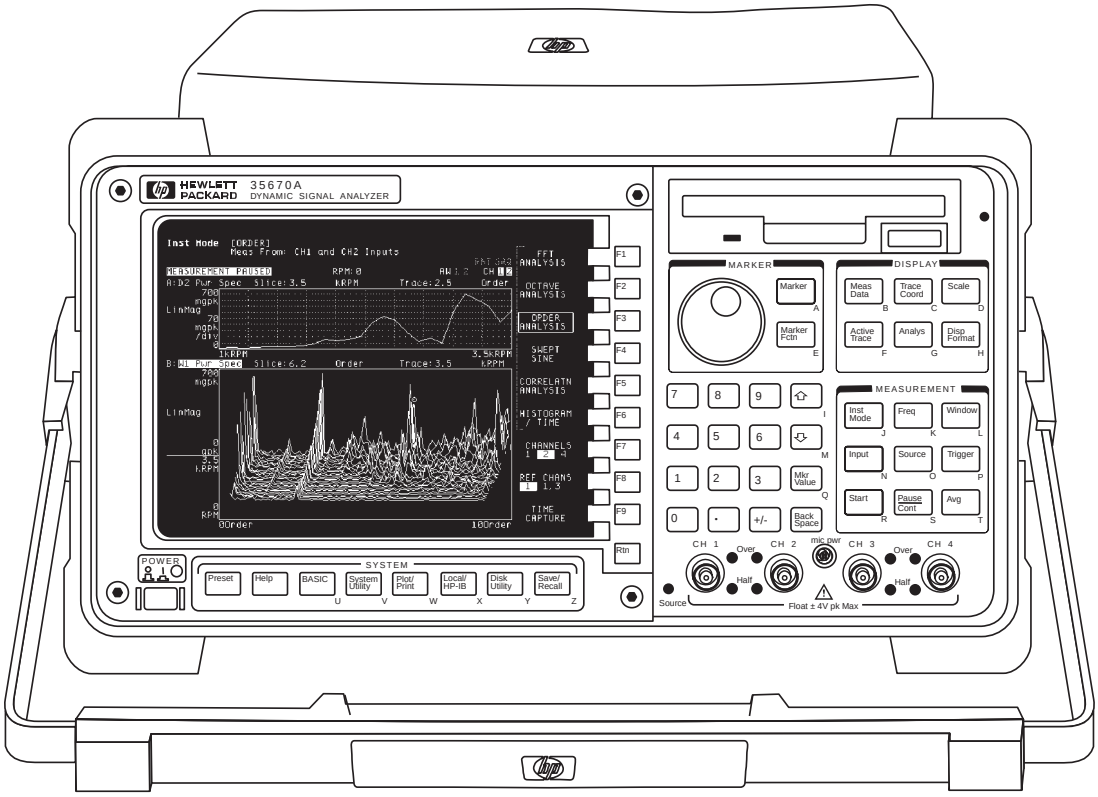
HP 35670A Dynamic Signal Analyzer

Technical Specifications

Versatile two- or four-channel high-performance FFT-based spectrum/ network analyzer

122 mHz to 102.4 kHz 16-bit ADC



Frequency Range	102.4 kHz 1 channel 51.2 kHz 2 channel 25.6 kHz 4 channel
Dynamic Range	90 dB typical
Accuracy	±0.15 dB
Channel Match	±0.04 dB and ±0.5 degrees
Real-time Bandwidth	25.6 kHz/1 channel
Resolution	100, 200, 400 & 800 lines
Time Capture	0.8 to 5 Msamples (option UFC)
Source Types	Random, Burst random, Periodic chirp, Burst chirp, Pink noise, Sine, Swept-Sine (option1D2), Arbitrary (option 1D4)

Summary of Features on Standard Instrument

The following features are standard with the HP 35670A:

