



Sweep Oscillators

Swept frequency oscillators are used in applications where the characteristics of a device must be determined over a wide, continuous range of frequencies. Combined with a broadband detector and display test set, sweep oscillators provide many benefits compared to CW frequency sources. A swept measurement provides a dynamic display of the data. The results of any adjustments to the unknown test device are seen immediately (real time) on the display. By replacing laborious point-by-point techniques swept measurements increase the speed and convenience of broadband testing. The continuous frequency characterization of the unknown device also eliminates the chance of missing important information between frequency points. Swept techniques are applicable in all phases of design, manufacture and maintenance.

Hewlett-Packard Sweep Oscillators

Hewlett-Packard sweepers cover the entire frequency spectrum from dc to 40 GHz. Self-contained, multi-octave sweepers cover the frequency range to 110 MHz. The 8620 family of solid state oscillators provide a versatile choice of configurations—single band, straddle band, or very wide band plug-ins from 10 MHz to 22 GHz. 10 MHz to 40 GHz coverage is available in the 8350 family of plug-in sweep oscillators. The 8340A provides broadband synthesized frequency coverage (10 MHz to 26.5 GHz) with excellent stability (5×10^{-10} /day) and phase noise. A chart of the individual frequency bands available appears on page 367.

Sweep Oscillator Features

Sweep Flexibility

Every HP sweeper has several different sweep modes available for setting the fre-

quency limits of the instrument. A full band or independently adjustable start/stop frequency sweep can be selected. Alternatively, a marker sweep or a symmetrical ΔF sweep about the desired center frequency can be chosen. Switching from one sweep mode to another is a simple pushbutton operation. In the auto mode the sweep retriggers automatically. Sweep times from 0.01 to more than 100 seconds can be selected. A manual sweep is also available as a front panel control, a real convenience for calibrating displays such as X-Y recorders. An external trigger is provided as well for applications where the sweeper must be synchronized to other instrumentation or remotely controlled.

On all sweeps a linear voltage proportional to frequency is available on an external connector which is useful for driving the horizontal of a display. Blanking and pen lift signals are also provided at rear output connectors during retrace time when the RF is off.

Marker capability, both Z-axis intensity dots and RF pips, are available on HP sweepers to note your important measurement frequencies. Two or more independent markers are offered on all sweepers with up to five markers on the new 8340A and 8350 mainframe. Crystal markers are offered on the 86222B and 83522A 10 MHz to 2.4 GHz RF plug-ins, and the 83525A/B 10MHz to 8.4 GHz plug-in.

Another powerful feature available on the new 8340A and 8350 sweeper mainframe is Save/Recall Mode. With Save/Recall Mode up to nine complete front panel states can be stored in memory and later recalled when the measurement is repeated. This saves considerable time when repetitive tests are required.

Power Output and Leveling

Power output is continuously adjustable at the front panel over approximately a 10 dB range of all plug-ins. Built-in attenuators are also available on most plug-ins for greater power control. Internal or external leveling is employed to obtain (1) a constant power output and (2) a good source match (low VSWR). This ensures high accuracy when making swept measurements.

The new 8340A and 83500 series of plug-ins offer calibrated output power and internal leveling as standard features. Power is calibrated over a 15 dB range (30dB for the 8340A) with 0.1 dB resolution (programmable to 0.02 dB); with an internal step attenuator, the calibrated range is extended to 85 dB (130 dB on the 8340A).

Power as well as frequency can be swept with the 8340A or the 8350 and 83500 series plug-ins. This means that both the frequency response and power response of level sensitive devices like transistors and amplifiers can be measured using the same test set-up. Using the Power Sweep function 1 dB gain compression can easily be measured at a CW frequency (Figure 1). Also, the ability to alternate between two discreet power levels on successive sweeps (8340A or 8350 and 83500

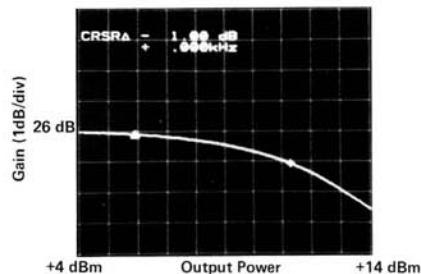


Figure 1.



SWEEP OSCILLATORS

General Information (cont.)

series plug-ins) allows a swept measurement of 1 dB compression point. Output power characteristics can be optimized simultaneously (Figure 2).

