

# FREQUENCY, FUNCTION & WAVEFORM SYNTHESIZERS

## Two-Channel Synthesizer, DC to 13 MHz

Model 3326A



HP 3326A



The HP 3326A Two-Channel Synthesizer combines two independent synthesizers, flexible modulation, and control circuitry into a single, powerful package. This single instrument can provide precise phase offset, two-tone sweep, fast frequency switching, internal modulation, and pulse signals for bench or systems use.

### Complete Two-Phase Solution

The HP 3326A can provide two signals whose phase is adjustable and calibrated anywhere in its 13 MHz frequency range without an external phasemeter.

Self-calibration can be performed internally or externally and yields accuracy of  $\pm 0.2$  degrees below 100 kHz. Phase can be set with 0.01 degree resolution at all frequencies. Using its unique phase-calibration circuitry, calibrated multi-phase signals are easily achieved with two or more HP 3326As.

### Powerful Two-Tone Capability

The HP 3326A is the single-source answer for producing a wide variety of broadband two-tone signals. Its two channels can be offset up to  $\pm 100$  kHz, either in the CW mode or while sweeping.

Channel amplitudes and functions (sine or square) can be selected independently and provided from separate outputs or through the built-in signal combiner. Low sinewave distortion (harmonics are at least  $-70$  dBc below 100 kHz) makes low-distortion intermodulation measurements a simple task.

### Versatile ATE Source

With two complete synthesizers in a single instrument, rack space and power are conserved. Features like internal amplitude and phase modulation, two-tone, and pulse modes allow this one instrument to do the job of several sources.

All functions, modes, and parameters of the HP 3326A are completely programmable over the HP-IB. Maximum accuracy is ensured with amplitude/phase calibrations that can be enabled, disabled and initiated under remote control.

### High Performance Modulation and Pulses

Precise amplitude and phase modulation is easy with both channels of the HP 3326A. Each channel can be used with simultaneous AM and PM, or one channel can modulate the other. Amplitude modulation frequency is dc to 100 kHz and envelope distortion is better than  $-46$  dB.

In the pulse mode both pulse and pulse-complement outputs are provided. Symmetry range is 1% to 99% and is settable in 0.1% increments. In addition, both pulse amplitudes and their offsets are independently controllable.

### Other Features

The HP 3326A has a host of convenience features to speed and simplify signal generation. Nine complete setup states can be stored in nonvolatile memory, along with automatic storage of the power-off state. A discrete sweep mode is available to generate from 2 to 63

frequency pairs with dwell times individually selectable for each frequency and each channel. Several flexible triggering modes allow hardware or software triggers to initiate frequency, amplitude, or phase changes, and sweeps.

DC offset is available in all modes, and all outputs are floating. Frequency resolution is 11 digits, and all sweeps and frequency changes are phase-continuous.

### Specifications

For complete specifications refer to the HP 3326A data sheet.

### Operating Modes

**Two Channel:** Channels A and B are independent

**Two-Phase:** Channels A and B are the same frequency, with calibrated phase offset between the two signals

**Two-Tone:** Channel B frequency offset 0 to 100 kHz from channel A frequency

**Pulse:** Channel B is the complement of Channel A

### Frequency (Waveforms are Sine, Square, Pulse, and DC)

**Range:** 0 Hz to 13 MHz

**Resolution:** 1  $\mu$ Hz below 100 kHz, 1 mHz at and above 100 kHz

**Stability:**  $\pm 5 \times 10^{-6}$ /year, 20° to 30°C. See also option 001, High Stability Frequency Reference.

**Accuracy:**  $\pm 5 \times 10^{-6}$  of selected value, 20° to 30°C, at time of calibration with standard frequency reference

### Sinewave Spectral Purity

**Harmonics:** Harmonically related signals will be less than the following levels relative to the fundamental, or  $< -90$  dBm, whichever is greater:

