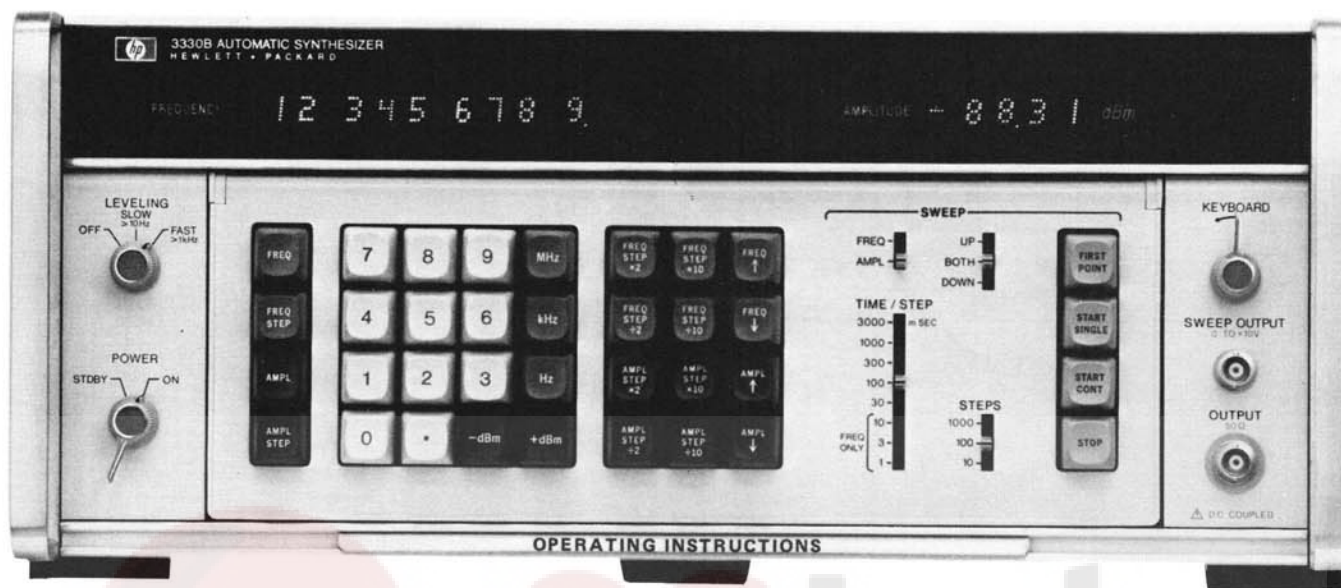


# FREQUENCY SYNTHESIZERS

0.1 Hz to 13 MHz automatic synthesizer

Model 3330B

- HP-IB
- Digital sweeping of frequency and amplitude



## OPERATING INSTRUCTIONS

HP-IB

### Description

The fully programmable (HP-IB) 3330B Frequency Synthesizer has a frequency stability of  $\pm 1 \times 10^{-8}$  per day,  $-50$  dB signal-to-phase noise, with a constant resolution of 0.1 Hz up to 13 MHz. Amplitude can be controlled to a resolution of 0.01 dB over a 100 dB range.

Solid-state displays show frequency and amplitude. Nine digits of frequency and four digits of amplitude are displayed on the Model 3330B.

Spectral purity, not normally associated with frequency synthesizers, is a unique feature of the 3330B. Spurious is  $>70$  dB below the carrier and harmonics are  $>60$  dB to 40 dB below the carrier, depending upon the frequency setting. As a sweeper, the 3330B uses digital sweeping for linearity. Either single or continuous sweeps may be set up. Parameters such as center frequency, frequency step, time per step, and the number of steps go into the memory, then are executed by pressing a single button. The ROM operates the sweep as set up until told to stop. Many of the sweep parameters can be changed while the instrument is sweeping. The instrument sweeps amplitude in steps as small as 0.01 dB. The amplitude can be stepped at the end of each frequency sweep cycle to produce a family of curves.

### Specifications

**Frequency range:** 0.1 Hz to 13,000,999.9 Hz.

**Frequency resolution:** 0.1 Hz (8 digits + overrange).

**Frequency stability**

**Long term:**  $\pm 1 \times 10^{-8}$  of frequency per day.  $\pm 1 \times 10^{-7}$  of frequency per month.

**Temperature:**  $\pm 1 \times 10^{-8}$  of frequency at  $25^\circ\text{C} \pm 10^\circ\text{C}$ .  $\pm 1 \times 10^{-7}$  of frequency at  $0^\circ\text{C}$  to  $55^\circ\text{C}$ .

**Signal to phase noise (integrated):** 50 dB down in a 30 kHz band, excluding  $\pm 1$  Hz, centered on carrier.

**Harmonic distortion:** with full output amplitude, any harmonically related signal will be less than the following specified levels.