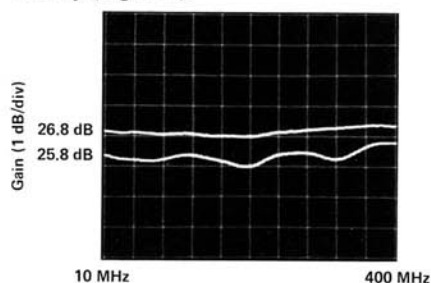


Figure 2.

Modulation

Modulation capabilities further extend the sweeper's usefulness both as a sweeper and a signal generator for signal simulations. Wide AM and FM bandwidths are useful for a variety of tests on communication receivers. The flexible FM capability allows remote analog frequency programming which is important for many applications.

External pulse modulation is also available on many plug-ins. Most plug-ins also accept the 27.8 kHz square wave modulation required by the HP 8756A Scalar Network Analyzer directly, eliminating the need for an external modulator. The 8350 mainframe will supply the 27.8 kHz square wave modulation directly to the plug-in.

The 8340A Synthesized Sweeper has extensive modulation capability, providing both internal pulse and AM modulation. The pulse modulation capability works for pulse widths as narrow as 100 nsec, having rise and fall times less than 25 nsec and ON/OFF ratio greater than 80 dB. The AM is DC coupled and has a 3 dB bandwidth of 100 kHz. The maximum modulation depth varies with available output power but it is never less than 90%. In addition, the 8340A may simultaneously pulse and amplitude modulate the RF to simulate the effect of antenna scan on a pulse modulated signal.

MLA Compatibility

In communications applications where up-converter simulation is required in conjunction with the HP Microwave Link Analyzer, the 86200 series of plug-ins provides this capability as an option in frequency ranges from 500 MHz to 18 GHz. Group delay of less than 1 nanosecond and linearity of better than 0.5% across 30 MHz across most of the frequency range permit very accurate RF to RF, RF to IF and RF to BB distortion measurements. See page XXX for more information.

Programming

The 8340A, 8350 mainframe and 83500 series plug-ins offer total HP-IB control of all front panel functions. Not only CW frequencies, but sweeps, markers, power levels, etc., can be remotely programmed via the HP-IB. This means there are no limitations to designing customized automatic systems for either component or system testing.

The 8620C solid state sweeper mainframe provides optional BCD or HP-IB program-

ming capability. More than ten thousand frequency points per band permit very fine frequency control. In addition, band selection, sweep mode, RF attenuator, and remote-local can be controlled remotely. This allows the sweeper to be used in a wide variety of automatic systems and sophisticated signal simulation applications.

Another way to improve the accuracy and stability of the 8350 or 8620C Sweep Oscillator is to phase-lock the output with the HP 5344S Source Synchronizer. With the 5344S the frequency may be set to a 1 Hz resolution and the long term stability becomes 5×10^{-10} /day. In addition to phase-locking a CW frequency the 5344S when used with a sweeper is also capable of phase continuous locked sweeps up to 40 MHz wide and broadband sweeps with a phase-locked start frequency.

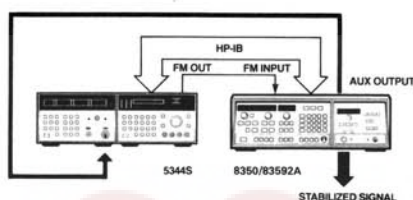


Figure 3.

In many applications, a computer can be used to assimilate data from a network analyzer (HP 8756A or HP 8410C). With automatic systems the computer can completely set up the measurement, sweep width, markers, power level, etc., and then document the measurement results in a printed or plotted format. For operations requiring a minimum of user interactions specification comparisons can be made for automatic "go no-go" testing. Using the programmable power capability of the 83500 series plug-ins, automatic power as well as frequency response testing is possible.

Digital Sweeping Synthesizers

The 3325A, 3330B, 3335A, 8660C, 8662A, and 8673A/S combine the precision frequency accuracy and stability of a synthesizer with the time saving convenience of a sweeper. Parameters such as start/stop/center frequencies, sweep width, frequency step and sweep time are entered and executed through a convenient keyboard or remote programming. Some additional features are phase continuous linear/log sweep in the 3325A and amplitude sweeping in steps as small as 0.01 dB in the 3330B. This in conjunction with frequency sweeping can provide a comprehensive family of curves.

Sweeper Applications

Sweepers are used extensively with swept frequency test sets to characterize the amplitude response of broadband devices or with network analyzers when the phase characteristics of the device (or S-parameters) are also needed. Two measurements—transmission and reflection—are basic to both types of analyzer. Hewlett-Packard offers a complete line of directional couplers, power splitters, and other transducers which together with the analyzers and sweep oscillators provide a total swept measurement solution.

