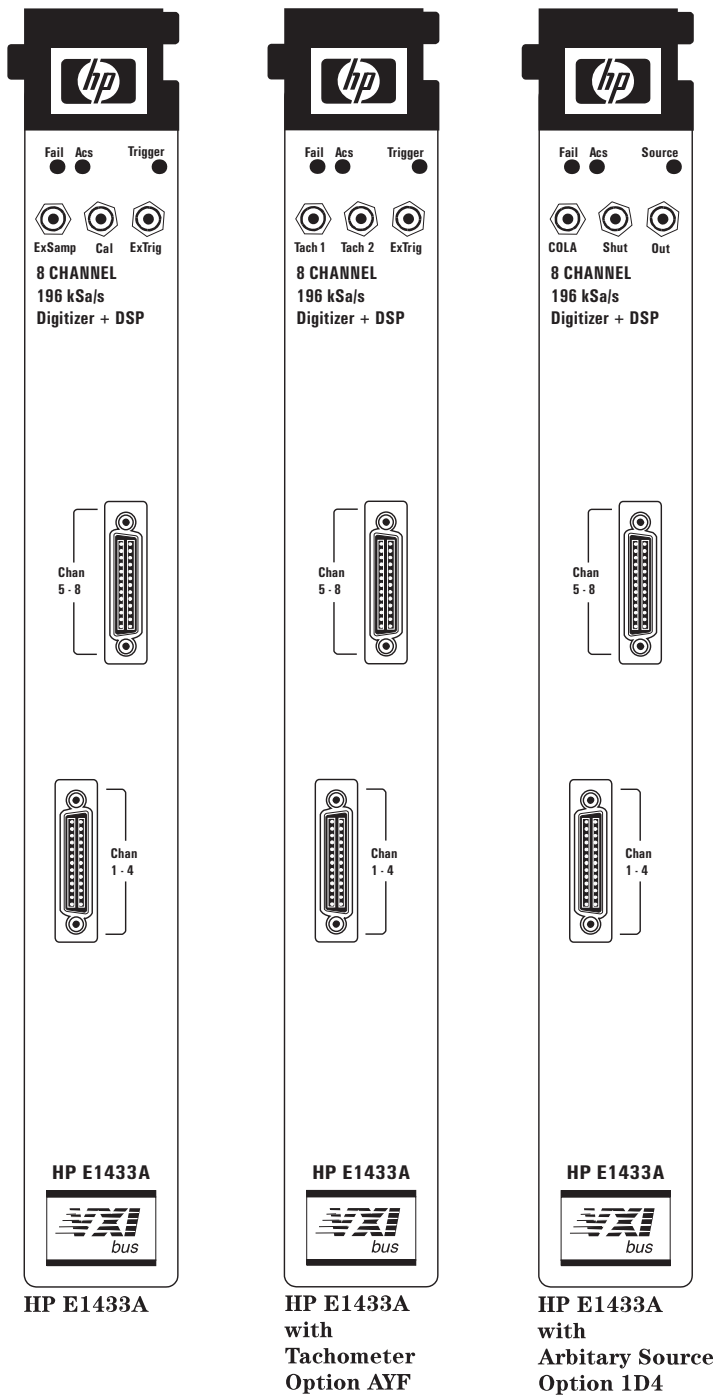


HP E1433A

Technical Specifications

8-Channel 196 kSa/sec Digitizer plus DSP

Rev. April 1999



The HP E1433A 8-Channel 196 kSa/s Digitizer plus DSP is a C-size VXI module. "196 kSa/s" refers to the maximum sample rate of 196608 samples per second per channel.

The HP E1433A may contain either one or two 4-channel input assemblies so that the module may have a total of up to 8 inputs.

This module integrates transducer signal conditioning, anti-alias protection, digitization and high speed measurement computation in a single slot VXI card. Onboard digital signal processing and up to 32 Mbytes of RAM maximizes total system performance and flexibility.