	10 Hz	50 kHz	100 kHz	1 MHz	13 MHz
+23.98 dBm	-----	-----	-----	-----	-----
	-80 dBc	-70 dBc	-55 dBc	-30 dBc	
+13.98 dBm	-----	-----	-----	-----	-----
	-80 dBc	-80 dBc	-65 dBc	-50 dBc	
-56.02 dBm	-----	-----	-----	-----	-----

**Integrated Phase noise:**  $-66$  dBc (Option 001 only, for a 30 kHz band centered on a 10 MHz carrier excluding  $\pm 1$  Hz about the carrier)

### Main Signal Outputs (Channels A & B, All Waveforms Unless Noted)

**Connectors:** Front panel BNC female

**Impedance:** 50  $\Omega$ ; output may be floated to  $\pm 42$  V peak

**Sync A:** TTL level squarewave at Channel A frequency.

### Output Amplitude (Sine Mode)

**Range:** 1 mVpp to 10 Vpp in 8 ranges without DC offset. See also option 002 High Voltage Output

**Units:** Volts peak-peak, Volts rms, dBm (50  $\Omega$ ), dBV

**Resolution:** 0.1% of full range for peak-peak entry  
0.3% of full range for rms entry  
0.01 dB for dBm or dBV entry

**Accuracy:** Relative to programmed value after self-calibration

	0.001 Hz	100 kHz	1 MHz	13 MHz
+23.98 dBm	-----	-----	-----	-----
	±0.1 dB	±0.3 dB	±0.6 dB	
+3.98 dBm	-----	-----	-----	-----
			±0.8 dB	
-36.02 dBm	±0.2 dB	±0.5 dB	-----	-----
			±1.0 dB	
-56.02 dBm	-----	-----	-----	-----

### Squarewave and Pulse Characteristics

**Rise/fall time:** ≤15 ns, 10% to 90% at full output  
**Overshoot:** ≤5% of peak-to-peak amplitude at full output  
**Pulse width range:** 1% to 99% of period or 20 ns, whichever is greater  
**Pulse width resolution:** 0.01% of period  
**Pulse width accuracy:** ≤±1% of period ±20 ns  
**Amplitude accuracy:** ±2%, 0.001 Hz to 100 kHz

### DC Offset

**Range:** (See also option 002, high voltage output)  
**DC only:** 0 to ±5 V  
**DC+AC:** DC+AC peak ≤5V; Max. DC offset is affected by AC range, Maximum is 4.5 V decreasing to 4.5 mV on lowest range  
**Resolution:** 3 digits  
**Accuracy:** (After self-calibration)  
**DC only:** ±75 mV  
**DC+AC:** (Sinewave) 10 Hz to 1 MHz: ±2% of range  
1 MHz to 13 MHz: ±5% of range

### Phase Offset

(Channel A vs B in Two-Phase mode)  
**Range:** ±720 degrees  
**Resolution:** 0.01 degree  
**Accuracy:** After self-calibration, for equal-level sinewaves 1 V to 10 V peak-peak

0.1 Hz to 10 Hz	±0.5 degrees
10 Hz to 100 kHz	±0.2 degrees
100 kHz to 1 MHz	±0.3 degrees
1 MHz to 13 MHz	±2.0 degrees

### Amplitude Modulation

Specifications apply to Channel A and Channel B with external modulation or to Channel A internal modulation with Channel B as the modulation source. External modulation is allowed in all modes; internal modulation is allowed only in the two-channel mode.  
**Waveforms:** Sine, square, or (external only) pulse, DC, etc.  
**Frequency Range:** Carrier: DC to 13 MHz  
Modulation: DC to 100 kHz  
**Modulation Depth:** 0 to 100%

### Phase Modulation

Specifications apply to Channel A and Channel B with external modulation or to Channel A internal modulation with Channel B as the modulation source. External modulation is allowed in all modes; internal modulation is allowed only in the two-channel mode.  
**Waveforms:** Sine, square, or (external only) pulse  
**Frequency Range:** Carrier: DC to 13 MHz  
Modulation: DC to 5 kHz  
**Phase Deviation:** 0° to 360°

