



STABILIZED SWEEP OSCILLATOR SYSTEMS

E20-8690A
E21-8690A
E22-8690A
E23-8690A

TECHNICAL DATA 15 DEC 68

FEATURES

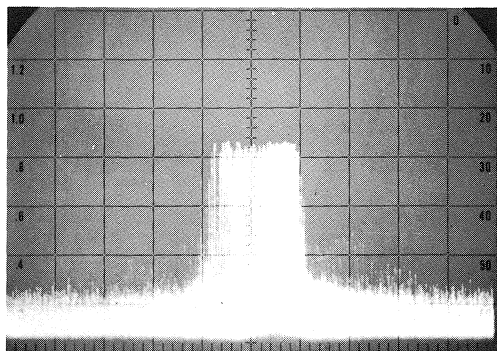
- STABILIZED AT ANY FREQUENCY
—1 TO 40 GHz
- STABILIZED CW OR SWEPT,
 $5 \times 10^{-7}/\text{SEC}$, $1 \times 10^{-5}/\text{HR}$
- POSITIVE FREQUENCY INDICATION

USES

- NARROW-BAND RECEIVER OR
FILTER TEST
- PARAMETRIC AMPLIFIER PUMP
- DOPPLER SYSTEM SOURCE

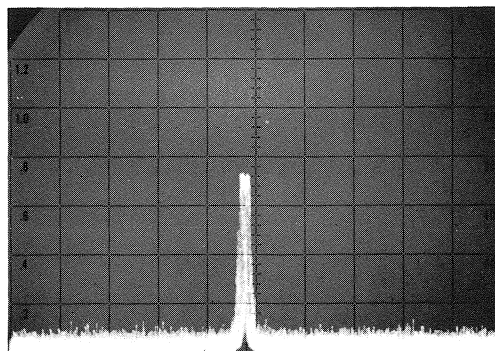


UNSTABILIZED



100 KHZ

STABILIZED



100 KHZ

Residual FM at 30 GHz as Viewed on HP 851B/8551B Spectrum Analyzer

DESCRIPTION

Highly Versatile Sources

The HP Stabilized Sweep Oscillator Systems provide the stable signals required by today's more sophisticated microwave applications. In these systems an HP 8690A Sweep Oscillator with appropriate interchangeable RF Unit is phase-locked to a 240-400 MHz reference oscillator. The reference oscillator stability is thereby transferred to the sweep oscillator. The reference oscillator is continuously tunable, so the sweep oscillators can be stabilized at any frequency in their respective ranges quickly and easily; there are no crystals to change. In addition, stabilized systems providing swept as well as CW operation are available. Frequency indication is unambiguous; it can be read directly from the sweeper dial. For more accurate frequency indication, a counter can be added. Furthermore, the phase-lock IF is 20 MHz; this choice of frequency eliminates IF feedthrough and related problems which arise in applications such as sensitive receiver testing when the receiver IF is the same as the phase-lock IF. These stabilized systems have unprecedented flexibility yet they can be operated

with ease by semi-skilled personnel in production line applications.

Four basic systems are available:

- 1) Coaxial (1 to 12.4 GHz), stabilized in CW mode only.
- 2) Waveguide (12.4 to 40 GHz), stabilized in CW mode only.
- 3) Coaxial (1 to 12.4 GHz), stabilized in sweep or CW mode.
- 4) Waveguide (12.4 to 40 GHz), stabilized in sweep or CW mode.

These configurations are illustrated in Figures 1 through 4. Each system includes frequency-independent and frequency-dependent subsystems. The frequency-independent subsystems (E20-, E21-, E22-, and E23-8690A) include the sweep oscillator mainframe, reference oscillator, synchronizer, mixer, and, for waveguide systems, the multiplier. The frequency-dependent subsystems (E07-8691A/B to E07-8697A) include the RF unit for the sweep

Table 1. Systems Breakdown

Stabilized Mode	Output Connector	Freq Range (GHz)	Freq-Independent Subsystem	Freq-Dependent Subsystem	
CW only ↓	Coax (type N) ↓ Waveguide ↓	1-2	E20-8690A	E07-8691A/B*	
		2-4	↓	E07-8692A/B*	
		4-8		E07-8693A/B*	
		8-12.4		E07-8694A/B*	
		12.4-18		E21-8690A	E07-8695A
		18-26.5		↓	E07-8696A
		26.5-40			E07-8697A
Swept or CW ↓	Coax (type N) ↓ Waveguide ↓	1-2	E22-8690A	E07-8691A/B*	
		2-4	↓	E07-8692A/B*	
		4-8		E07-8693A/B*	
		8-12.4		E07-8694A/B*	
		12.4-18		E23-8690A	E07-8695A
		18-26.5		↓	E07-8696A
		26.5-40			E07-8697A

* A or B suffix indicates grid-modulated or PIN-diode-modulated RF unit. Refer to 8690A Technical Data.

oscillator and all other items to complete the system. A complete systems breakdown is shown in Table 1.