Specifications

Frequency

Sample Rate (Hz)	Bandwidth (Hz)	Sample Rate (Hz)	Bandwidth (Hz)	Sample Rate (Hz)	Bandwidth (Hz)
196608 ¹	76800	8000	3125	610.3515	238.4185
192000 ¹	75000	7812.5	3051.757	600	234.375
163840 ¹	64000	7680	3000	520.8333	203.4505
156250 ¹	61035.15	6666.666	2604.166	512	200
153600 ¹	60000	6553.6	2560	500	195.3125
133333.3 ¹	52083.33	6400	2500	488.2812	190.7348
131072 ¹	51200	6250	2441.406	480	187.5
128000 ¹	50000	6144	2400	416.6666	162.7604
125000 ¹	48828.125	6000	2343.75	409.6	160
122880 ¹	48000	5120	2000	400	156.25
102400 ¹	40000	5000	1953.125	390.625	152.5878
100000 ¹	39062.5	4915.2	1920	384	150
98304 ¹	38400	4882.812	1907.348	375	146.4843
96000 ¹	37500	4800	1875	320	125
81920 ¹	32000	4166.666	1627.604	312.5	122.0703
78125 ¹	30517.57	4096	1600	307.2	120
76800 ¹	30000	4000	1562.5	305.1757	119.2092
66666.66 ¹	26041.66	3906.25	1525.878	300	117.1875
65536 ¹	25600	3840	1500	260.4166	101.7252
64000 ¹	25000	3333.333	1302.083	256	100
62500 ¹	24414.06	3276.8	1280	250	97.65625
61440 ¹	24000	3200	1250	244.1406	95.36743
51200 ¹	20000	3125	1220.703	240	93.75
50000 ¹	19531.25	3072	1200	208.3333	81.38020
49152 ¹	19200	3000	1171.875	204.8	80
48000 ¹	18750	2560	1000	200	78.125
40960	16000	2500	976.5625	195.3125	76.29394
39062.5	15258.78	2457.6	960	192	75
38400	15000	2441.406	953.6743	187.5	73.24218
33333.33	13020.83	2400	937.5	160	62.5
32768	12800	2083.333	813.8020	156.25	61.03515
32000	12500	2048	800	153.6	60
31250	12207.03	2000	781.25	152.5878	59.60464
30720	12000	1953.125	762.9394	150	58.59375
25600	10000	1920	750	130.2083	50.86263
25000	9765.625	1666.666	651.0416	128	50
24576	9600	1638.4	640	125	48.82812
24000	9375	1600	625	122.07031	47.68371
20480	8000	1562.5	610.3515	120	46.875
19660.8	7680	1536	600	104.1666	40.69010
19531.25	7629.394	1500	585.9375	102.4	40
19200	7500	1280	500	100	39.0625
16666.66	6510.416	1250	488.28125	97.65625	38.14697
16384	6400	1228.8	480	96	37.5
16000	6250	1220.703	476.8371	93.75	36.62109
15625	6103.515	1200	468.75	80	31.25
15360	6000	1041.666	406.9010	78.125	30.51757
13333.33	5208.333	1024	400	76.8	30
13107.2	5120	1000	390.625	76.29394	29.80232
12800	5000	976.5625	381.4697	75	29.29687
12500	4882.812	960	375	65.10416	25.43131
12288	4800	833.3333	325.5208	64	25
12000	4687.5	819.2	320	62.5	24.41406
10240	4000	800	312.5	61.0351	23.84185
10000	3906.25	781.25	305.1757	60	23.4375
9830.4	3840	768	300	52.08333	20.34505
9765.625	3814.697	750	292.9687	51.2	20
9600	3750	640	250	50	19.53125
8333.33	3255.208	625	244.1406	48.82812	19.07348
8192	3200	614.4	240	46.875	18.31054

Frequency (continued)