The HP 8756A Scalar Network Analyzer operates over the 10 MHz to 26.5 GHz frequency range (operation at higher frequencies can be achieved using the HP 11664C Detector Adapters). It is a two channel diode detection receiver system with -50 dBm sensitivity and ratio capability. Combined with the 8350 and broadband plug-ins like the 83592 (.01 – 20 GHz) it is ideal for simultaneous magnitude-only transmission and reflection measurements. Convenience is enhanced since the 8350 provides the required 27.8 kHz modulation directly. With the 8756A alternate sweep testing is possible, since Channel 1 is only permitted to respond to the 8350's current state while Channel 2 responds to the alternate state. This allows "simultaneous" measurements of both filter skirt and passband responses (see Figure 4).

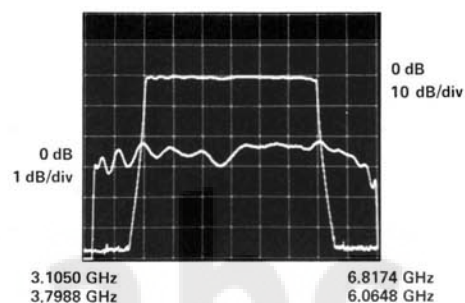


Figure 4.

For measurements requiring low harmonics, the new 83592C RF Plug-in for the 8350 Sweep Oscillator mainframe offers -55 dBc harmonic suppression from 2 to 20 GHz. For measurements that require lower harmonics, more sensitivity and/or phase information, sweepers may be used with network analyzers. For example, with the 83522A or 86222A/B RF Plug-ins and the 8410C Network Analyzer, phase-magnitude transmission or reflection coefficients can be measured across the full, 0.11-2.4 GHz range in one continuous sweep. Since the 8410C is a tuned receiver there is a spurious-free sensitivity of -78 dBm.

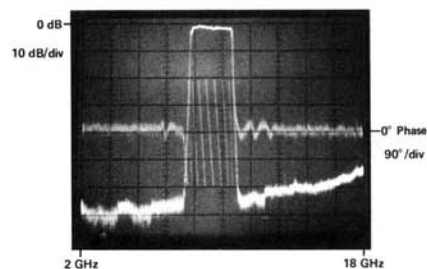


Figure 5.

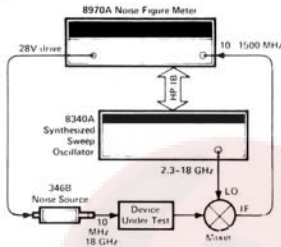
Figure 5 is a CRT photo of simultaneous phase and magnitude transmission characteristics of an 8 to 10 GHz bandpass filter using the 86290B Sweep Oscillator Plug-in.

For high power applications such as RF-susceptibility tests and high attenuation measurements, Hewlett-Packard offers TWT amplifiers which provide better than 1 watt from 1 to 18 GHz.



Synthesizer accuracy and stability can be obtained by phase-locking the Hewlett-Packard sweep oscillators to a harmonic of a very stable source or to the 5344S Source Synchronizer. This high stability is important in many applications including microwave spectroscopy and high-Q swept frequency measurements.

Noise figure measurements above 1500 MHz can be made using the 8970A Noise Figure Meter with either the 8340A or the 8350 serving as the local oscillator. To perform these measurements the 8970A Noise Figure Meter sends frequency commands over the interface bus (HP-IB) to tune the sweep oscillator to the frequency of interest. With this equipment noise figure and gain measurements can be made on microwave components such as amplifiers, transistors or mixers.



Two-tone sweep testing of devices such as mixers and receiver front ends requires two signals offset from each other by the IF. This is accomplished by phase-locking the difference frequency of two sweep oscillators to a

very stable source. The sweepers may then be swept across the band of interest.

The modulation and built-in attenuator features of Hewlett-Packard sweep oscillators make them useful in many traditional CW signal generator applications. The excellent stability, phase noise, frequency range and modulation capability of the new 8340A make it well suited for most of these applications. In addition, accuracy, linearity, and flatness of the broadband plug-ins like the 83590A, 83594A, 83595A, 83592A/B/C, 86290A/B/C, 83525A/B, 86222A/B, and 83522A make them more than adequate in many applications requiring a general purpose CW generator.

For wideband applications these RF plug-ins feature performance that rivals octave band oscillators in the areas of frequency purity and accuracy, harmonics, flatness, and power.