CW Operation

The CW operation of all four systems is similar. The output of the sweep oscillator is mixed with harmonics of the HP 8464A or 8466A Reference Oscillator, which is continuously tunable from 240 to 400 MHz. The mixing products are applied to the HP 8709A Synchronizer, which has a 20-MHz IF amplifier terminated in a phase comparator. This circuit compares the phase of the IF signal to the output of an internal 20-MHz crystal oscillator. The synchronizer then supplies the sweeper RF unit with a dc error signal (up to ± 15 volts) proportional to the phase difference between the IF and crystal oscillator signals. The error signal corrects the output frequency of the sweep oscillator, completing the phase-lock loop. Lock range is about 50 MHz. The synchronizer also includes a search circuit which sweeps the output error voltage and thereby the sweeper frequency to facilitate the initial locking process. The search or capture range is about 20 MHz. The search circuit is automatically disabled when lock is achieved.

Positive Identification of Lock Points

Although the phase-lock IF amplifier passes either 20-MHz mixing product (reference oscillator harmonic 20 MHz above or below the sweeper frequency) the search oscillator is disabled only when the reference oscillator harmonic is 20 MHz below the sweeper frequency. Therefore, adjacent lock points are spaced by the reference oscillator frequency rather than twice the IF (40 MHz). Since the accuracy and resolution of the frequency dial on the sweeper is adequate to distinguish between lock points, it is easy to determine to which harmonic the system is locked.

Phase-locking the system is simple. The desired frequency is set on the sweeper dial, and the reference oscillator is then tuned for lock (indicated by a front-panel light on the synchronizer). For systems which include a counter, the reference oscillator is tuned to obtain the desired sweeper frequency on the counter (although the counter indicates sweeper frequency, it actually counts the reference oscillator). The sweeper is then tuned to the appropriate lock point; the wide spacing of the lock points (240 to 400 MHz) makes picking the right lock point easy.