Instrument Modes
FFT Analysis
Correlation Analysis
Histogram/Time
Time Capture

Measurement
Frequency Domain
Frequency Response
Linear Spectrum
Cross Spectrum
Power Spectrum
Coherence
Power Spectral Density

Time Domain (oscilloscope mode)
Time Waveform
Cross-Correlation
Autocorrelation
Orbit Diagram

Amplitude Domain
Histogram, PDF, CDF

Trace Coordinates
Linear Magnitude
Log Magnitude
dB Magnitude
Group Delay
Phase
Unwrapped Phase
Real Part
Imaginary Part
Nyquist Diagram
Polar

Trace Units
Y-axis Amplitude: combinations of units, unit value, calculated value, and unit format describe y-axis amplitude

Units: volts, g, meters/sec^2, inches/sec^2, meters/sec, inches/sec, meters, mils, inches, pascals, Kg, N, dyn, lb, user-defined EUs

Unit Value: rms, peak, peak-to-peak

C*alculated Value:* V, V^2, V^2/Hz, $\sqrt{\text{Hz}}$, V^{2}s/Hz (ESD)

Unit Format: linear, dB's with user selectable dB reference, dBm with user selectable impedance.

Y-Axis Phase: degrees, radians

X-Axis: hz, cpm, order, seconds, user-defined

Display Formats
Single
Quad
Dual Upper/Lower Traces
Small Upper and Large Lower
Front/Back Overlay Traces
Measurement State
Bode Diagram
Waterfall Display with Skew, -45 to 45 Degrees
Trace Grids On/Off
Display Blanking
Screen Saver

Display Scaling
Autoscale
Manual Scale
Input Range Tracking
Selectable Reference
Linear or Log X-Axis
Y-Axis Log
X & Y Scale Markers with Expand and Scroll

Marker Functions
Individual Trace Markers
Coupled Multi-Trace Markers
Absolute or Relative Marker
Peak Search
Harmonic Markers
Band Marker
Sideband Power Markers
Waterfall Markers
Time Parameter Markers
Frequency Response Markers

Signal Averaging (FFT Mode)
Average Types (1 to 9,999,999 averages)
RMS
RMS Exponential
Time
Time Exponential
Peak Hold

Averaging Controls
Overload Reject
Fast Averaging On/Off
Update Rate Select
Select Overlap Process Percentage
Preview Time Record

Measurement Control
Start Measurement
Pause/Continue Measurement

Triggering
Continuous (Freerun)
External (Analog or TTL Level)
Internal Trigger from any Channel
Source Synchronized Trigger
HP-IB Trigger
Armed Triggers
Automatic/Manual
RPM Step
Time Step
Pre- and Post-Trigger Measurement Delay

Tachometer Input:
±4 V or ±20 V range
40 mv or 200 mV resolution
Up to 2048 pulses/rev
Tach hold-off control

Source Outputs
Random
Periodic Chirp
Pink Noise
Burst Random
Burst Chirp
Fixed Sine
Note: Some source types are not available for use in optional modes. See option description for details.

Input Channels
Manual Range
Up-Only Auto Range
Up/Down Auto Range
Floating or Grounded
Anti-alias Filters On/Off
AC or DC Coupling
LED Half Range and Overload Indicators
A-Weight Filters On/Off
Transducer power supplies (4 ma constant current)

Frequency
20 Spans from 195 mHz to 102.4 kHz (1 channel mode)
20 Spans from 98 mHz to 51.2 kHz (2 channel mode)
Digital zoom with 244 μHz resolution throughout the 102.4 kHz frequency bands.

