SIGNAL ANALYZERS

Single Channel, Dynamic Signal Analyzer 0.000125 Hz to 100 kHz

Model 3561A

- Spectrum and network analysis, waveform recording, 1/3 and 1/1 octave analysis
- High accuracy, ± 0.15dB
- 80 dB dynamic range and full alias protection
- High speed (7.5kHz Real Time Rate)
- Band selectable zoom analysis for 640 μHz resolution
- Full CRT annotation and softkey ease-of-use
- Auto-ranging, auto-calibration, auto-scaling
- Internal non-volatile memory stores 2 traces and 6 states. Optional bubble (non-volatile) memory stores 127 traces and states.

DESIGNED FOR HP-IB SYSTEMS

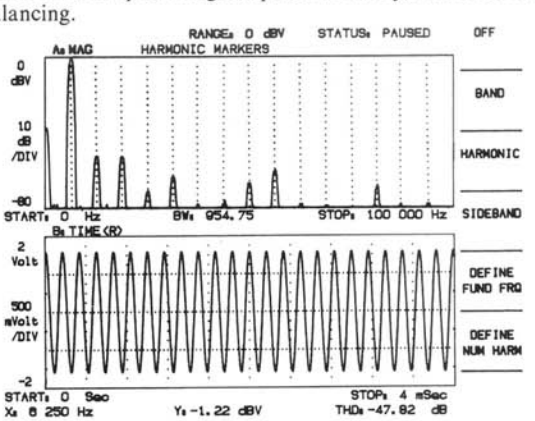
HP 3561A

Description

The HP 3561A is a versatile, single channel, real time spectrum analyzer with applications in electronics, vibration analysis, and acoustics. It is actually several instruments in one, operating in both the frequency domain and the time domain. In the frequency domain it serves as a spectrum analyzer with ± 0.15dB amplitude accuracy and 2 degrees triggered phase accuracy. Utilizing the built-in tracking noise source, it also can serve as a network analyzer. (Trace math can be used when phase response or high accuracy is desired.) Digital signal processing allows the HP 3561A to digitally synthesize 1/3 or 1/1 octave filters, providing a high accuracy, drift free octave analyzer. Operating in the time domain the HP 3561A can be used as a low frequency digital storage oscilloscope. The HP 3561A contains a 40k-sample time buffer and complete triggering flexibility, so waveform recording is easy. Time or frequency measurements can be stored in an optional non-volatile "bubble" memory for later analysis. Annotated hardcopy is easily obtained by pressing "plot"... the HP 3561A will control HP-GL plotters and raster dump printers directly. All of these capabilities in one portable instrument make the HP 3561A a powerful addition to any bench, and with a standard HP-IB interface, the HP 3561A makes an excellent systems instrument as well.

Spectrum Analysis

The HP 3561A offers swept analyzer performance with FFT speed. Up to two orders of magnitude speed improvement can be realized, especially in measurements requiring 1 Hz or better frequency resolution. The HP 3561A delivers 158 dB of automatically calibrated measurement range, from +27 dBV (22.4 volts RMS) to −131 dBV (0.28 microvolts RMS). Dynamic range is 80 dB, and amplitude accuracy is ± 0.15 dB on the +27 dBV to −40 dBV ranges (± 0.25 dB on the −41 dBV to −51 dBV ranges). Signals can be read in RMS volts, volts squared, milliwatts, dBV, dBm (with user-selected impedance), and user-defined engineering units. Band, harmonic and sideband power can be computed directly using the built-in special marker functions. Frequencies spaced as narrow as 640 μHz can be resolved throughout the 100 kHz range, with frequency accuracy ± 0.003% of display center frequency. Phase spectra relative to a trigger signal can be measured with up to 2 degrees phase accuracy, useful for machinery balancing.



Harmonic marker function computes total harmonic distortion (THD) directly in dB or percent.

Network Analysis

A band-limited, band-translated noise source allows the HP 3561A to make amplitude and phase frequency response measurements. To make a network measurement, connect the internal noise source to the device under test, adjust the source amplitude, and measure the input spectrum. Store the input spectrum in memory and measure the response spectrum. A simple trace math operation produces the desired frequency response. Amplitude resolution is 0.01 dB and phase resolution is 0.1 degree.