Sample Rate (Hz)	Bandwidth (Hz)	Sample Rate (Hz)	Bandwidth (Hz)	Sample Rate (Hz)	Bandwidth (Hz)
40	15.625	6.510416	2.543131	1.017252	0.3973642
39.0625	15.25878	6.4	2.5	1	0.390625
38.4	15	6.25	2.441406	0.976562	0.3814697
38.14697	14.90116	6.103515	2.384185	0.953674	0.3725290
37.5	14.64843	6	2.34375	0.9375	0.3662109
32.55208	12.71565	5.859375	2.288818	0.813802	0.3178914
32	12.5	5	1.953125	0.8	0.3125
31.25	12.20703	4.882812	1.907348	0.78125	0.3051757
30.51757	11.92092	4.8	1.875	0.762939	0.2980232
30	11.71875	4.768371	1.862645	0.75	0.2929687
26.04166	10.17252	4.6875	1.831054	0.732421	0.2861022
25.6	10	4.069010	1.589457	0.625	0.2441406
25	9.765625	4	1.5625	0.610351	0.2384185
24.41406	9.536743	3.90625	1.525878	0.6	0.234375
24	9.375	3.814697	1.490116	0.585937	0.2288818
23.4375	9.155273	3.75	1.464843	0.5	0.1953125
20	7.8125	3.255208	1.271565	0.476837	0.1862645
19.53125	7.629394	3.2	1.25	0.46875	0.1831054
19.2	7.5	3.125	1.220703	0.4069010	0.1589457
19.07348	7.450580	3.051757	1.192092	0.4	0.15625
18.75	7.324218	3	1.171875	0.390625	0.1525878
16.27604	6.357828	2.929687	1.144409	0.3814697	0.1490116
16	6.25	2.5	0.9765625	0.375	0.1464843
15.625	6.103515	2.441406	0.9536743	0.3125	0.1220703
15.25878	5.960464	2.4	0.9375	0.3051757	0.1192092
15	5.859375	2.384185	0.9313225	0.3	0.1171875
13.02083	5.086263	2.34375	0.9155273	0.2929687	0.1144409
12.8	5	2.034505	0.7947285	0.25	0.0976562
12.5	4.882812	1.953125	0.7629394	0.2384185	0.0931322
12.20703	4.768371	1.907348	0.7450580	0.234375	0.0915527
12	4.6875	1.875	0.7324218	0.2034505	0.0794728
11.71875	4.577636	1.627604	0.6357828	0.2	0.078125
10	3.90625	1.6	0.625	0.1953125	0.0762939
9.765625	3.814697	1.5625	0.6103515	0.1907348	0.0745058
9.6	3.75	1.525878	0.5960464	0.1875	0.0732421
9.536743	3.725290	1.5	0.5859375	0.15625	0.0610351
9.375	3.662109	1.464843	0.5722045	0.1525878	0.0596046
8.138020	3.178914	1.25	0.4882812	0.15	0.0585937
8.3.125		1.220703	0.4768371	0.1464843	0.0572204
7.8125	3.051757	1.2	0.46875		
7.629394	2.980232	1.192092	0.4656612		
7.5	2.929687	1.171875	0.4577636		

¹ These sample rates also have available bandwidths that are 1.15 times the bandwidth of this table.

Frequency Accuracy

± 0.012% (120 ppm)

Input

Full Scale Input Ranges (in volts peak) 5 mV to 10 V (1, 2, 5 steps)

Maximum Input Level 42 V_p

Input Impedance

(dc coupled or ac coupled above 10 Hz)

Differential 2 M Ω nominal
Either side-to-chassis 1 M Ω nominal

Programmable AC Coupling 3 dB Corner Frequency 1 to 100 Hz

[2 pole, 12 dB/oct.]

Common Mode Rejection Ratio

ac or dc coupled, 10 Hz to 1 kHz > 70 dB
Maximum signal, low side to chassis ± 10 V_{pk}
Maximum signal, high side to chassis ($V_T = 0$) ± 11.5 V_p
Maximum signal, high side to chassis $V_T \pm 10$ V_{pk} (must be ≤ 20 V)
(V_T = transducer offset cancellation voltage setting)

Amplitude Over-Range Detection

Common mode overload ± 11.5 V_p (typical)

Differential mode overload (dc coupled) 105% of full scale

Differential mode overload (ac coupled)
for cutoff frequency ≤ 6 Hz 100% of full scale
for cutoff frequency > 6 Hz 50% of full scale, worst case

Residual DC 1% of full scale + 2 mV

Amplitude

Amplitude Accuracy at 1 kHz $\pm 0.5\%$ of reading, $\pm 0.01\%$ of full scale

Flatness (relative to 1 kHz, at full scale)

< 29 kHz $\pm 1\%$ (± 0.09 dB)
< 88 kHz $\pm 2\%$ (± 0.17 dB)

Amplitude Resolution 16 bits, less 5 dB over-range

Cross Channel Matching (any HP E1433A module in the same mainframe)