### Frequency Sweep

**Sweep Types:** Linear, discrete  
**Sweep Forms:** Triangle, ramp  
**Sweep Time:** 5 ms to 1000 s  
**Sweep Elements** (Discrete): 2 to 63 frequency pairs and dwell times, user defined; dwell times = 5 ms to 1000 s/element  
**Maximum Sweep Width:** 13 MHz

### Output Combiner

Channel A and B are combined on the Channel A output. B output is off. Combiner may be used in the two-channel, two-phase, and two-tone modes. DC offset is automatically set to 0 V.  
**Frequency Range:** DC to 13 MHz  
**Return Loss:** >20 dB

### Auxiliary Outputs (All Connectors are Rear-Panel BNC)

**10 MHz reference:** +3 dBm output to phase lock other instruments to the HP 3326A  
**10 MHz oven output:** +3 dBm oven-stabilized frequency reference (option 001 only)  
**X-axis drive:** Linear ramp proportional to sweep time  
**Z-axis blank:** TTL low during sweep  
**Sweep Marker:** TTL low at selected marker frequency in sweep  
**20-33 MHz LO:** >100 mV square wave output offset 20 MHz from Channel B output

### Auxiliary Inputs (All Connectors are Rear-Panel BNC)

**Reference Input:** For phase-locking to an external frequency reference. Signal of 1, 2, 5, or 10 MHz, ±10 ppm, 0 to +20 dBm  
**External Trigger Input:** TTL level to initiate linear or discrete sweep on high to low transition  
**Channel A and B external phase calibration inputs**  
**Channel A and B external amplitude modulation inputs**  
**Channel A and B external phase modulation inputs**

### HP-IB Remote Control

Compatible with IEEE Standard 488-1978  
**Interface Functions:**  
 SH1,AH1,T6,L4,SR1,RL1,PP0,DC1,DT1,C0,E1

### Option 001 High Stability Frequency Reference

**Stability:** ±5×10<sup>-8</sup>/week after 72 hours continuous operation  
±1×10<sup>-7</sup>/month after 15 days continuous operation

### Option 002 High Voltage Output

Multiplies the output level by 4 and expands the allowable DC offset range. Specifications apply to both channels in all modes with the internal combiner off.  
**Frequency range:** DC to 1 MHz  
**Output impedance:** <2 Ω, DC to 50 kHz; <10 Ω, 50 kHz to 1 MHz  
**Amplitude range:** 4 mV to 40 Vpp into >1kΩ, <200 pF load without DC offset (must be entered in peak-to-peak units only)  
**DC offset:** ±20 V, independent of amplitude range. DC + AC peak must not exceed 20 V

### Option 003 Rear Terminal Outputs

Provides Channel A and B main outputs only on rear panel BNC's. Front panel main outputs are removed. Specifications unchanged.

### General

**Power:** 100/120/220/240 V, +5%, -10%, 48 to 66 Hz; 120 VA, 150 VA with all options, 10 VA standby  
**Weight:** 27 kg (60 lb) net, 37 kg (81 lb) shipping  
**Dimensions:** 177 mm H x 425.5 mm W x 497.8 mm D (7" x 16 3/4" x 19 3/8")

### Accessories Available

**HP 15507A Isolator:** For isolation of signal ground between frequency reference and instrument input/output  
**HP 9211-2656 transit case** for protection in transportation and storage

### Ordering Information

	Price
HP 3326A Two-Channel Synthesizer	\$9,760
Option 001 High Stability Frequency Reference	\$665
Option 002 High Voltage Output	\$305
Option 003 Rear Terminal Outputs (Rear only)	N/C
Option 907 Front Handle Kit	\$61
Option 908 Rack Flange Kit	\$36
Option 909 Rack Flange and Handle Combination Kit	\$92
Option 910 Extra Operating Manual	\$102
Option 914 Delete Service Manual	less \$115
Option W30 Ext. Warranty	\$190