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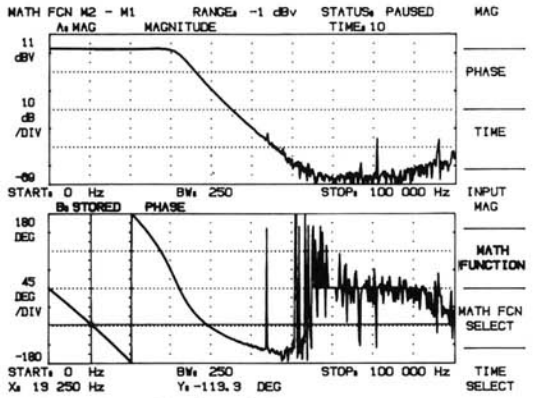

Figure 2: Network amplitude and phase response are measured using the unique internal noise source and trace math.

Waveform Recording

A high linearity 13 bit analog-to-digital converter makes the HP 3561A a natural for waveform recording. Forty-three sample rates ranging from 256 kHz to 0.026 Hz can be selected. If other sample rates are required, the analyzer can be made to sample on an external TTL clock signal. Up to 40k samples of time data can be stored internally in buffer memory, with complete trigger control. Trigger on an analog level with positive or negative slope and variable level. In either mode you can specify pre- or post-trigger values from 40k samples pre-trigger to 1023k samples of post-trigger delay. Data collected in the time domain is easily analyzed in the frequency domain, making the HP 3561A extremely useful in analyzing transients and other non-steady-state signals.

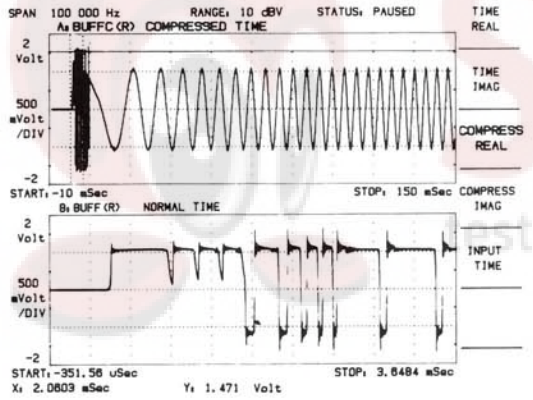

Figure 3: Up to 40,000 samples of a transient waveform can be captured, with analysis in either the time domain or the frequency domain.

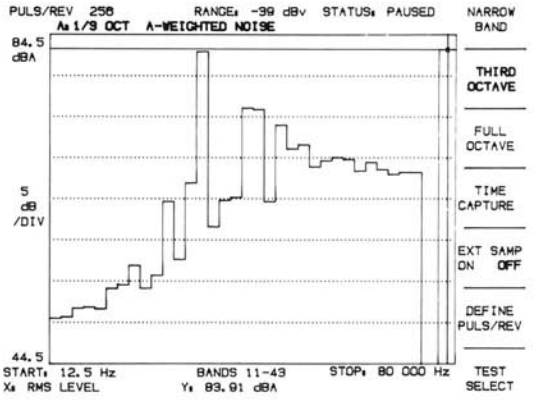

Figure 4: The combination of octave and narrowband analysis makes the HP 3561A a powerful instrument for noise and vibration analysis.

1/3 and 1/1 Octave Analysis

Octave analysis is often used in acoustic and vibration work for analyzing signals that are "proportional bandwidth". That is, they exhibit bandwidths that are proportional to their center frequencies. The HP 3561A digitally synthesizes a series of parallel bandpass filters, each with bandwidth proportional to center frequency. The advantage of the digital technique is better stability and accuracy — there are no analog components to drift, age, or respond to temperature. A built-in hardware A-weight filter can be switched in for acoustic signals where the effects of the human ear must be taken into account.

Digital Averaging

Digital averaging is provided for improving a measurement in the presence of noise. RMS, RMS exponential, time and peak averaging are provided. Automatic overload signal rejection can be invoked to prevent an otherwise valid reading from being contaminated by one overloaded spectrum. A fast average display mode can be selected which speeds up the averaging process by turning off the display refresh during intermediate averages. This can result in a factor of 3 speed improvement over normal averaging mode. Coupled with its high real time rate, the HP 3561A can make averaged measurements in the same amount of time it formerly took to make an unaveraged measurement!

Flexible Display Formats and Complete Annotation

Display a single trace, two traces in upper/lower format, or two traces overlaid in front/back format. When several traces must be viewed at once, use the "spectral map" format which can display up to 60 separate traces stacked onto one display. Choose log or linear frequency spacing and log or linear amplitude units. Define your own units, give them a name, and the analyzer will read out in your units! Each trace is completely annotated and can be labelled with your own alphanumeric trace label. A view state display function is provided to quickly give you a summary of the analyzer's current setup state.