Cross Channel Amplitude Match

(full-scale signal, input ranges equal)
up to 29 kHz ± 0.1 dB
29 kHz to 88 kHz ± 0.2 dB

Cross Channel Phase Match

(full-scale signal, input ranges equal)
ac coupled (freq $> 2 \times$ AC HPF corner freq)
to 750 Hz $\pm 0.9^\circ$
750 Hz to 88 kHz $\pm (f/22000)^\circ$

dc coupled
10 Hz to 88 kHz $\pm (f/22000)^\circ$
at 1 kHz $\pm 0.045^\circ$

Dynamic Range

Resolution 16 bits

Spurious Free Dynamic Range*

(includes spurs, harmonic distortion, intermodulation distortion, alias products and sidebands > 300 Hz)

(source impedance = 50 Ω)

51.2 kSa/s F_s , ≤ 1 Vpk	< -90 dBfs (typical)
48 kSa/s to 65.536 Sa/s F_s	< -80 dBfs
above 65.536 Sa/s F_s	< -74 dBfs

Crosstalk < -80 dBfs (typical)

(receiving channel source impedance = 50 Ω , low side grounded, full scale, < 10 kHz signal on other channels, input ranges within 20 dB)

Noise (input terminated with 50 Ω , 5 mV range)

Noise density above 100 Hz	< 70 nVrms/ $\sqrt{\text{Hz}}$
Total rms noise, 10 Hz to 10 kHz	< 7 μ Vrms

Trigger

Trigger Detection Digital

Trigger Modes Input, external, source, TTL TRG, software, RPM (requires option AYP)

Max Trigger Delay

(8 channels active)

Pre-trigger delay	262 kSa (4 MB RAM), 2 MSa (32 MB RAM)
Post-trigger delay	16 MSa

* 5 mV range degrades 4 dB.

Option 1D4 Arbitrary Source Specifications

General

Output Modes Sine and pseudo random with burst , arbitrary waveform with continuous output

Frequency Bands

Sine, noise modes

Reconstruction filter bandwidth 0 to 25.6 kHz
 DSP data rate (Fs) 48.00 kHz to 65.536 kHz
 Data word size 16 bits

Arb modes

Reconstruction filter bandwidth 0 to 6.4 kHz
 Data word size 20 bits

Frequency Accuracy ± 0.012% (120 ppm)

Signal Output

Number of Output Channels 1

Maximum Amplitude 10 Vp nominal

Output Impedance < 0.5 Ω (typical)

Maximum Output Current 100 mA (typical)

Maximum Capacitive Load 0.01 μF (typical)

Amplitude Control

(signal amplitude = range × scale factor)

Maximum amplitude 10 Vp nominal
 Amplitude ranges 79 mVp to 10 Vp in 0.375 dB steps
 Amplitude scale factor 0.0 to 1.0, with 20-bit resolution

Residual Output Noise Voltage
 (Freq > 500 Hz) < 500 nV/√Hz

Residual DC Offset

Offset after autozero ± 2 mV
 Offset after shutdown ± 20 mV
 Zeroing resolution 100 μV

Output Overload Trip > 17 V

Amplitude Ramp-down Time (Programmable) 0 to 30 seconds

Shutdown

Shutdown input TTL levels
 Shutdown time < 5 s
 Shutdown time, ac fail < 4 ms

Sine Output Mode

Sine Frequency (65536 Hz Fs)

Frequency range	0 to 25.6 kHz
Frequency resolution	244 μ Hz

Amplitude Accuracy

(1 kHz sine wave, into $\geq 200 \Omega$)

10 Vp to 0.158 Vp ranges	± 0.20 dB (2.3 %)
0.152 Vp to 79 mVp ranges	± 0.40 dB (4.7 %)

Flatness (relative to 1 kHz)	± 0.5 dB
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Harmonic and Aliased-harmonic Distortion

($\geq 1 \text{ k}\Omega$ load)

1 Vp range, 1.0 scale factor, 0 to 6.4 kHz	< -80 dBc
2 to 10 Vp range, 0.05 to 1.0 scale factor, 0 to 25.6 kHz	< -70 dBc

Spurious responses	< -60 dBVp
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Constant Level Output

