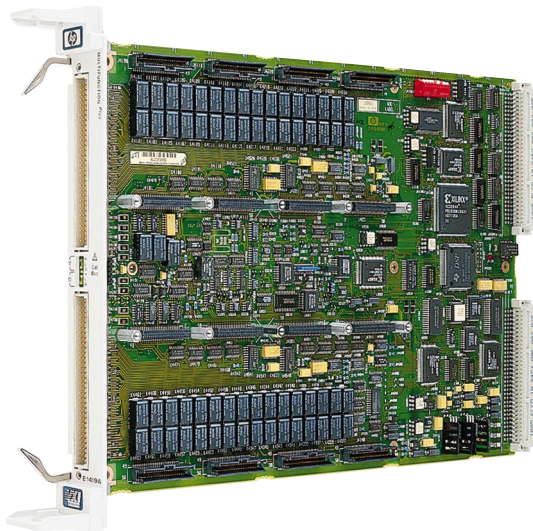


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# Multifunction<sup>Plus</sup> Measurement and Control HP E1419A Technical Specifications

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- 1-Slot, C-size, register based
- Comprehensive signal conditioning on board
- Wide choice of Input/Output signal types
- Powerful control capability
- On-board data reduction and engineering unit conversion
- Custom program development



HP E1419A

## Description

The HP 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 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 scalable configurations, on-board Engineering Unit (EU) conversion, and real-time decision making.

HP VEE graphical programming provides easy-to-use supervisory and analytical control. Example templates for checking channel setup, calibration, loading custom EU conversions, and others are included. Drivers are available for use with National Instruments' LabVIEW.

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

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## Compact Packaging with Signal Conditioning

The HP E1419A provides for configurable signal conditioned I/O with up to eight individual plug-ons for analog, digital, and frequency needs. More specifically the capabilities of the HP E1419A with SCP's are:

- HP E1501A 8-Channel Direct Input SCP
- HP E1502A 8-Channel 7 Hz Low-pass Filter SCP
- HP E1503A 8-Channel Programmable Filter and Gain SCP
- HP E1504A Breadboard SCP (for creating custom circuits)
- HP E1505A 8-Channel Current Source SCP
- HP E1506A 8-Channel 120 Ohm Strain Completion & Excitation SCP
- HP E1507A 8-Channel 350 Ohm Strain Completion & Excitation SCP
- HP E1508A 8-Channel x16 Gain & 7 Hz Fixed Filter SCP
- HP E1509A 8-Channel x64 Gain & 7 Hz Fixed Filter SCP
- HP E1510A 4-Channel Sample & Hold Input SCP
- HP E1511A 4-Channel Transient Strain SCP
- HP E1512A 8-Channel 25 Hz Fixed Filter SCP
- HP E1513A 8-Channel Divide-by-16 Fixed Attenuator & 7 Hz Low-pass Filter SCP
- HP E1514A 4-Channel Isolated x1 Gain & 10 Hz Fixed Filter SCP
- HP E1515A 4-Channel Isolated x1 Gain & 100 Hz Fixed Filter SCP
- HP E1516A 4-Channel Isolated x64 Gain & 10 Hz Fixed Filter SCP
- HP E1517A 4-Channel Isolated x64 Gain & 100 Hz Fixed Filter SCP
- HP E1518A 4-Wire Resistance Measurement SCP
- HP E1531A 8-Channel Voltage Output SCP
- HP E1532A 8-Channel Current Output SCP
- HP E1533A 16-Bit Digital I/O SCP
- HP E1534A 8-Bit Frequency/Totalize/PWM SCP
- HP E1535A Watchdog Timer SCP
- HP E1536A 8-Bit Isolated Digital I/O SCP
- HP E1537A 4-Channel Voltage Output SCP
- HP E1538A Enhanced Frequency/Totalize/PWM SCP

The on-board calibration reference is automatically routed to the input of the signal conditioning during the calibration cycle, thus eliminating the need to remove the module for calibration.

## Wide Choice of Inputs/Outputs

The HP 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.

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## 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.

## Signal Conditioning Plug-Ons

A Signal Conditioning Plug-on (SCP) is a small daughter board that mounts on HP'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, watchdog timeout, and stepper motor control.

Refer to each SCP's *Technical Specifications* for more information.

## Voltage Measurements

Use any of the following SCPs with the HP E1419A to make voltage measurements: HP E1501A/E1502A/E1503A, HP E1508A/E1509A, and HP E1512A/E1513A/E1514A/E1515A/E1516A/E1517A.