5 Hz to 100 kHz:  $-60$  dB.

100 kHz to 1 MHz:  $-50$  dB.

1 MHz to 13 MHz:  $-40$  dB.

### Spurious

All nonharmonically related spurious signals will be greater than 70 dB below selected output level or  $\leq 110$  dBm/50 $\Omega$ , whichever is greater.

**Frequency switching and settling time:** the time required for frequency switching and settling is a function of the largest frequency digit affected by the frequency change in question.

Largest digit changed	0.1 Hz or 1 Hz	10 Hz or 100 Hz	1 kHz or 10 kHz	100 kHz, 1 MHz or 10 MHz
Switching and settling time	$<1$ ms to within 500 $\mu\text{Hz}$	$<1$ ms to within 0.05 Hz	$<1$ ms to within 5 Hz $<50$ ms to within 0.01 Hz	$<1$ ms to within 500 Hz $<50$ ms to within 1 Hz

**Internal frequency reference:** 5 MHz crystal oscillator in temperature stabilized oven.

### Frequency adjustments

**Coarse:** internal adjustment adequate for five years of aging.

**Fine:** one turn pot or  $\pm 5$  V dc for  $1.2$  to  $2.5 \times 10^{-7}$  max control with internal reference or  $3 \times 10^{-5}$  max control with rear panel switch in ext. ref. position without an external reference applied.

**External frequency reference:** the 3330B may be phase locked with a 200 mV to 2 V rms signal that is any subharmonic of 20 MHz from 1 MHz through 10 MHz.

**Rear panel output:** front or rear panel output is standard.

### Auxiliary outputs

**20 - 33 MHz tracking output:**  $>100$  mV rms/50 $\Omega$ .

**1 MHz reference output:**  $>220$  mV rms/50 $\Omega$  (0 dBm/50 $\Omega$ ).

**Synthesized search or tune:** a frequency step (0.1 Hz min) may be entered. This step may be added to or subtracted from the synthesized output signal. Rate of search or tune is selected by the time per step control.

**Digital sweeping of frequency:** accomplished by entering and setting the center frequency, a frequency step, number of steps, time per step, and sweep direction.

**Sweep width:** the product of the step size and number of steps.

**Step size:** continuously adjustable in 0.1 Hz increments.

**Step accuracy:**  $\pm 1 \times 10^{-8}$  per day for standard reference crystal.

**Number of steps:** 10, 100, or 1000.

**Time per step:** 1 ms, 3 ms, 10 ms, 30 ms, 100 ms, 300 ms, 1000 ms, and 3000 ms.

**Direction of sweep:** up, both, down.



**Single sweep:** initiated by momentary pushbutton.

**Continuous sweep:** initiated by momentary pushbutton.

**Manual sweep:** accomplished by holding down the freq ↑ or freq ↓ keys. Display will follow output.

**Sweep output:** stepped dc voltage proportional to sweep position, 0 to +10V.

**Accuracy:** ±0.2% of full scale.

**Linearity:** ±0.1% of full scale.

#### Digital outputs

**Step count:** 0 to 1000 count on 12 BCD (1-2-4-8) lines to indicate sweep position.

**Sweep status:** line to indicate when instrument is sweeping.

**Step ready:** indicates instrument has spent the selected time per step and is ready to go to the next step.

**Sweep modification (continuous):** during a continuous sweep, the step size, center frequency, sweep direction, and time per step may be changed without stopping the sweep.

**Center frequency modification:** accomplished by pressing freq ↑ or freq ↓.

**Frequency step:** to widen or narrow the sweep width, the frequency step size may be expanded or contracted by factors of 2 or 10. The keys labeled freq step ×2, freq step ÷2, freq step ×10 and freq step ÷10 may be pressed.

**Sweep modification (single):** during a single sweep, the time per step and direction sweep may be changed without stopping the sweep.

#### Amplitude section

**Amplitude:** maximum 2.1 V rms into open circuit; maximum 1.05 V rms into 50Ω.

**Amplitude range:** +13.44 dBm to -86.55 dBm into 50Ω.

**Amplitude resolution:** 0.01 dB.

**Output impedance:** 50Ω (75Ω Opt 001).

**Display:** four digit readout in dBm with reference to 50Ω.

**Leveled frequency response:** (10 kHz reference) 10 Hz-13 MHz.\*

+13.44 dBm to -16.55 dBm: ±0.05 dB.

-16.55 dBm to -36.55 dBm: ±0.1 dB.

-36.55 dBm to -66.55 dBm: ±0.2 dB.

-66.55 dBm to -86.55 dBm: ±0.4 dB.