Output Level at 1 kHz

(after 1 second settling, amplitude scale factor > 0.001)	1 Vp (nominal)
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Output Impedance	1.2 $\text{k}\Omega$ (typical)
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Flatness

25 Hz to 5 kHz, amplitude scale factor 0.001 to 1.0	1.13 Vp to 0.50 Vp (+10, -6.0 dB) (typical)
5 Hz to 20 kHz, amplitude scale factor 0.01 to 1.0	1.13 Vp to 0.44 Vp (+10, -7.0 dB) (typical)
5 Hz to 20 kHz, amplitude scale factor 0.1 to 1.0	1.13 Vp to 0.88 Vp (± 1.0 dB) (typical)

Sine Wave Distortion	-40 dBc (typical)
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|at 1 kHz, amplitude scale factor 0.1 to 1.0|

Residual dc Offset	< 5 mV (typical)
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Summer Input

Maximum Input Level	10 Vp
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Gain, Summer Input to Signal Output	0 ± 0.5 dB at 1 kHz
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Input Impedance	$> 10 \text{ k}\Omega$ (typical)
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Flatness, dc to 25.6 kHz	± 0.5 dB (typical)
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Sine Wave Distortion	-80 dBc (typical)
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Residual dc Offset	1 mV (typical)
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Option AYF Tachometer Input Specifications

General

Option AYF, Tachometer Input, provides two tachometer inputs. When this option is installed, 2 of the 3 SMB connectors on the VXI module are used for tachometer inputs. When this option is not installed, these connectors are normally used for "External Sample" and "Trigger."

Each tachometer input has a programmable trigger level. Each tach pulse causes a "Tach Edge Time" to be recorded in a 16384-word FIFO. A "Tach Edge Time" is the instantaneous value of the 32-bit "Tach Counter". A "Decimate" number can be set to ignore a number of tach pulses before recording each Tach Edge Time. A "Holdoff" time can be set to avoid false triggering due to ringing.

One of the tachometer inputs can be programmed for use as a trigger input rather than a tachometer input. In this mode, the tachometer option can trigger the system and measure the time between the trigger and the next sample clock edge.

The analog signal from either of the Tachometer inputs can be routed to an input channel using the internal calibration path.

Tach Counter	32-bit counter with roll-over detector bit
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Decimate Counter	16-bit counter
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Input Signal Trigger Level (typical)

Voltage Range	- 25 V to + 25 V
Resolution, levels < ± 5V	40 mV
Resolution, levels > ± 5V	200 mV
Hysteresis, levels < ± 5V	0 to 250 mV
Hysteresis, levels > ± 5V	0 to 1.25 mV
Slope	Programmable, positive or negative

Input Signal Timing

Minimum pulse width	5 μs
Maximum pulse rate	100 kHz
Trigger holdoff	1 to 65536 clock periods

Input Impedance	20 kΩ (typical)
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Features

VXI Standard Information

Conforms to VXI revision 1.4
C-size, single slot width
Register-based programming
"Slave" Data Transfer Bus functionality
A24 address capability
D32 data capability
Optional Local Bus capability
SMBUS driver and receiver
Requires 2 or 4 TTLTRG_ lines for multi-module synchronization

Signal Processing

33 MHz Motorola 96002 DSP
2 banks of 128 K word static RAM
4 M bytes dynamic RAM (32 M bytes with option ANC)
128 K bytes Flash ROM
Direct Memory Access (DMA) data transfer

Software Drivers

Driver Type

C libraries with source code

Supported Operating Systems

Microsoft Windows 95 and NT[®], and HP-UX 10.20

Supply Media

CD-ROM

VXI Plug & Play Compliance

C libraries support MS Windows 95 and NT, and HP-UX.

HP-UX 10.X for HP 9000
Series 700 and 800 computers are
X/Open Company UNIX 93
branded products.

MS Windows is a U.S. registered
trademark of Microsoft Corporation.