Resolution
100, 200, 400, 800 and 1600 lines

Windows
Hann
Flat Top
Uniform
Force/Exponential

Math
+,-,*, /
Magnitude
Square Root
LN
*jω or /jω
Differentiation
Integration
Conjugate
Real and Imaginary
FFT, FFT^{-1}
EXP
PSD
A, B, and C weighting
Constants K1thru K5
Functions F1 thru F5

Analysis
Limit Test with Pass/Fail
Data Table with Tabular Readout
Data Editing

Time Capture Functions
Capture transient events for repeated analysis in FFT, octave, order, histogram, or correlation modes (except swept-sine). Time-captured data may be saved to internal or external disk, or transferred over HP-IB. Zoom on captured data for detailed narrowband analysis. Up to 750K samples of data can be saved in the standard unit.

Data Storage Functions
Built-in 3.5 in., 1.44-Mbyte flexible disk also supports 720-KByte disks, and 128-Kbyte NVRAM disk. Both MS-DOS® and HP-LIF formats are available. Data can be formatted as either ASCII or Binary (SDF). The HP 35670A provides storage and recall from the internal disk, internal RAM disk, internal NVRAM disk, or external HP-IB disk for any of the following information:

Instrument Setup States
User-Math
Time Capture Buffers
Waterfall Display Data
Data Tables
Trace Data
Limit Data
HP Instrument BASIC Programs
Curve Fit/Synthesis Tables

Interfaces
HP-IB (IEEE-488.1 and 488.2)
Parallel
RS-232C Serial

Hard-Copy Output
To Serial or Parallel HP-GL Plotters
To Raster Printers
To Serial or Parallel HP-GL Printers
To Disk File (Supports Raster Printer, HP-GL Plotter, and HP-GL Printer)
Time Stamp

HP-IB Capabilities
Listener/Talker (Direct control of plotters, printers, disk drives)
Conforms to IEEE 488.1/488.2
Conforms to SCPI 1992
Controller with HP Instrument Basic option

Standard Data Format (SDF) Utilities
Exchange data between virtually all HP Dynamic Signal Analyzers
Easy data transfer to spreadsheets
Data transfer to MATRIX$_x$ and Matlab

SDF utilities run in an external PC

Calibration & Memory
Single or Automatic Calibration
Built-In Diagnostics & Service Tests
Nonvolatile Clock with Time/Date
Time/Date Stamp on Plots and Saved Data Files

Online Help
Access to Topics via Keyboard or Index

Fan
On/Off

MS-DOS® is a U.S. registered trademark of Microsoft Corporation.
MATRIX$_x$ is a product of Integrated Systems Inc.
Matlab is a product of The Math Works.

Instrument specifications apply after 15 minutes warm-up and within 2 hours of the last self-calibration. When the internal cooling fan has been turned OFF, specifications apply within 5 minutes of the last self-calibration. All specifications are with 400 line frequency resolution and with anti-alias filters enabled unless stated otherwise.

Frequency

Maximum Range**

1 Channel Mode	102.4kHz, 51.2 kHz (option AY6*)
2 Channel Mode	51.2 kHz
4 Channel Mode (option AY6 only)	25.6 kHz

Spans

1 Channel Mode	195.3 mHz to 102.4 kHz
2 Channel Mode	97.7 mHz to 51.2 kHz
4 Channel Mode (option AY6 only)	48.8 mHz to 25.6 kHz

Minimimum Resolution

1 Channel Mode	122 µHz (1600 line display)
2 Channel Mode	61 µHz (1600 line display)
4 Channel Mode (option AY6 only)	61 µHz (800 line display)

Maximum Real-Time Bandwidth
(FFT Span for Continuous Data Acquistion)
(Preset, Fast Averaging)

1 Channel Mode	25.6 kHz
2 Channel Mode	12.8 kHz
4 Channel Mode (option AY6 only)	6.4 kHz

Measurement Rate *(Typical)*
(Preset, Fast Averaging)

1 Channel Mode	≥ 70 Averages/Second
2 Channel Mode	≥ 33 Averages/Second
4 Channel Mode (option AY6 only)	≥ 15 Averages/Second

Display Update Rate

Typical *(Preset, Fast Average OFF)*	≥ 5 Updates/Second
Maximum *(Preset, Fast Average Off, Single Channel, Single Display, Undisplayed Trace Displays set to Data Registers)*	≥ 9 Updates/Second

Accuracy
±30 ppm (.003%)

* Option AY6 single channel maximum range extends to 102.4 kHz without anti-alias filter protection.