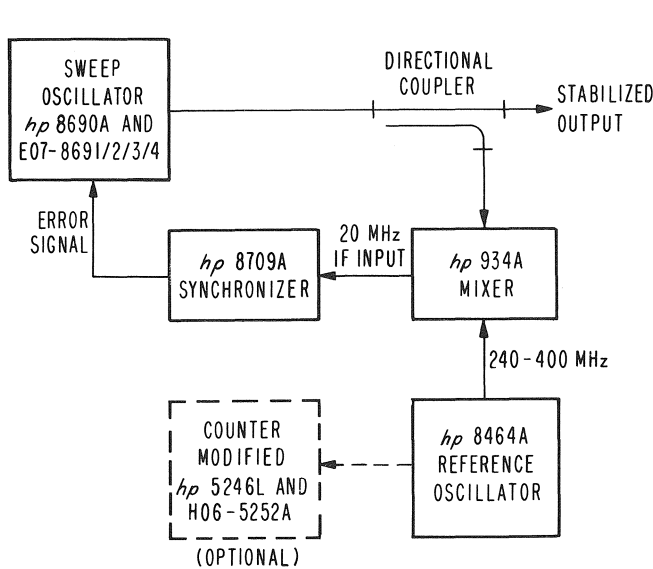


Figure 1. Coaxial systems (1 to 12.4 GHz) stabilized in CW only

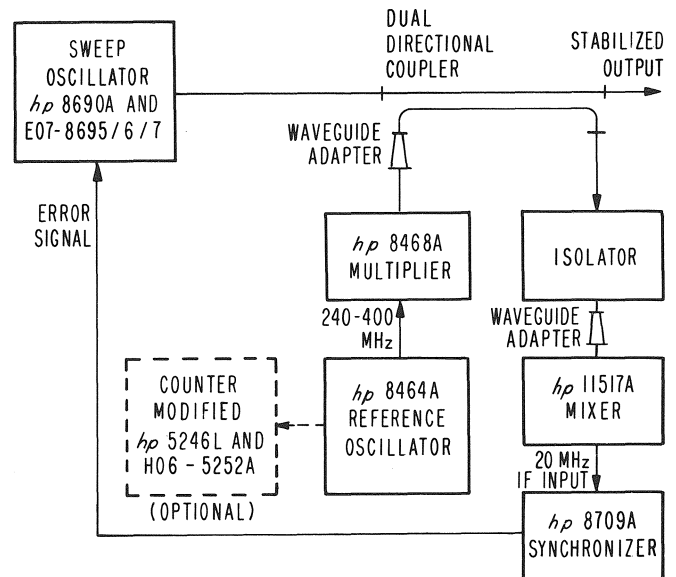


Figure 2. Waveguide systems (12.4 to 40 GHz) stabilized in CW only

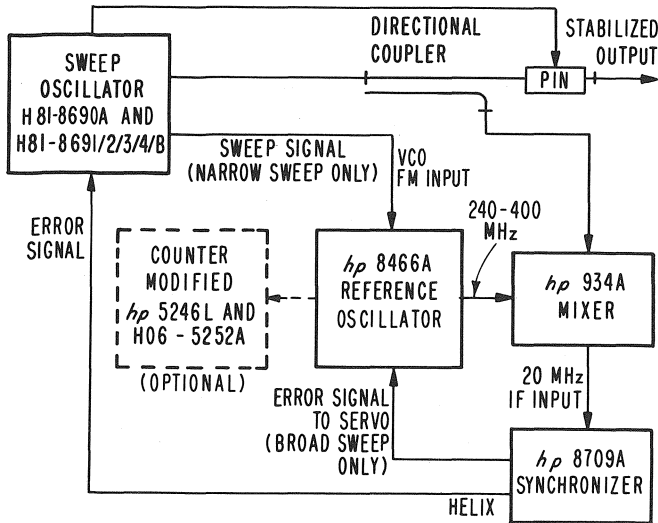


Figure 3. Coaxial systems (1 to 12.4 GHz) stabilized in swept or CW mode

Swept Operation

Operation of the E22-8690A and E23-8690A systems in the swept mode is somewhat similar to their operation in the CW mode. However, the 8466A Reference Oscillator and the sweeper must track throughout the sweep. The method of tracking depends upon the sweep width. For broadband sweeps, a mechanical servo control loop tunes the reference oscillator. The error signal for the servo loop is obtained from a low-level output (± 1 volt) from the phase comparator in the 8709A Synchronizer. While the reference oscillator determines short-term stability, long-term stability is that of the unstabilized sweep oscillator.

For the narrow or ΔF sweep mode ($\pm 1/2\%$ of the band), the mechanical servo loop is opened. The referenced oscillator is swept electrically by the sweep voltage from the sweep oscillator; this voltage is applied to a varactor in the oscillator circuit. As the reference oscillator sweeps, an error signal developed in the phase comparator causes the sweep oscillator frequency to track the reference oscillator. In this case, then, both the long- and short-term stability are that of the reference.