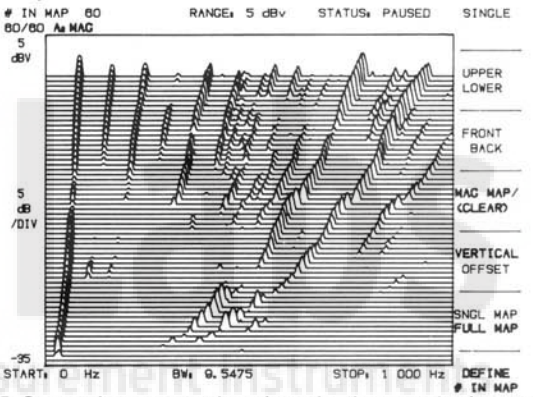

Figure 5: Spectral maps greatly reduce the time required to analyze changes in up to 60 successive measurements.

Internal Mass Storage

The standard HP 3561A contains 2 traces and 6 setup states of nonvolatile memory. When more storage is required, such as when you wish to store a 40,000-sample waveform captured in waveform recording mode, the "bubble memory" option can be installed. This non-volatile memory allows you to store any combination of 127 traces and states internally. Data stored in internal memory can be transferred via HP-IB to a computer for further analysis or archiving.

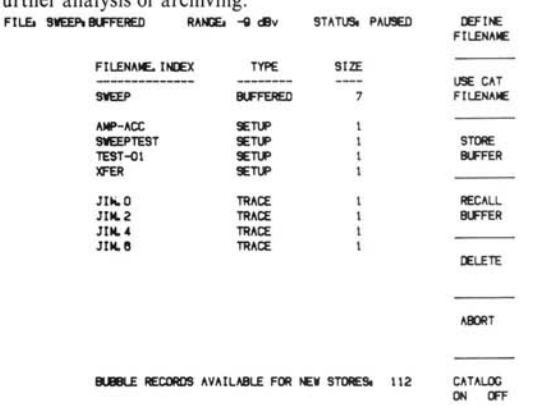

Figure 6: Traces and setups are stored in bubble memory by file name. The bubble memory catalog makes recall of stored files easy.

Annotated Hardcopy

You can obtain fast hardcopy of any display just by pressing the plot button. The HP 3561A controls HP-GL plotters and HP raster dump printers directly. A "marker plot" key allows you to annotate several locations on a plot with amplitude and frequency, or amplitude and time. Simply tune the cursor to the point of interest, press marker plot and the

analyzer annotates the location of interest. Do this as many times as you wish for complete, accurate documentation of measurements.

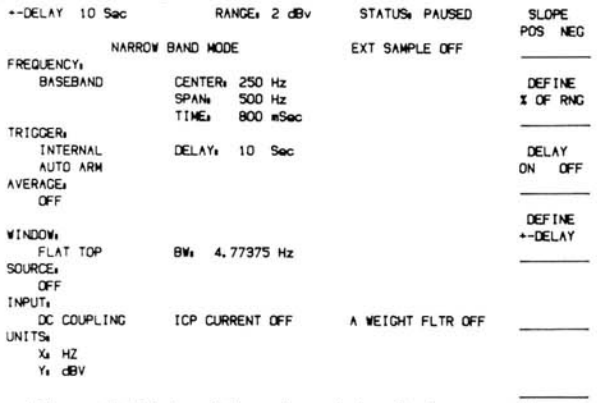

Figure 7: Plots of the view state display provide quick hard copy of instrument setup for complete measurement documentation.

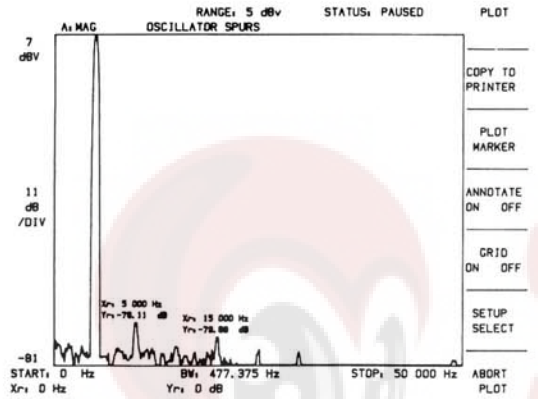

Figure 8: The marker plot function prints x and y marker values for any number of points on the plot.