**Show All Lines mode allows display of up to 131.1, 65.5 and 32.7 kHz respectively. Amplitudes accuracy is unspecified and not alias protected.

Single Channel Ampltude

Absolute Amplitude Accuracy (FFT)
(A combination of Full Scale Accuracy, Full Scale Flatness, and Amplitude Linearity.)
±2.92% (0.25dB) of Reading
±0.025% of Full Scale

FFT Full Scale Accuracy at 1 kHz (0 dBfs)
±0.15 dB (1.74%)

FFT Full Scale Flatness (0 dBfs)
Relative to 1 kHz
±0.2 dB (2.33%)

FFT Amplitude Linearity at 1 kHz
Measured on +27 dBVrms range with time avg, 0 to -80 dBfs
±0.58% (0.05dB) of reading ±0.025% of full scale

Amplitude Resolution (16 bits less 2 dB over-range) with averaging
0.0019% of full scale (typical)

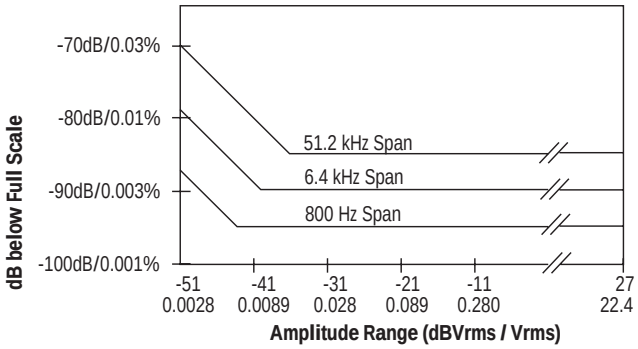
Residual DC Response (FFT Mode)
Frequency Display
(Excludes A-weight filter)
<-30 dBfs or 0.5 mVdc

FFT Dynamic Range

Spurious Free Dynamic Range 90 dB typical
(Includes Spurs, Harmonic Distortion, Intermodulation Distortion, (<-80 dBfs)
Alias Products) Excludes alias responses at extremes of span.
Source impedence = 50Ω.
800 Line Display.

Full Span FFT Noise Floor (typical)
Flat Top Window, 64 RMS Averages, 800 Line Display.

Typical Noise Floor vs. Range for Different Frequency Spans



Harmonic Distortion <-80 dBfs
Single Tone (in band), ≤ 0 dBfs

Intermodulation Distortion <-80 dBfs
Two tones (in-band), each ≤ -6.02 dBfs

Spurious and Residual Responses <-80 dBfs
Source impedence = 50Ω.

Frequency Alias Responses
Single Tone *(out of displayed range),*
≤ 0 dBfs, ≤1 MHz
(≤200 kHz with IEPE transducer power supply On)
2.5% to 97.5% of the Frequency Span <-80 dBfs
Lower and Upper 2.5% of Frequency Span <-65 dBfs

Input Noise

Input Noise Level
Flat Top Window, -51 dBVrms range
Source Impedance = 50Ω

Above 1280 Hz <-140 dBVrms/$\sqrt{Hz}$
160 Hz to 1280 Hz <-130 dBVrms/$\sqrt{Hz}$

Note: To calculate Noise as dB below Full Scale:
Noise [dBfs] = Noise [dB/$\sqrt{Hz}$] + 10LOG(NBW) - Range[dBVrms]; where NBW is the Noise Equivalent BW of the Window (see below).