For a complete discussion of swept frequency measurements the following application notes and others are available from your local Hewlett-Packard sales office.

- AN 155-2 "100 dB Dynamic Range Measurements Using the 8755 Frequency Response Test Set"
- AN 183 "High Frequency Swept Measurements"
- AN 187-6 "Frequency Performance of the 8620C Sweep Oscillator Under Remote Programming"
- AN 312-1 "Configuration of a Two-tone Sweeping Generator"
- PN 8340A-1 "Increasing Frequency

Switching Speed on the HP 8340A Synthesized Sweeper"

- PN 8340A-5 "60 GHz Frequency Coverage Using the HP 8340A Synthesized Sweeper and the WJ 1204-4X Frequency Extender"
- PN 8340A-6 "Reduced Harmonic Distortion Using the Integra TMF-1800H Tracking Filter with the HP 8340A Synthesized Sweeper"
- PN 8340A-7 "Microwave Noise Figure Measurements Using the 8340A Synthesized Sweeper with the 8970A Noise Figure Meter"
- PN 8350A-1 "Using the HP 8350A Sweep Oscillator with the Wiltron 560 Scalar Network Analyzer"
- PN 8350A-2 "Improved Frequency Accuracy by Calibrating HP 83590 Series RF Plug-ins to HP 8350A Sweep Oscillator Mainframe"
- PN 8350-3 "A Penlift Dwell Circuit for the HP 8350 Sweep Oscillator"
- PN 8350A-5 "60 GHz Frequency Coverage Using the HP 8350A Sweep Oscillator and WJ 1204-4X Frequency Extender"
- PN 8350-6 "Reduced Harmonic Distortion Using the Integra TMF-1800H Tracking Filter with the HP 8350 Sweep Oscillator"
- PN 8350A-7 "Microwave Noise Figure Measurements Using the 8350A Sweep Oscillator with the 8970A Noise Figure Meter"
- PN 8620C-1 "Using the HP 8620C Sweep Oscillator with the Wiltron 560 Scalar Network Analyzer"
- PN 8756A-1 "Automating the 8756A Scalar Network Analyzer"

Sweep Oscillator—Summary Chart

Frequency Range*	Model Number														
	8350 Series	8620 Series**	Other Sweepers	100 kHz	1 MHz	10 MHz	100 MHz	1 GHz	2 GHz	4 GHz	8 GHz	12 GHz	18 GHz	26 GHz	40 GHz
0.1 Hz-13 MHz 10 Hz-21 MHz 1 μHz-21 MHz 1 mHz-50 MHz 200 Hz-80 MHz 10 kHz-1280 MHz 10 kHz-2600 MHz			3312A 3336A/B/C 3325A 8165A 3335A 8662A 8660C	←	←	←	←	←	←	←	←	←	←	←	←
100 kHz-110 MHz 10 MHz-1.3 GHz 10 MHz-2.4 GHz 10 MHz-8.4 GHz 10 MHz-20 GHz 10 MHz-26.5 GHz 10 MHz-26.5 GHz	83522A 83525A/B 83592A/B 83595A	86220A 86222A/B	8601A 8340A 8673S	←	←	←	←	←	←	←	←	←	←	←	←
1.7-4.3 GHz 1.8-4.2 GHz 2-8.4 GHz 3.6-8.6 GHz 2-18.6 GHz 2-20 GHz 2-22 GHz 2-26.5 GHz	83540A/B 83590A 83594A	86235A 86230B 86240A/B 86240C 86290A/B/C 86290A/B Opt H08	8673A	←	←	←	←	←	←	←	←	←	←	←	←
3.2-6.5 GHz		86241A		←	←	←	←	←	←	←	←	←	←	←	←
5.9-9.0 GHz 5.9-12.4 GHz 7-11 GHz 7.5-18.6 GHz 8-12.4 GHz	83545A	86242D 86245A 86250D Opt H08 86251A 86250D		←	←	←	←	←	←	←	←	←	←	←	←
10-15.5 GHz 12.4-18 GHz 17-22 GHz 18-26.5 GHz 26.5-40 GHz	83570A 83572A/B	86260B 86260A 86260C		←	←	←	←	←	←	←	←	←	←	←	←

*Other Special Frequency Ranges Can Be Provided Upon Request.
**86200 Series RF Plug-ins are usable with the 8350A Mainframe via the 11869A Adapter. 83500 Series Plug-ins are not usable in the 8620C Mainframe.