Other Features

In most noise and vibration measurements, a transducer is used to convert the physical phenomena to voltage. These transducers generally require some type of signal conditioning. The HP 3561A contains an internal power supply for ICP type (integrated circuit piezoelectric) transducers. This eliminates an extra piece of equipment, which enhances portability and saves money. Trace math operations are provided that allow you to manipulate traces like numbers on a calculator. This is useful for converting units, compensating for systematic errors, and displaying spectra as a percentage of some reference value.

HP 3561A Specifications

Frequency

Range: 0.000125 Hz to 100 kHz
Spans: 0.01024 Hz to 100 kHz in a 1, 2, 2.5, 5, 10 sequence. Other spans are available but are too numerous to list here.
Accuracy: ± 0.003% of display center frequency.
Resolution: 0.25% of frequency span.
Window: Flat Top, Hann, Uniform, and Exponential.
Bandwidth

	Flat Top	Hann	Uniform
3 dB Bandwidth (% of frequency span)	0.90%	0.37%	0.25%

Real Time Bandwidth: (Typical) Single display, 3.0 kHz. Fast average display, 7.5 kHz.

Amplitude

Measurement Range: +27 to −120 dBV noise floor (22.4 VRMS to 1μV noise floor.) Input range is selected in 1-dB steps from +27 to −51 dBV. Optimum range is determined automatically in the autorange mode.
Dynamic range: 80 dB

Accuracy at the Passband

Center:	± 0.15 dB	+27 to −40 dBV input ranges
	± 0.25 dB	−41 to −51 dBV input ranges
Flat Top window:	+0, −0.01 dB	
Hann window:	+0, −1.5 dB	
Uniform window:	+0, −4.0 dB	

Note: Overall accuracy is the sum of the accuracy at the passband center plus the selected window accuracy.
Resolution
Log: 0.01 dB
Linear: 4 digits

Phase

Accuracy: ±2 degrees, dc-10 kHz; ± 10 degrees, 10-100 kHz (signals no more than 40 dB below full range).
Resolution: 0.1 degree.

Input

Impedance: $1X10^6$ ohms ± 5% shunted by 95 pF maximum.
Isolation: Input low may be connected to chassis ground or floated up to 30 volts RMS (42 volts peak) above ground.
Coupling: signal by be ac or dc coupled. Low frequency 3-dB point <1 Hz in ac mode.
A-weighting: Hardware A-weighting filter conforms to ANSI standard S1.4-1971 (R1976).
ICP current: Nominal 4 mA current source provided, compatible with integrated circuit piezoelectric accelerometers.

Output

Source: Band-limited, band-translated, psuedo-random, random, or impulse, or TTL "synch" signals are available on rear panel. Level is selectable between 0.7 and 0.007 volts RMS, nominal. Impedance 50Ω ±5Ω.
Print/Plot: Controls HP-GL plotters and HP raster dump printers directly.

Display

General: Magnitude, phase, time and math traces may be selected. Units available are; Horizontal: Hz, seconds, RPM, orders; linear or log spacing. Vertical: dBV, dBm (selectable Z), volts, volts squared, and user-defined units.
Scale: Linear or log magnitude scales may be selected. Full scale, dB/division, and degrees/division are user definable. Center scale user definable in phase or time traces.
Math: Arithmetic operations can be performed on new or recalled frequency spectra. Add, subtract, multiply, divide, integrate, differentiate and user-defined constants are provided. 1/BW is provided for Power Spectral Density (PSD) computations.

Internal Memory

	Non-volatile	Volatile
Standard:	2 traces, 6 states	40 time records
Optional:	Traces + states + (1+ 2* time capture records)= 127	40 time records

Marker

Single, relative, harmonic, sideband, and power cursors are provided. THD can be calculated from up to 20 harmonics. Sideband power relative to specified carrier can be calculated from up to 10 sidebands. MKR to peak, MKR to center, MKR to full scale and marker peak track are provided.

General

Power: 100/120 Vac +5%, −10%, 48-440 Hz; 220/240 Vac +5%, −10%, 48-66 Hz.
Weight: 15 kg (33 lb) net, 21.6 kg (47.5 lb) shipping.
Dimensions: 335 mm W x 595 mm D x 197 mm H (13.2″ x 23.4″ x 7.8″)
***HP -IB Interface Functions:** Implementation of IEEE Std. 488-1978 SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0.

Ordering Information

	Price
HP 3561A Dynamic Signal Analyzer	$ 10,300
Option 001 Extended Non-volatile Memory	add $ 1,500