## Temperature Measurements

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

## Resistance Measurements

Resistance is measured using either the HP E1505A 8-Channel Current Source SCP and an input SCP or the HP 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

**Note:** SCPs are available for making both static strain measurements (HP E1506A and E1507A) and dynamic strain measurements (HP E1510A and E1511A).

Two SCPs are required to make static strain measurements: one to provide the excitation and bridge completion and one to make the measurement connection. Use the following SCPs for static strain measurements.

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

## 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. While the intrinsic design of the HP 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, this still may not be small enough skew for some applications.

## Transient Voltage Measurements

The HP 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 HP E1510A can be used in strain applications primarily where the bridge is external.

## Transient Strain Measurements

The HP E1511A, a double-wide SCP, has all the capabilities of the HP 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 four SCPs (16 channels) can be installed on an HP E1419A.

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

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## Analog Output

Use the HP E1531A or E1537A for voltage outputs, and the HP E1532A for current outputs. The HP E1531A and E1532A have eight (8) output channels available on each SCP; the HP E1537A has four (4) output channels.

## Digital I/O

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

## Frequency/Totalize/PWM

The HP E1534A 8-Bit Frequency/Totalize/PWM SCP and HP E1538A Enhanced Frequency/Totalize/PWM SCP provide eight (8) channels which can be individually configured as a frequency or totalizer input, or as a pulse width modulated output.

## Watchdog Timer

The HP E1535A Watchdog Timer SCP provides four channels of one-shot circuit controlled by software which can be used to open an external relay on various levels of fault.

## Create Custom Input Circuits

The HP E1504A Breadboard SCP allows you to create custom signal conditioning on up to eight channels. The board is primarily designed to help you implement custom filters and attenuators. Included on the board is over-voltage input protection circuitry and SCP identification circuitry. The remainder of the board area, 6 square inches, is for your custom circuitry.

## I/O General

A total of eight (8) Signal Conditioning Plug-ons (SCPs) can be installed in multiple combinations of input or output configurations on a single HP E1419A. The first four positions support only the non-programmable analog input SCPs such as the HP E1501A, E1502A, E1508A, E1509A, E1512A, E1513A, E1514A, E1515A, E1516A, and E1517A. The HP E1419A is shipped pre-configured with the HP E1501A direct inputs in the first four SCP positions.

## Configuration

The following SCPs may only be installed in SCP positions 5 through 8. Only four of these SCPs may be installed per module.

- HP E1505A
- HP E1506A
- HP E1507A
- HP E1510A
- HP E1511A
- HP E1531A
- HP E1532A
- HP E1533A
- HP E1534A
- HP E1535A
- HP E1536A
- HP E1537A
- HP E1538A

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## Product Specifications

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### 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 HP E1419A modules can be synchronized at the same rate using the TTL trigger output from one HP E1419A to trigger the others.
<b>Alternate synchronization:</b>	Multiple HP E1419A modules can be synchronized at different integer-related rates using the ALG:SCAN:RATIO command and the TTL trigger output from one HP E1419A module to trigger the others.

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### 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

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### Sample Timer

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

**Note:** For detailed information on noise characteristics and reduction techniques for the HP E1419A, refer to the product note: HP E1413A/B/C, E1313A, and E1415A Recommended Wiring and Noise Reduction Techniques, HP pub. no. 5965-1635E.

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## 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 HP 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 SCP's *Technical Specifications* for measurement specifications.

<b>Measurement resolution:</b>	16 bits (including sign)
<b>Maximum reading rate:</b>	56 kSamples/s dependent upon configuration
<b>Memory:</b>	64 kSa
<b>Maximum input voltage:</b>	Normal mode plus common mode
<b>Operating:</b>	$<\pm 16$ V peak
<b>Damage level:</b>	$>\pm 42$ V peak
<b>Maximum common mode voltage:</b>	
<b>Operating:</b>	$<\pm 16$ V peak
<b>Damage level:</b>	$>\pm 42$ 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>	
<b>Phase jitter scan-to-scan:</b>	80 ps rms
<b>Phase jitter card-to-card:</b>	41 ns peak 12 ns rms

## Measurement Accuracy

Specifications are 90 days,  $23 \pm 1$  °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 =  $10 \mu\text{V}/^\circ\text{C} \div \text{SCP gain, per } ^\circ\text{C change from CAL:ZERO temperature}$*