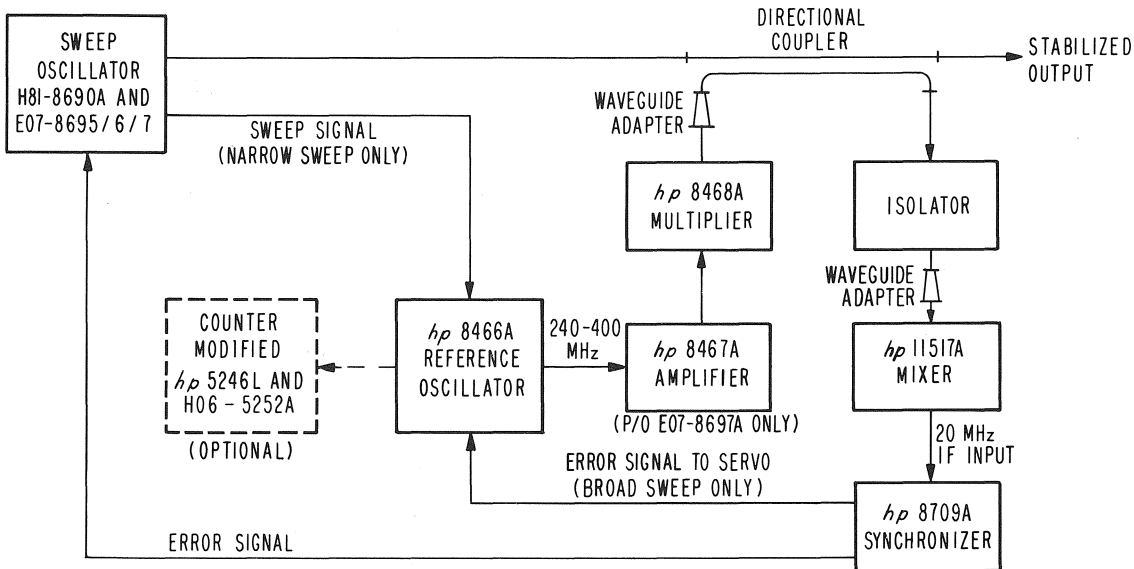


Figure 4. Waveguide systems (12.4 to 40 GHz) stabilized in swept or CW mode

SPECIFICATIONS

(The microwave signal sources in these systems are 8690A Sweep Oscillators with appropriate 8691A/B-8697A RF Units. Specifications listed in the 8690A Technical Data apply except as modified below.)

E20-8690A and E21-8690A Systems

Stabilized Mode: CW only.

Frequency Range:

E20-8690A: 1 to 12.4 GHz depending upon RF Unit; see E07-8691A/B-E07-8694A/B below.

E21-8690A: 12.4 to 40 GHz depending upon RF Unit; see E07-8695-E07-8697A below.

Frequency Stability in Stabilized Mode:

With time: $\leq 5 \times 10^{-7}/s$, $\leq 1 \times 10^{-5}/h$

With temperature: $\leq 1 \times 10^{-4}/^{\circ}C$

With line voltage: $< 2 \times 10^{-5}$ for $\pm 10\%$ change in line voltage.

Residual FM: $\leq 5 \times 10^{-7}$.

Price: (the E07-8691A/B-E07-8697A for the appropriate frequency range must also be ordered; see below):

E20-8690A: \$4600.00

E21-8690A: \$6055.00

E22-8690A and E23-8690A Systems

Stabilized Mode: CW or swept.

Frequency Range:

E22-8690A: 1 to 12.4 GHz depending upon RF Unit; see E07-8691A/B-E07-8694A/B below.

E23-8690A: 12.4 to 40 GHz depending upon RF Unit; see E07-8695A-E07-8697A below.

Maximum Sweep Range while Stabilized:

Narrow-band (ΔF) sweep: $\pm 0.5\%$ of range.

Broad-band sweep: 1.66 to 1.

Minimum Sweep Time while Stabilized:

Narrow-sweep (ΔF) mode: 10 ms

Broad-sweep mode: 30 s

Frequency Stability while stabilized:

With time: $\leq 5 \times 10^{-7}/s$ (all modes), $< 1 \times 10^{-5}/h$ (CW and narrow-sweep modes only).

With temperature: $\leq 1 \times 10^{-4}/^{\circ}C$.

With line voltage: $< 2 \times 10^{-5}$ for $\pm 10\%$ change in line voltage.

Residual FM: $\leq 5 \times 10^{-7}$.

Price: (The E07-8691A/B-E07-8697A for the appropriate frequency range must also be ordered; see below):

E22-8690A: \$7610.00

E23-8690A: \$9010.00

E07-8691A/B-E07-8697A

Frequency Range:

E07-8691A/B: 1 to 2 GHz.

E07-8692A/B: 2 to 4 GHz.

E07-8693A/B: 4 to 8 GHz.

E07-8694A/B: 8 to 12.4 GHz.

E07-8695A: 12.4 to 18 GHz.

E07-8696A: 18 to 26.5 GHz.

E07-8697A: 26.5 to 40 GHz.

Price:

E07-8691A, \$2825.00

E07-8691B, \$3275.00

E07-8692A, \$2625.00

E07-8692B, \$3075.00

E07-8693A, \$2550.00

E07-8693B, \$3025.00

E07-8694A, \$2650.00

E07-8694B, \$3150.00

E07-8695A, \$3810.00

E07-8696A, \$4435.00

E07-8697A, \$7955.00