Window Parameters	Uniform	Hann	Flat Top
-3 dB Bandwidth*	0.125% of Span	0.185% of Span	0.450% of Span
Noise Equivalent Bandwidth*	0.125% of Span	0.1875% of Span	0.4775% of Span
Attenuation at ±1/2 Bin	4.0 dB	1.5 dB	0.01 dB
Shape Factor (-60 dB BW/-3 dB BW)	716	9.1	2.6

* For 800 line displays. With 1600, 400, 200, or 100 line displays, multiply bandwidths by 0.5, 2, 4, and 8, respectively.

Single Channel Phase

Phase Accuracy Relative to External Trigger ±4.0 deg
16 Time Averages
Center of Bin, DC Coupled
0 dBfs to -50 dBfs Only
0 Hz < freq ≤ 10.24 kHz Only

For Hann and Flat Top windows, phase is relative to a cosine wave at the center of the time record. For the Uniform, Force, and Exponential windows, phase is relative to a cosine wave at the beginning of the time record.

Cross-Channel Amplitude

FFT Cross-Channel Gain Accuracy ±0.04 dB (0.46%)
Frequency Response Mode
Same Amplitude Range
At Full Scale: Tested with10 RMS Averages on the -11 to +27 dBVrms Ranges, and 100 RMS Averages on the -51 dBVrms Range

Cross-Channel Phase

Cross-Channel Phase Accuracy ±0.5 deg
(Same conditions as Cross-Channel Amplitude)

Input

Input Ranges *(full scale)* (Auto-Range Capability)	+27 dBVrms (31.7 Vpk) to -51 dBVrms (3.99 mVpk) in 2 dB steps
Maximum Input Levels	42 Vpk
Input Impedance	1 MΩ ±10% 90 pF nominal
Low Side to Chassis Impedance Floating Mode Grounded Mode	1 MΩ ±30%(typical) <0.010µF ≤100 Ω
AC Coupling Rolloff Source Impedance = 50Ω	<3 dB rolloff at 1Hz
Common Mode Rejection Ratio Single Tone at or below 1 kHz -51dBVrms to -11 dBVrms Ranges -9 dBVrms to +9 dBVrms Ranges +11 dBVrms to +27 dBVrms Ranges	 >75 dB typical >60 dB typical >50 dB typical
Common Mode Range *(floating mode)*	± 4 V pk
IEPE Transducer Power Supply Current Source Open Circuit Voltage	 4.25 ± 1.5 mA +26 to +32 Vdc
A-Weight Filter Conforms to ANSI Standard S1.4-1983; and to IEC 651-1979; 10 Hz to 25.6 kHz	Type 0 tolerance
Crosstalk Between Input Channels, and Source-to-Input (Receiving Channel Source Impedance = 50Ω)	 <-135 dB below signal or <-80 dBfs of receiving channel, whichever response is greater in amplitude

Time Domain

Specifications apply in Histogram/Time Mode, and unfiltered time display

DC Amplitude Accuracy	±5.0 %fs
Rise Time of -1 V to 0 V Test Pulse	<11.4 µSec
Settling Time of -1 V to 0 V Test Pulse	<16 µSec to 1%
Peak Overshoot of -1 V to 0 V Test Pulse	<3%
Sampling Period 1 Channel Mode 2 Channel Mode 4 Channel Mode (Option AY6 Only)	 3.815 µSec to 2 Sec in 2x Steps 7.629 µSec to 4 Sec in 2x Steps 15.26 µSec to 8 Sec in 2x Steps

Trigger

Trigger Modes	Internal, Source, External (analog setting) HP-IB
Maximum Trigger Delay Post Trigger Pre Trigger No two channels can be further than ±7168 samples from each other.	 8191 seconds 8191 sample periods
External Trigger Max Input	±42 Vpk
External Trigger Range Low Range High Range	 -2 V to +2 V -10 V to +10 V
External Trigger Resolution Low Range High Range	 15.7 mV 78 mV