## 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 two: 1) Single-shot, 3 sigma and 2) Worst Case. To calculate accuracy assuming temperature is held constant within  $\pm 1$  °C of the temperature at calibration, the following formula applies:

$$\text{Single Shot } 3\sigma = \frac{\pm\sqrt{(\text{GainError} - \mu\text{V})^2 + (\text{OffsetError} - \mu\text{V})^2 + (\text{Noise} - 3\sigma)^2}}{\mu\text{V}}$$

## Correcting for Temperature

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

Replace

$$(\text{GainError} - \mu\text{V})^2$$

with

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

Replace

$$(\text{OffsetError} - \mu\text{V})^2$$

with

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

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## Power Available for SCPs

<b><math>\pm 24</math> V:</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 busses:</b>	TTL Trigger bus (T)
<b>C-size compatibility:</b>	n/a

### Instrument Drivers

See the HP Website ([http://www.hp.com/go/inst\\_drivers](http://www.hp.com/go/inst_drivers)) for driver availability and downloading.

<b>Command module firmware:</b>	Downloadable
<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>HP Panel Drivers:</b>	No
<b>VXIplug&amp;play Win Framework:</b>	No
<b>VXIplug&amp;play Win 95/NT Framework:</b>	Yes
<b>VXIplug&amp;play HP-UX Framework:</b>	No

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

### Cooling/Slot

<b>Watts/slot:</b>	14.00
<b>ΔP mm H<sub>2</sub>O:</b>	0.08
<b>Air flow liter/s:</b>	0.8

### Module Current (with no SCPs installed)

	I <sub>PM</sub> (A)	I <sub>DM</sub> (A)
+5 V:	1.0	0.02
+12 V:	0.06	0.01
-12 V:	0	0
+24 V:	0.1	0.01
-24 V:	0.1	0.01
-5.2 V:	0.15	0.01
-2 V:	0	0

## Ordering Information

Description	Product No.
Multifunction Plus Measurement and Control	E1419A <sup>1</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 and Gain SCP	E1503A
Breadboard SCP	E1504A**
8-Channel Current Source SCP	E1505A
8-Channel 120 Ohm Strain Completion & Excitation SCP	E1506A
8-Channel 350 Ohm 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 Divide-by-16 Fixed Attenuator & 7 Hz Low-pass Filter SCP	E1513A**
4-Channel Isolated x1 Gain & 10 Hz Fixed Filter SCP	E1514A**
4-Channel Isolated x1 Gain & 100 Hz Fixed Filter SCP	E1515A**
4-Channel Isolated x64 Gain & 10 Hz Fixed Filter SCP	E1516A**
4-Channel Isolated x64 Gain & 100 Hz Fixed Filter SCP	E1517A**
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 Frequency/Totalize/PWM SCP	E1534A
Watchdog Timer SCP	E1535A
8-Bit Isolated Digital I/O SCP	E1536A
4-Channel Voltage Output SCP	E1537A
Enhanced Frequency/Totalize/PWM SCP	E1538A

\*\*Note: The HP E1419A ships with four HP E1501A 8-Channel Direct Input SCPs mounted in the first four (of eight) SCP positions. Only those SCPs marked (\*\*\*) will operate in the first four SCP positions and any of those may be substituted for the HP E1501A using the delete option 001 and purchasing them separately. The HP E1419A ships with no SCPs specified for the final four SCP positions. Any of the SCPs listed in the ordering information may be used in these four SCP positions.

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

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## For More Information

Refer to the following list for more detailed information on each individual Signal Conditioning Plug-On.

