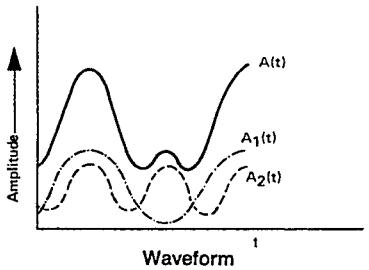
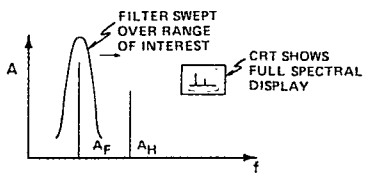
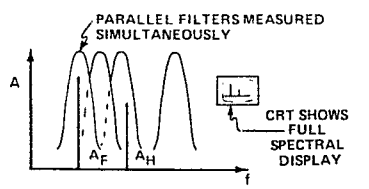


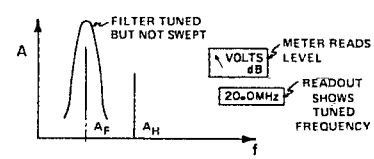
Waveform



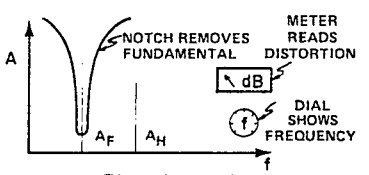
Spectrum analyzer



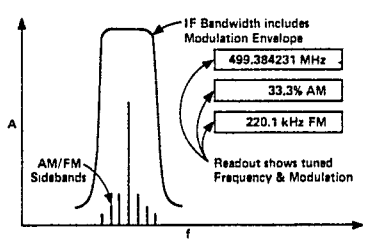
Fourier analyzer



Wave analyzer



Distortion analyzer



Modulation analyzer

In addition to the swept-tuned frequency mode, spectrum analyzers can also be used in the fixed-tuned mode (zero span) to provide time-domain measurement capability much like that of an oscilloscope.

Vector signal analyzers extend the capabilities available in a spectrum analyzer. Though similar to Fourier analyzers, vector signal analyzers provide capabilities through the RF range, offering fast, high-resolution spectrum measurements, demodulation, and advanced time-domain analysis. They are especially useful for characterizing complex signals such as burst, transient, or modulated signals used in communications, video, broadcast, sonar, and ultrasound imaging applications.

With the addition of desktop technical computers, the capability of spectrum analyzers can be greatly enhanced. Computers can be used to directly control the operation of spectrum analyzers over HP-IB. Computers can also be used to develop downloadable programs (DLPs) for spectrum analyzers with the capability to store such programs in non-volatile memory. These custom measurement routines are then as easy to use as any of the standard instrument features. Custom measurement "personality" cards are available for many spectrum analyzers.

In addition, spectrum analyzers with HP-IB capability can directly control a plotter or printer, enabling a hard copy of the CRT display to be made without the use of a computer. Application areas that require accurate, high-speed, repetitive routines; physical separation of the operator and the analyzer; unattended operation or operation by personnel with limited technical skills—all are candidates for automation.

Areas that benefit significantly from automated spectrum analysis include:

- EMC testing
- frequency spectrum monitoring
- production testing of RF or microwave components, subsystems, or systems
- remote site testing

The basic measurement capabilities of the spectrum analyzer, combined with its ability to automate and to interface with other HP-IB instruments and peripherals, make this instrument ideal for many general-purpose and specialized applications.

Fourier Analyzers

Fourier analyzers offer fast, high-resolution spectrum and network analysis. Unlike conventional swept analyzers, Fourier-based analyzers can measure dynamic signals because they measure all frequencies simultaneously, not one at a time.

Fourier analyzers characterize signals using digital signal-processing techniques based on the Discrete Fourier Transform. For a complete description of these techniques, see Application Note 243, "The Fundamentals of Signal Analysis."

Fourier analyzers are especially useful on low-frequency signals (<100 kHz) or where very fast measurements are desired. They can improve measurement speed by a factor of between 10 and 100, and allow accurate measurements on frequencies as low as a few μHz. Signal components as closely spaced as $20\,\mu$Hz can be clearly resolved and accurately measured.

Since both the magnitude and this phase of each frequency component are measured, the Fourier analyzer can measure the statistical properties of signals or the joint properties or relationships of two or more signals. Applications include acoustic, modal, vibration, or rotating machine analysis. In addition, various types of modulation can be detected and measured.

Simultaneous measurement of magnitude and phase on two or more channels provides high-quality network measurements. Transfer functions or frequency response can be easily measured, and the use of band-limited or band-translated random noise as the stimulus allows the entire frequency span of interest to be measured at once. Measurement of the coherence function can provide an indication of the validity of many network measurements.

Distortion and Audio Analyzers

The Hewlett-Packard distortion and audio analyzers consist of a narrow-band rejection filter and broadband detector. Before the fundamental is rejected, the analyzer first measures the amplitude of the fundamental, all the harmonic components, and the noise. Then the rejection filter is employed to remove the fundamental. The ratio of the two measurements is total harmonic distortion plus noise.

Audio Analyzers

The audio analyzer performs several basic low-frequency measurements in addition to distortion, making it a general-purpose audio test set. The audio analyzer includes the SINAD function for testing mobile radio receiver sensitivity. It contains a low-distortion audio oscillator for stimulus-response testing in combination with its distortion analyzer. It has a true rms voltmeter and dc voltmeter for accurate measurement of complex waveform levels. Swept ac level and swept distortion measurements can be made using the internal source and rms voltmeter. A reciprocal frequency counter is included that continuously counts the frequency of the input signal.

True Harmonic Distortion Measurements

Computer-controlled spectrum analyzers provide a rapid means of measuring true harmonic distortion levels. The fundamental and its harmonic components are rapidly measured one at a time, and the distortion is computed and either stored or printed.

Modulation Analyzers/Measuring Receivers

A modulation analyzer is a precision receiver designed to detect the entire modulation envelope of a signal under test. It can measure and display the carrier characteristics of RF frequency and power, as well as AM, FM, and phase modulation characteristics such as AM depth, peak deviation, residual modulation, and various associated ratios. The modulation analyzer faithfully recovers the actual modulation signal for further analysis such as distortion testing.

In addition to having all the capabilities of the modulation analyzer, the measuring receiver can measure power down to -127 dBm. With very high accuracy, it can look at signals up to millimeter-wave frequencies. This makes it ideal for calibration of signal generators and attenuators.