Tachometer

Pulses per Revolution	0.5 to 2048
RPM	5 ≤ RPM ≤ 491,519
RPM Accuracy *(Typical)*	±100 ppm (0.01%)
Tach Level Range Low Range High Range	 -4 V to +4 V -20 V to +20 V
Tach Level Resolution Low Range High Range	 39 mV 197 mV
Maximum Tach Input Level	±42 Vpk
Minimum Tach Pulse Width	600 nSec
Maximum Tach Pulse Rate	400 kHz (typical)

Source Output

Source Types	Sine, Random Noise, Chrip,Pink Noise, Burst Random, Burst Chirp
Amplitude Range	AC: ±5 V peak* DC: ±10 V* * Vac_{pk} + |Vdc| ≤ 10 V
AC Amplitude Resolution	
Voltage ≥ 0.2 Vrms	2.5 mVpeak
Voltage < 0.2 Vrms	0.25 mVpeak
DC Offset Accuracy	±15 mV ± 3% of (|DC| + Vac_{pk}) Settings
Pink Noise Adder	Add 600 mV typical when using pink noise
Output Impedance	< 5 Ω
Maximum Loading	
Current	±20 mA peak
Capacitance	0.01 µF
Sine Amplitude Accuracy at 1 kHz RIoad >250 Ω 0.1Vpk to 5Vpk	±4% (0.34 dB) of setting
Sine Flatness (relative to 1 kHz) 0.1 V to 5 V peak	±1 dB
Harmonic and Sub-Harmonic Distortion and Spurious Signals *(In Band)*	
0.1 Vpk to 5 Vpk Sine Wave	
Fundamental <30 kHz	<-60 dBc
Fundamental >30 kHz	<-40 dBc

Digital Interfaces

External Keyboard	Compatible with PC-style 101-key keyboard model number HP C4950B (#ABA) and C1405-60015 mini DIN to DIN adapter.
HP-IB	
Conforms to the following standards:	IEEE 488.1 (SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C12, E2) IEEE 488.2-1987 Complies with SCPI 1992
Data Transfer Rate *(REAL 64 Format)*	<45 mSec for a 401 point trace
Serial Port	
Parallel Port	
External Multisync Monitor Port	

General Specifications

Safety Standards	CSA Certified for Electronic Test and Measurement Equipment per CSA C22.2, NO. 231 This product is designed for compliance to: UL1244, Fourth Edition IEC 348, 2nd Edition, 1978
EMI / RFI Standards	CISPR 11
Acoustic Power	LpA < 55 dB *(Cooling Fan at High Speed Setting)* < 45 dB *(Auto Speed Setting at 25°C)*

Fan Speed Settings of High, Automatic, and Off are available. The Fan Off setting can be enabled for a short period of time, except at higher ambient temperatures where the fan will stay on.

Environmental Operating Restrictions	**Operating:** Disk In Drive	**Operating:** No Disk In Drive	**Storage & Transport**
Ambient Temp.	4°Cto 45°C	0°C to 55°C	-40°C to 70°C
Relative Humidity (non-condensing)			
Minimum	20%	15%	5%
Maximum	80% at 32°C	95% at 40°C	95% at 50°C
Vibrations *(5 - 500 Hz)*	0.6 Grms	1.5 Grms	3.41 Grms
Shock	5G (10 mSec 1/2 sine)	5G (10 mSec 1/2 sine)	40G (3 mSec 1/2 sine)
Max. Altitude	4600 meters (15,000 ft.)	4600 meters (15,000 ft.)	4600 meters (15,000 ft.)

