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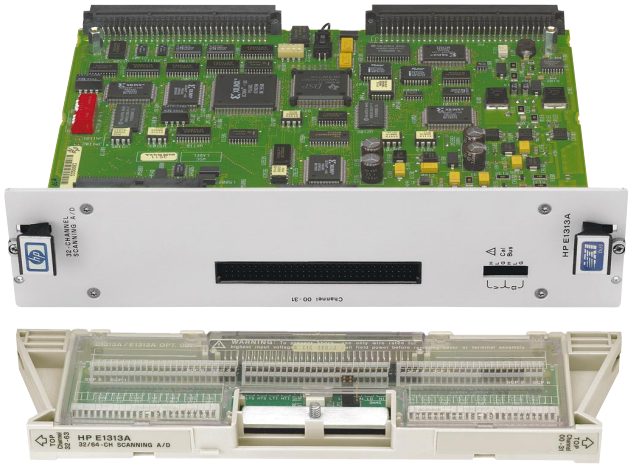
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32-Channel Scanning A/D Converter
HP E1313A
Technical Specifications

- **3-Slot, B-size, register based**
- **Comprehensive signal conditioning on board**
- **Flexible scanning/auto sequencing**
- **High-speed data transfers into controller**
- **On-board data reduction and hi/low limit checking**
- **Signal digitizing to 1.5 kHz/channel sampling rate**



HP E1313A

Description

The HP E1313A 32-Channel Scanning A/D is a **B-size, 3-slot register-based VXI module**. With Option 001 an additional 32 channels and VXI slot are added. It is designed for high-performance data-acquisition and computer-aided test applications. The key requirements of these applications are high-speed scanning, 16-bit resolution, high accuracy (0.01% of reading), 4 mV to 16 V full-scale input, 64 kSa dual-ported FIFO buffer for block transfers, current value buffer for on-line monitoring, and automatic self-calibration. The HP E1413C is a 64-channel, 1-slot, C-size VXI module that is functionally identical to the HP E1313A.

The unique design of the analog subsystem provides a new level of density by combining a 100 kHz 16-bit A/D with a 32-channel differential FET multiplexer. Additional measurement capabilities are provided by adding Signal Conditioning Plug-ons (SCPs) to the HP E1313A. Refer to the SCP's *Technical Specifications* for more information.

This module provides multifunction measurement capability including dc voltage, temperature, resistance, and strain.

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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Comprehensive Signal Conditioning on Board

A full range of signal conditioning is provided by optional Signal Conditioning Plug-on daughter boards (SCPs) that mount inside the HP E1313A. Most SCPs buffer the signal to be measured and filter or amplify it before presenting it to the HP E1313A's FET multiplexer and A/D converter (traditional signal conditioning). Other available SCPs provide more advanced functions such as sample-and-hold or strain bridge excitation and completion. More specifically the capabilities of the HP E1313A with SCPs 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

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

Flexible Scanning/Auto Sequencing

Measurement scans can be made in any channel order using any function on any channel — all at full speed, including autoranging. Up to four unique scan lists, each with up to 1,024 channel entries, can be stored in RAM and selected on the fly with a single software command. In addition, these scan lists can be automatically sequenced with a unique auto sequencing scan list. Lists can be sequenced so as to simplify the scanning of channels at different rates.

High-Speed Data Transfers into Controller

Data transfer speed has been greatly improved because multiple HP E1313As can scan in parallel at full speed and then sequentially transfer data over the VXI backplane in D16 or D32 format at rates that match even the fastest embedded VXI computer. And the data is transferred in computer-ready, IEEE-754, 32-bit floating-point real Engineering Unit format. Two on-board RAMs facilitate overall performance. The FIFO RAM is a dual-ported high-speed buffer that stores up to 64,000 samples until the controller is ready for efficient fast data transfer. For on-line monitoring, the Current Value Table RAM contains the most recently measured values for each channel in use. The CVT and FIFO RAMs can be accessed asynchronously.

On-Board Data Reduction and Hi/Low Limit Checking

Averaging can be enabled on a scan basis to provide averaging for each channel over two to 256 samples in binary steps. The averaged data goes to both the CVT and the FIFO buffer. The maximum sample rate is >1 kSa/s per channel for 64 channels, although higher rates are possible with fewer channels. When averaging multiple channels in a scan list, scan list switching and autoranging are not allowed. This would distort the average.

Individual high and low limits per channel can be downloaded to the HP E1313A in engineering units format. If a limit is exceeded, an interrupt or trigger line can be pulled and the limit register can be read to determine the out-of-limit channel. A cumulative mode can be selected that holds the channel number of any out-of-limit reading since the last INIT command. The FIFO buffer can then be read to determine the actual out-of-limit readings.

Signal Digitizing

The HP E1313A is suitable for digitizing of multichannel transient signals up to a 1 kHz sampling rate when used with the HP E1510A 4-Channel Sample & Hold Input SCP anti-aliasing filters. Digitizing higher frequency signals using the HP E1501A 8-Channel Direct Input SCP will require the use of external anti-aliasing filters. The scan trigger, either internally or externally generated, is used to initiate the channel samples controlled by the internal sample timer. The typical scan trigger jitter time is ± 100 ps.

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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 signal.

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

Voltage Measurements

Use any of the following SCPs with the HP E1313A 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 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. The current source is provided through the HP E1505A or the HP E1518A.

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 E1313A provides scanning of 32 channels, with maximum skew of 320 µS 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 E1313A.

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

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.

Configuration

Up to four modules may be used in an HP E1302A 20-slot, B-size mainframe for a total of 256 channels.

The HP E1302A may require additional RAM to use this module.

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Available Accessories

HP E1313A options may also be ordered as standalone SCP products. The SCP model number and equivalent HP E1313A options are shown below.

