Scan Triggers

<b>Internal:</b>	100 $\mu$ sec to 6.5536 sec
<b>Resolution:</b>	100 $\mu$ sec
<b>Trigger count:</b>	1 to 65535 or infinite

### Sample Timer

<b>Range:</b>	10 $\mu$ sec to 32768 msec
<b>Resolution:</b>	0.5 $\mu$ sec

## Measurement Specifications

The following specifications include the SCP and scanning A/D performance together as a unit. Accuracy is stated for a single sample. Averaging multiple samples will improve accuracy by reducing noise of the signal. The basic E1419A scanning A/D has a full scale range of  $\pm 16$  V and five autoranging gains of x1, x4, x16, x64, and x256. An SCP must be used with each eight channel input block to provide input protection and signal conditioning.

Refer to the information on each individual SCP for measurement specifications.

<b>Measurement resolution:</b>	16 bits (including sign)
<b>Maximum reading rate:</b>	Up to 56 kSamples/s dependent upon configuration
<b>Memory:</b>	64 kSa
<b>Maximum input voltage:</b>	Normal mode plus common mode
Operating:	$<\pm 16$ V peak
Damage level:	$>\pm 42$ V peak
<b>Maximum common mode voltage:</b>	
Operating:	$<\pm 16$ V peak
Damage level:	$>\pm 42$ V peak
<b>SCP input impedance:</b>	$>100$ M $\Omega$ differential
<b>Maximum tare cal offset:</b>	65.5 mV range $\pm 75\%$ of full scale, other ranges $\pm 25\%$ of full scale
<b>Jitter:</b>	
Phase jitter scan-to-scan:	80 ps rms
Phase jitter card-to-card:	41 ns peak 12 ns rms

## Measurement Accuracy

Typically  $\pm 0.01\%$  of input level; varies with the SCP used. Specifications are 90 days,  $23 \pm 1^\circ$  C, with \*CAL done after a 1 hr warm-up and CAL:ZERO done within 5 minutes. **Note:** Beyond the 5 min. limitation and CAL:ZERO not done, apply the following drift error: Drift =  $10 \mu\text{V}/^\circ\text{C} \div$  SCP gain, per  $^\circ\text{C}$  change from CAL:ZERO temperature.

## Accuracy Data

Measurement accuracy is dependent upon the SCP module used. Refer to the accuracy tables and graphs for the individual SCP to determine the overall measurement accuracy.

Many definitions of accuracy are possible. Here we use single-shot with 3 sigma noise. To calculate accuracy assuming temperature is held constant within  $\pm 1^\circ$  C of the temperature at calibration, the following formula applies:

$$\text{Single Shot } 3\sigma = \pm(\sqrt{(\text{Gain Error})^2 + (\text{Offset Error})^2} + 3\sigma \text{ noise})$$

## Correcting for Temperature

To calculate accuracy over temperature range outside the  $\pm 1^\circ \text{C}$  range, results after \*CAL are given by replacing each of the above error terms as follows:

Replace

$$(\text{GainError})^2$$

with

$$(\text{GainError})^2 + (\text{GainTempco})^2$$

Replace

$$(\text{OffsetError})^2$$

with

$$(\text{OffsetError})^2 + (\text{OffsetTempco})^2$$

### Power Available for SCPs

<b><math>\pm 24 \text{ V}</math>:</b>	1.0 A
<b>5 V:</b>	3.5 A

## General Specifications

### VXI Characteristics

<b>VXI device type:</b>	A16, slave only, register based
<b>Data transfer bus:</b>	n/a
<b>Size:</b>	C
<b>Slots:</b>	1
<b>Connectors:</b>	P1/2
<b>Shared memory:</b>	n/a
<b>VXI buses:</b>	TTL Trigger bus (T)

**Instrument Drivers** - See the Agilent Technologies Website ([http://www.agilent.com/find/inst\\_drivers](http://www.agilent.com/find/inst_drivers)) for driver availability and downloading.

<b>Command module firmware:</b>	Downloadabl
<b>Command module firmware rev:</b>	A.08
<b>I-SCPI Win 3.1:</b>	No
<b>I-SCPI Series 700:</b>	Yes
<b>C-SCPI LynxOS:</b>	Yes
<b>C-SCPI Series 700:</b>	Yes
<b>Panel Drivers:</b>	No
<b>VXIplug&amp;play Win Framework:</b>	No
<b>VXIplug&amp;play Win 95/98/NT Framework:</b>	Yes
<b>VXIplug&amp;play HP-UX Framework:</b>	No

\*The Agilent VEE application can use VXIplug&play drivers or panel drivers.