Regulatory Compliance

Safety Standards

Designed for compliance to:
UL 1244, 4th Edition
IEC 348, 2nd Edition, 1978
CSA C22.2, No. 231

Radiated Emissions

(tested in a "typical" system configuration, consisting of an HP E1401B Mainframe, HP V743 Controller, and HP E1432A module with option 1D4 or AYP)

CISPR 11: 1990, Group 1, Class A
(requires connector shields HP E1400-80920 or HP E1421-80920)

Tested for compliance to the European Economic Area's EMC directive

Electrostatic Discharge

Tested for compliance to the European Economic Area's EMC directive

Radiated Immunity

Tested for compliance to the European Economic Area's EMC directive

Environmental

Operating Restrictions

Ambient Temperature

0° to 50°C

Humidity, Non-condensing

20% RH to 90% RH at 40°C

Maximum Altitude

4600 meters (15,000 feet)

Storage and Transport Restrictions

Ambient Temperature

- 20° to 65°C

Humidity, Non-condensing

20% RH to 90% RH at 40°C

Maximum Altitude

4600 meters (15,000 feet)

General Characteristics

VXI Power Requirements

dc Current

No options installed

+5.0 V	5.50 A
+12.0 V	0.56 A
-12.0 V	0.05 A
+24.0 V	0.44 A
-24.0 V	0.42 A
-5.2 V	0.95 A
-2.0 V	0.01 A

Tachometer option installed (AYF)

+5.0 V	0.14 A
+12.0 V	0.00 A
-12.0 V	0.00 A
+24.0 V	0.10 A
-24.0 V	0.06 A
-5.2 V	0.00 A
-2.0 V	0.00 A

Source option installed (1 D4)

+5.0 V	0.60 A
+12.0 V	0.19 A
-12.0 V	0.18 A
+24.0 V	0.03 A
-24.0 V	0.03 A
-5.2 V	0.00 A
-2.0 V	0.00 A

Dynamic Current

+5.0 V	0.20 A
+12.0 V	0.02 A
-12.0 V	0.01 A
+24.0 V	0.01 A
-24.0 V	0.01 A
-5.2 V	0.02 A
-2.0 V	0.01 A

VXI Cooling Requirements

5.08 liters/second
0.51 mm H₂O

Warm-up Time

15 minutes

Performance Benchmarks

Because these performance benchmarks depend on the software and hardware configuration, they are included as supplemental, non-warranted characteristics.

VXI Data Transfer Rate (P1 connector)

From HP E1433A DRAM to VXI V743 Controller	6.5 MB/s
From HP E1433A DRAM to MXI to external HP Series 700 Controller	1.5 MB/s
From HP E1433A DRAM to VXLink interface	345 kB/s
From HP E1433A DRAM to E6233A Pentium Controller	1.6 MB/s
From HP E1433A DRAM to National MXI-2 to external 200 MHz Pentium Pro	1.2 MB/s

Local Bus Data Transfer Rate

From HP E1433A DRAM, one block, during continuous acquisition.	15.7 MB/s
From HP E1433A's DRAM to HP E1562D	5 MB/s to 7.8 MB/s
From HP E1433A's DRAM to HP E1562E	10 MB/s to 15.7 MB/s
Maximum number of input channels for continuous throughput at 196 kSa/s sample rate	40 channels

FIFO Memory

(Maximum FIFO size, 4MB DRAM installed)	2 MSa/number active channels (standard)
(Maximum FIFO size, 32 MB DRAM installed)	16 MSa/number active channels (opt. ANC)

Specification Note

Specifications describe warranted performance over the temperature range of 0° to 50°C, after a 15-minute warm-up from ambient conditions. Supplemental characteristics identified as "typical", provide useful information by giving non-warranted performance parameters. Typical performance is applicable from 20° to 30°C.

Abbreviations

F_s = sample rate of ADC.
F_c = cut off frequency of high pass or low pass filters.
dB_fs = dB relative to full scale amplitude range.
dB_c = dB relative to carrier amplitude.
Typical = typical, non-warranted, performance specification included to provide general product information.

Warranty Information

The HP E1433A comes with a 3-yr warranty. During that period, the unit will either be replaced or repaired, at HP's option, and returned to the customer without charge. There is an option available at extra cost which extends the repair support to five years.

For More Information

www.hp.com/go/data_acq

HP E1432/33/34A
Product Overview
5965-9834E

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

United States:

Hewlett-Packard Company
Test and Measurement Call Center
P.O. Box 4026
Englewood, CA 90155-4026
1 800 452 4844

Canada:

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

Europe:

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

Japan:

Hewlett-Packard Japan Ltd.
Measurement Assistance Center
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