Description			HP Pub. No.
Direct Input SCP	HP E1501A	Technical Specifications	5966-2391E
Low-Pass Filter SCP	HP E1502A	Technical Specifications	5966-2390E
Gain/Filter SCP	HP E1503A	Technical Specifications	5966-2389E
Breadboard SCP	HP E1504A	Technical Specifications	5966-2388E
Current Source SCP	HP E1505A	Technical Specifications	5966-2387E
120 $\Omega$ Strain Gage SCP	HP E1506A	Technical Specifications	5966-2386E
350 $\Omega$ Strain Gage SCP	HP E1507A	Technical Specifications	5966-2385E
8-Channel Fixed x16 Gain/Filter SCP	HP E1508A	Technical Specifications	5966-2384E
8-Channel Fixed x64 Gain/Filter SCP	HP E1509A	Technical Specifications	5966-2383E
4-Channel Sample and Hold SCP	HP E1510A	Technical Specifications	5966-2392E
4-Channel Transient Strain SCP	HP E1511A	Technical Specifications	5966-2393E
Low-Pass Filter SCP	HP E1512A	Technical Specifications	5966-2394E
Attenuator Input SCP	HP E1513A	Technical Specifications	5966-2395E
Isolated x1, 10 Hz Low-Pass SCP	HP E1514A	Technical Specifications	5966-2396E
Isolated x1, 100 Hz Low-Pass SCP	HP E1515A	Technical Specifications	5966-2398E
Isolated x64, 10 Hz Low-Pass SCP	HP E1516A	Technical Specifications	5966-2399E
Isolated x64, 100 Hz Low-Pass SCP	HP E1517A	Technical Specifications	5966-2397E
Resistance Measurement SCP	HP E1518A	Technical Specifications	5966-2400E
8-Channel Voltage Output SCP	HP E1531A	Technical Specifications	5966-2401E
8-Channel Current Output SCP	HP E1532A	Technical Specifications	5966-2414E
16-Bit Digital Input/Output SCP	HP E1533A	Technical Specifications	5966-2402E
Frequency/Totalize/PWM SCP	HP E1534A	Technical Specifications	5966-2404E
Watchdog Timer SCP	HP E1535A	Technical Specifications	5966-2408E
Isolated 8-Bit Digital I/O SCP	HP E1536A	Technical Specifications	5966-2407E
4-Channel Voltage Output SCP	HP E1537A	Technical Specifications	5966-2406E
Enhanced Frequency/Totalize/PWM SCP	HP E1538A	Technical Specifications	5966-2409E

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**Related Literature**

*1998 Test System and VXI Products Data Book*,  
HP Pub. No. 5966-2812E

*1998 Test System and VXI Products Catalog*,  
HP Pub. No. 5966-2815

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**Warranty**

Standard Hewlett-Packard VXIbus hardware products are warranted against defects in materials and workmanship for a period of three years unless otherwise noted. HP software and firmware products that are designated by HP for use with a hardware product, when properly installed on that hardware product, are warranted not to fail to execute their programming instructions due to defects in materials and workmanship.

For a complete and detailed warranty statement please see the *HP Test System and VXI Products Data Book* or visit the HP Website at <http://www.hp.com/go/vxi>.

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**HP Website Directory**

Main HP Website  
<http://www.hp.com>

HP Test and Measurement  
<http://www.hp.com/go/tmdir>

HP VXI Product Information  
<http://www.hp.com/go/vxi>

HP VXI Channel Partners  
<http://www.hp.com/go/vxichanpart>

HP VEE Application Website  
<http://www.hp.com/go/hpvee>

Data Acquisition and Control Website  
[http://www.hp.com/go/data\\_acq](http://www.hp.com/go/data_acq)

HP Instrument Driver Downloads  
[http://www.hp.com/go/inst\\_drivers](http://www.hp.com/go/inst_drivers)

**For more information about Hewlett-Packard test & measurement products, applications, services, and for a current sales office listing, visit our website, <http://www.hp.com/go/tmdir>. You can also contact one of the following centers and ask for a test and measurement sales representative.**

**United States:**

Hewlett-Packard Company  
Test and Measurement Call Center  
P.O. Box 4026  
Englewood, CO 80155-4026  
1 800 452 4844

**Canada:**

Hewlett-Packard Canada Ltd.  
5150 Spectrum Way  
Mississauga, Ontario L4W 5G1  
(905) 206 4725

**Europe:**

Hewlett-Packard  
European Marketing Centre  
P.O. Box 999  
1180 AZ Amstelveen  
The Netherlands  
(31 20) 547 9900

**Japan:**

Hewlett-Packard Japan Ltd.  
Measurement Assistance Center  
9-1, Takakura-Cho, Hachioji-Shi,  
Tokyo 192, Japan  
Tel: (81) 426 56 7832  
Fax: (81) 426 56 7840

**Latin America:**

Hewlett-Packard  
Latin American Region Headquarters  
5200 Blue Lagoon Drive, 9th Floor  
Miami, Florida 33126  
U.S.A.  
Tel: (305) 267-4245  
(305) 267-4220  
Fax: (305) 267-4288

**Australia/New Zealand:**

Hewlett-Packard Australia Ltd.  
31-41 Joseph Street  
Blackburn, Victoria 3130  
Australia  
1 800 629 485

**Asia Pacific:**

Hewlett-Packard Asia Pacific Ltd.  
17-21/F Shell Tower, Times Square,  
1 Matheson Street, Causeway Bay,  
Hong Kong  
Tel: (852) 2599 7777  
Fax: (852) 2506 9285

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HP Publication No.: 5965-8828E