AC Power	90 Vrms - 264 Vrms *(47 - 440 Hz)* 350 VA maximum
DC Power	12 VDC to 28 VDC Nominal 200 VA maximum
DC Current at 12 V	standard: <10 A typical 4 channel: <12 A typical
Warm-Up Time	15 minutes
Weight	15 kg (33 lb) net 29 kg (64 lb) shipping
Dimensions (Excluding Bail Handleand Impact Cover)	
Height	190 mm (7.5")
Width	340 mm (13.4")
Depth	465 mm (18.3")

HEWLETT PACKARD

Computed Order Tracking - Option 1D0

$\left(\frac{\text{Maximum Order x Maximum RPM}}{60}\right) \leq$

Online (Real Time)	1 Channel Mode	25,600 Hz
	2 Channel Mode	12,800 Hz
	4 Channel Mode	6,400 Hz
Capture Playback	1 Channel Mode	102,400 Hz
	2 Channel Mode	51,200 Hz
	4 Channel Mode	25,600 Hz

Number of Orders ≤ 200 5 ≤ RPM ≤ 491.519
(Maximum useable RPM is limited by Resolution,
Tach Pulse Rate,Pulses/Revolution and Average Mode Settings.)

Delta Order 1/128 to 1/1

Resolution
(Maximum Order) / (Delta Order) ≤ 400

Maximum RPM Ramp Rate 1000 RPM / second real-time (typical)
1000 - 10,000 RPM Run Up
Maximum Order = 10
Delta Order = 0.1
RPM Step = 30 (1 Channel)
= 60 (2 Channel)
= 120 (4 Channel)

Order Track Amplitude Accuracy ±1 dB (typical)

Real Time Octave Analysis - Option 1D1

Standards
Conforms to ANSI Standard S1.11 - 1986, Order 3, Type 1-D, Extended and Optional Frequency Ranges

Conforms to IEC 651-1979 Type 0 Impulse , and ANSI S1.4

Frequency Ranges *(at centers)*

Online (Real Time):

	Single Channel	2 Channel	4 Channel
1/1 Octave	0.063 - 16 kHz	0.063 - 8 kHz	0.063 - 4 kHz
1/3 Octave	0.08 - 40 kHz	0.08 - 20 kHz	0.08 - 10 kHz
1/12 Octave	0.0997 - 12.338 kHz	0.0997 - 6.169 kHz	0.0997 - 3.084 kHz

Capture Playback:

1/1 Octave	0.063 - 16 kHz	0.063 - 16 kHz	0.063 - 16 kHz
1/3 Octave	0.08 - 31.5 kHz	0.08 - 31.5 kHz	0.08 - 31.5 kHz
1/12 Octave	0.0997 - 49.35 kHz	0.0997 - 49.35 kHz	0.0997 - 49.35 kHz

One to 12 octaves can be measured and displayed.

1/1-, 1/3-, and 1/12-octave true center frequencies related by the formula: f(i+1)/f(i) = 2^(1/n); n=1, 3, or 12; Where 1000 Hz is the reference for 1/1, 1/3 Octave, and 1000*2^(1/24) Hz is the reference for 1/12 octave. The marker returns the ANSI standard preferred frequencies.

Accuracy
1 Second Stable Average
Single Tone at Band Center: ≤ ± 0.20 dB

Readings are taken from the Linear Total Power Spectrum Bin .
It is derived from sum of each filter.

1/3-Octave Dynamic Range >80 dB (typical) per ANSI S1.11-1986
2 Second Stable Average
Total power limited by input noise level

Swept Sine Measurements - Option 1D2

Dynamic Range 130 dB
Tested with 11 dBVrms source level at:
100 mSec integration

Arbitrary Waveform Source - Option 1D4

Amplitude Range AC: ±5 V peak*
DC: ±10 V*
* Vac_{pk} + |Vdc| ≤ 10V

Record Length # of Points = 2.56 x Lines ofResolution, or # of Complex Points = 1.28 x Lines of Resolution

DAC Resolution

0.2828 Vpk to 5 Vpk	2.5 mV
0 Vpk to 0.2828 Vpk	0.25 mV

Abbreviations

dBVrms = dB relative to 1 Volt rms.

dBfs = dB relative to full scale amplitude range. Full scale is approx. 2 dB below ADC overload.

Typical = typical, non-warranted, performance specification included to provide general product information.

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