**Amplitude attenuator accuracy:** ±0.02 dB/10 dB step (at 10 kHz) of attenuation down from maximum output.

**Amplitude accuracy (absolute):** ±0.05 dB at 10 kHz and +13.44 dBm (15°C ±5°C). (For absolute accuracy at other frequencies and amplitudes, add 0.05 dB to the leveled frequency response specification, plus the attenuator accuracy specification.)

**Amplitude modulation:** requires external modulation source. Rear panel BNC. ALC switch must be in slow position.

**Modulating signal:** 100 Hz to 100 kHz.

**Modulation depth:** 0.95 V rms modulating signal for 95% modulation depth.

**Digital sweeping of amplitude:** accomplished by entering and setting the center amplitude, an amplitude step, number of steps, time per step and sweep direction.

**Type:** linear and symmetrical about the center amplitude.

**Sweep width:** product of the step size and number of steps.

**Step size:** 0.01 dB to 99.99 dB in 0.01 dB increments.

**Number of steps:** 10, 100, or 1000.

**Time per step:** 30 ms, 100 ms, 300 ms, 1000 ms, 3000 ms.

**Direction of sweep:** up, both, down.

**Single sweep:** momentary pushbutton. Display follows output.

**Continuous sweep:** momentary pushbutton. Display of center amplitude or step.

**Manual sweep:** accomplished by holding down the ampl ↑ or ampl ↓ keys. Display will follow output. Sweep output, digital outputs,

\*Add ±0.5 dB for leveling off.

sweep modification (continuous), sweep modification (single), all the same as with frequency sweep.

#### Digital remote control

Remote control of the 3330B is accomplished via the Hewlett-Packard Interface Bus (HP-IB) which is a standard feature of the instrument. Both the standard nonisolated HP-IB version and an optional isolated HP-IB version (Opt. 004) allow full programming of all frequency, amplitude and sweep functions.

The HP-IB interface allows the 3330B to be interconnected with up to 14 additional HP-IB compatible instruments on a common interface bus. Using an industry-standard addressing scheme, the 3330B can be singled out to receive its individual programming instructions. This permits multiple 3330B's, or other HP-IB sources, to be connected to the same interface bus, each programmed to different frequencies and amplitudes.

Connection of instruments to a system controller is vastly simplified since all HP-IB instruments are interfaced with a common I/O card and driver. Hewlett-Packard Models 9815A, 9825A, 9830A and 9831A Calculators, and Models 21MX and 2100 Series computers are all compatible with HP-IB.

#### Options

**001:** 75 ohms-1 V rms (factory installation only). Attenuation and output referenced to 75Ω.

**Amplitude range:** +11.25 dBm to -88.74 dBm.

**002:** High Stability Crystal Oven.

**Long term frequency stability:** ±1 × 10<sup>-9</sup> per day. +2 × 10<sup>-8</sup> per month.

**Long term temperature:** ±1 × 10<sup>-9</sup> total frequency at 25°C, ±10°C. ±1 × 10<sup>-8</sup> total of frequency at 25°C, 0°C to +55°C.

**Frequency adjustments:** same as standard instrument.

**003:** deletion of Crystal Oven. 20 MHz ambient temperature crystal reference oscillator.

**Frequency stability:** ±10 parts in 10<sup>6</sup>/yr.

**Frequency adjustments:** rear panel 1 turn pot or rear panel voltage control input for 30 × 10<sup>-6</sup> maximum control.

**004:** isolated Digital Input (factory installation only). With this option, the digital input lines are electrically isolated from the signal ground. (HP-IB)

**DC isolation:** ±250 V.

**AC isolation:** >30 dB, 0 to 1 MHz.

**005:** 5 V rms-50 ohm output. This option gives the 3330B a 1/2 watt output.

**Amplitude range:** +26.99 dBm to -73 dBm into 50 ohms.

#### General

**Operating temperature:** 0°C to +55°C.

**Storage temperature:** -40°C to +70°C.

**Turn on time:** application of power to "On": 20 min to within ±1 × 10<sup>-7</sup> of the final frequency.

**"Standby" to "On":** 15 s to full specifications.

**Power requirements:** 115 V or 230 V ±10%, 48 Hz to 63 Hz, 20 W standby, 200 W on.

**Weight:** net, 22.6 kg (53 lb). Shipping, 26.8 kg (63 lb).

**Dimensions:** 177 mm H × 426 mm W × 547 mm D (7" × 16 3/4" × 21 1/2").

#### Options

**001:** 75Ω-1 V output

**002:** crystal oven

**003:** deletion of oven

**004:** isolated HP-IB

**005:** 5 V-50Ω output

#### Price

N/C

add \$580

less \$150

add \$440

add \$295

#### 3330B Automatic Synthesizer

**\$7015**