### Module Current (with no SCPs installed)

	$I_{PM}$ (A)	$I_{DM}$ (A)
<b>+5 V:</b>	1.0	0.02
<b>+12 V:</b>	0.06	0.01
<b>-12 V:</b>	0	0
<b>+24 V:</b>	0.1	0.01
<b>-24 V:</b>	0.1	0.01
<b>-5.2 V:</b>	0.15	0.01
<b>-2 V:</b>	0	0

### Cooling/Slot

<b>Watts/slot:</b>	14.00
<b><math>\Delta P</math> mm H<sub>2</sub>O:</b>	0.08
<b>Air flow liter/s:</b>	0.8

## Ordering Information

Description	Product No.
Multifunction Plus Measurement and Control	E1419A <sup>1, 2</sup>
Delete 4 Direct Input SCP's	E1419A 001
Screw Terminal Block E1419A	E1419A 011
Spring-Clamp Terminal Block	E1419A 013
Interface to Rack Mount Panel	E1419A A3F
Convert 3 yr. Return to 1 yr. OnSite	E1419A W01
8-Channel Direct Input SCP	E1501A**
8-Channel 7 Hz Low-pass Filter SCP	E1502A**
8-Channel Programmable Filter/Gain SCP	E1503A
8-Channel Current Source SCP	E1505A
8-Channel 120 $\Omega$ Strain Completion & Excitation SCP	E1506A
8-Channel 350 $\Omega$ Strain Completion & Excitation SCP	E1507A
8-Channel x16 Gain & 7 Hz Fixed Filter SCP	E1508A**
8-Channel x64 Gain & 7 Hz Fixed Filter SCP	E1509A**
4-Channel Sample & Hold Input SCP	E1510A
4-Channel Transient Strain SCP	E1511A
8-Channel 25 Hz Fixed Filter SCP	E1512A**
8-Channel $\div$ 16 Fixed Attenuator & 7 Hz Low-pass Filter SCP	E1513A**
4-Wire Resistance Measurement SCP	E1518A
8-Channel Voltage Output SCP	E1531A
8-Channel Current Output SCP	E1532A
16-Bit Digital I/O SCP	E1533A
8-Bit Isolated Digital I/O SCP	E1536A
Enhanced Frequency/Totalize/PWM SCP	E1538A

<sup>1</sup>**Note:** No terminal block is included with the E1419A. You must specify a terminal block option when ordering.

<sup>2</sup>**Note:** A total of eight (8) Signal Conditioning Plug-ons (SCPs) can be installed in multiple combinations of input or output configurations on a single E1419A. The first four positions support only the non-programmable analog input SCPs (marked with asterisks [\*\*] in the Ordering Information table). The E1419A is shipped preconfigured with the E1501A direct inputs in the first four SCP positions. Any non-programmable input SCP marked with asterisks (\*\*) may be substituted by ordering Option 001 with the E1419A, then purchasing the SCP separately.

## For More Information

For more detailed information on individual SCPs, refer to the corresponding catalog pages for those products, or contact Agilent to request individual data sheets.

## **Agilent Technologies' Test and Measurement Support, Services, and Assistance**

Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Support is available for at least five years beyond the production life of the product. Two concepts underlie Agilent's overall support policy: "Our Promise" and "Your Advantage."

### **Our Promise**

Our Promise means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

### **Your Advantage**

Your Advantage means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and on-site education and training, as well as design, system integration, project management, and other professional engineering services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

**By internet, phone, or fax, get assistance with all your test & measurement needs.**

### **Online assistance:**

***[www.agilent.com/find/assist](http://www.agilent.com/find/assist)***

### **Phone or Fax**

United States:  
(tel) 1 800 452 4844

Canada:  
(tel) 1 877 894 4414  
(fax) (905) 282 6495

China:  
(tel) 800 810 0189  
(fax) 1 0800 650 0121

Europe:  
(tel) (31 20) 547 2323  
(fax) (31 20) 547 2390

Japan:  
(tel) (81) 426 56 7832  
(fax) (81) 426 56 7840

Korea:  
(tel) (82 2) 2004 5004  
(fax) (82 2) 2004 5115

Latin America:  
(tel) (305) 269 7500  
(fax) (305) 269 7599

Taiwan:  
(tel) 080 004 7866  
(fax) (886 2) 2545 6723

Other Asia Pacific Countries:  
(tel) (65) 375 8100  
(fax) (65) 836 0252  
Email: [tm\\_asia@agilent.com](mailto:tm_asia@agilent.com)

Product specifications and descriptions in this document subject to change without notice.

© Agilent Technologies, Inc. 2001  
Printed in USA September 1, 2001  
5965-8828E



**Agilent Technologies**