Product No.	SCP Model No.	Description
HP E1313A 011	HP E1501A	8-Channel Direct Input SCP
HP E1313A 012	HP E1502A	8-Channel 7 Hz Low-pass Filter SCP
HP E1313A 013	HP E1503A	8-Channel Programmable Filter and Gain SCP
HP E1313A 014	HP E1504A	Breadboard SCP
HP E1313A 015	HP E1505A	8-Channel Current Source SCP
HP E1313A 016	HP E1506A	8-Channel 120 Ohm Strain Completion & Excitation SCP
HP E1313A 017	HP E1507A	8-Channel 350 Ohm Strain Completion & Excitation SCP
HP E1313A 018	HP E1508A	8-Channel x16 Gain & 7 Hz Fixed Filter SCP
HP E1313A 019	HP E1509A	8-Channel x64 Gain & 7 Hz Fixed Filter SCP
HP E1313A 020	HP E1510A	4-Channel Sample & Hold Input SCP
HP E1313A 021	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

Product Specifications

Timing Signals

Timing: Scan-to-scan timing and sample-to-sample timing can be set independently.

Scan triggers: Can be derived from a software command or a TTL level from other VXI modules, internal timer, or external hardware. Typical latency 17.5 µs.

Synchronization: Multiple HP E1313A modules can be synchronized at the same rate using the TTL trigger output from one HP E1313A to trigger the others.

Alternate synchronization: Multiple HP E1313A modules can be synchronized at different integer-related rates using the scan timer/N mode and the TTL trigger output from one HP E1313A module to trigger the others.

Scan Triggers

Internal: 100 µsec to 6.5536 sec

Resolution: 100 µsec

Trigger count: 1 to 65535 or infinite

Sample Timer

Range: 10 µsec to 32768 msec

Resolution: 0.5 µsec

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

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 E1313A scanning A/D has a full scale range of ± 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.

Measurement resoultion: 16 bits (including sign)

Maximum reading rate: 100 kSamples/s divided by the number of channels in the scan. For example:
100K/64=1.56K samples/sec/ch
100K/16=6.25K samples/sec/ch

Memory: 64 kSa

Maximum input voltage: Normal mode plus common mode

- **Operating:** <± 16 V peak
- **Damage level:** >± 42 V peak

Maximum common mode voltage:

- **Operating:** <± 16 V peak
- **Damage level:** >± 42 V peak

SCP input impedance: >100 MΩ differential

Maximum tare cal offset: 62.5 mV range ± 75% of full scale. Other ranges ± 25% of full scale

Jitter:

- **Phase jitter scan-to-scan:** 80 ps rms
- **Phase jitter card-to-card:** 41 ns peak, 12 ns rms

Measurement Accuracy

Specifications are 90 days, 23 ± /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 µV/ °C ÷ SCP gain, per °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 ±1 °C of the temperature at calibration, the following formula applies:

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

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Correcting for Temperature

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

Replace

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

with

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

Replace

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

with

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

Power Available for SCPs

±24 V:	0.55 A
5 V:	3.5 A

General Specifications

VXI Characteristics

VXI device type:	Register based
Data transfer bus:	n/a
Size:	B
Slots:	3 or 4
Connectors:	P1/2
Shared memory:	n/a
VXI busses:	TTL Trigger bus (T)
C-size compatibility:	No

Instrument Drivers

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

Command module firmware:	Downloadable
Command module firmware rev:	A.06
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
HP Panel Drivers:	Yes, VID, *plug&play*
VXI*plug&play* Win Framework:	No
VXI*plug&play* Win 95/NT Framework:	No
VXI*plug&play* HP-UX Framework:	No

Cooling/Slot

Watts/slot:	15.00
ΔP mm H_2O:	0.08
Air flow liter/s:	0.08

Module Current

	I_{PM} (A)	I_{DM} (A)
+5 V:	1	0.02
+12 V:	0.7	0.1
–12 V:	0.15	0.1
+24 V:	0	0
–24 V:	0	0
–5.2 V:	0	0
–2 V:	0	0

Ordering Information

Description	Product No.
32-Channel Scanning A/D (muxed 16-bit)	HP E1313A
Expansion to 64 channels	HP E1313A 001
Direct Input SCP	HP E1313A 011
Low-pass Filter SCP	HP E1313A 012
Gain/filter SCP	HP E1313A 013
Breadboard SCP	HP E1313A 014
Current Source SCP	HP E1313A 015
120 ohm Strain Gage SCP	HP E1313A 016
350 ohm Strain Gage SCP	HP E1313A 017
8-Channel Fixed Gain/Filter SCP	HP E1313A 018
8-Channel Fixed Gain/Filter SCP (64x)	HP E1313A 019
4-Channel Sample and Hold SCP	HP E1313A 020
4-Channel Transient Strain SCP	HP E1313A 021
Interface to rack mount terminal panel	HP E1313A A3F
3 yr. retn. to HP to 1 yr. OnSite warr.	HP E1313A W01
Term Blk Assy E1313A	HP E1313-80001
Field kit to expand E1313A to 64 chnls.	HP E1313F
Low Pass Filter SCP	HP E1512A
Attenuator Input SCP	HP E1513A
Isolated X1, 10 Hz Low Pass SCP	HP E1514A
Isolated X1, 100 Hz Low Pass SCP	HP E1515A
Isolated X64, 10 Hz Low Pass SCP	HP E1516A
Isolated X64, 100 Hz Low Pass SCP	HP E1517A
Resistance Measurement SCP	HP E1518A

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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 Ω Strain Gage SCP	HP E1506A	Technical Specifications	5966-2386E
350 Ω 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

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.

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

HP Instrument Driver Downloads
http://www.hp.com/go/inst_drivers

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Test and Measurement Call Center
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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

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