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FUNCTION GENERATORS & WAVEFORM SYNTHESIZERS

Multi-function Synthesizer

HP 8904A

- Sine to 600 kHz, square, ramp, triangle to 50 kHz
- 12-bit direct digital synthesis
- Tone, DTMF, digital, Hop Ram sequence modes
- One or two outputs
- One to four internal channels
- AM, FM, ØM, DSBSC, and pulse modulation
- Unit-to-unit phase synchronization
- Optional 600 Ω high power, balanced output



HP 8904A

DESIGNED FOR HP-IB SYSTEMS

HP Instrument Drivers

HP 8904A Function Synthesizer

The standard HP 8904A multi-function synthesizer generates accurate sine waves from 0 Hz to 600 kHz with 0.1 Hz resolution. The HP 8904A also has five other standard functions: square, triangle, ramp, from 0 Hz to 50 kHz plus dc, and Gaussian white noise. All waveform values in the HP 8904A are digitally calculated in real time by Hewlett-Packard's Digital Waveform Synthesis IC yielding 12-bit digital accuracy. Full HP-IB programmability is also included standard on the HP 8904A.

Two Outputs

Option 002 adds a second, identical synthesizer and floating 50 Ω output section to the HP 8904A. Frequency, amplitude, waveform, and phase can be independently set for the two sources. Either synthesizer can be precisely varied in phase relative to each other from 0 degrees to 359.9 degrees with a resolution of 0.1 degree.

Complex Signal Generation

Option 001 adds internal synthesizers (for a total of four) which can modulate channel A or be summed to give complex waveform generating capabilities to the HP 8904A. All four synthesizers are independent with precise phase offset capabilities. These synthesizers can be digitally summed before being output. In addition to summing, Option 001 allows channels B, C, and D to modulate channel A with AM, FM, ØM, DSBSC, or pulse modulation.

FM Stereo Composite Mode

Option 001 also includes a mode for generating FM stereo composite signals. Test signals in this mode include Left = Right, Left = – Right, Left Only, and Right Only. Single keystrokes select test-tone frequency, composite level, test signal mode, and pilot tone level. Stereo separation is typically greater than 65 dB.

Communication Signaling

Option 001 also adds four sequence modes to the HP 8904A: tone, DTMF, digital, and Hop Ram sequence modes. These modes make the HP 8904A a powerful tool for use in communications signaling. Tone and DTMF modes allow creation of single or dual tone sequences up to 750 states in length. Digital sequence mode can generate bit streams up to 3000 bits in length with 100 μs resolution. Hop Ram sequence mode allows sequencing of 16 tones, each with an associated amplitude, frequency, and phase value.

Fast Hop

Option 003 adds the ability to externally hop channel A in frequency, phase, or amplitude. Up to 16 frequency/phase/amplitude states can be entered into the Hop Ram memory. To hop, an external device must address the four-bit wide, TTL-level address bus provided on the rear panel. Phase continuous switching can be done in as little as 20 μs.

Unit-to-Unit Phase Synchronization

With Option 005, multiple HP 8904A's can be phase synchronized to provide more than two phase-related outputs. In the synchronous mode, one unit is specified to be the master clock unit and all others are designated slaves. Two signals are then routed from the clock master unit to all slave units through external low-loss power splitters. To synchronize the units, a phase reset command is given to the master HP 8904A via HP-IB or from the front panel. The total phase error between units will be the larger of ± 0.1 degree or 60 ns for frequencies from 0.1 Hz to 100 kHz. Up to eight HP 8904A's may be synchronized.

600 Ω Balanced Output

Option 006 changes output 1 from a 50 Ω electronically-floating output to a transformer-coupled, 600 Ω -balanced output. Option 006 provides high power, balanced signals into 600 Ω loads. Maximum output is 10 volts rms into 600 Ω. The Option 006 output restricts the frequency range of output 1 to 30 Hz to 100 kHz. In addition, complex waveforms such as square, ramp, and triangle waveforms are degraded and dc cannot be passed through the Option 006 output. In many applications, however, the HP 8904A Option 006 is a direct replacement for the HP 200CD wide range oscillator.

HP 8904A Specifications (for 50 Ω output only)

Frequency

Range: Sine wave: 0 Hz to 600 kHz
Square, triangle, ramp: 0 Hz to 50 kHz
Resolution: 0.1 Hz
Accuracy (internal 10 MHz timebase)**:** 50 ppm

AC Amplitude (sine wave only)

Range: 0 to 10 V p-p into a 50 Ω load
Accuracy (> 40 mV p-p into 50 Ω)**:** 1%, 0.1 Hz to 100 kHz;
3%, 100 kHz to 600 kHz
Flatness: (> 630 mV p-p into 50 Ω): ± 0.1% (± 0.009 dB),
0.1 Hz to 100 kHz

DC Amplitude

Range: 0 to ±10 V p-p open circuit
Accuracy: Larger of ± 20 mV or ± 2.1%

Spectral Purity (sine wave only)

THD + N (including spurs, amplitude > 50 mV rms into 50 Ω)**:**
– 63 dBc rms (0.07%), 20 Hz to 7.5 kHz, 30 kHz BW
– 63 dBc rms (0.07%), 7.5 kHz to 20 kHz, 80 kHz BW

Gaussian Noise

Spectral Characteristic: Equal energy per unit bandwidth ("white")
Time-Domain Characteristic: Gaussian distribution
Flatness (>100 mV p-p)**:** Typically ±0.5 dB, 0.1 Hz to 100 kHz

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Option 001 Specifications

Modulation is for channel A only, and specified for sine-wave carrier and modulation. External modulation is NOT possible.

Amplitude Modulation (with Option 001)

Rate: 0 to 600 kHz
Depth Range: 0% to 100 % of carrier amplitude

Frequency Modulation (with Option 001)

Rate: 0 to 600 kHz
Deviation Range: 0 to 600 kHz

Phase Modulation (with Option 001)

Rate: 0 to 600 kHz
Deviation Range: 0° to 179.9°/channel

Pulse or DSBSC Modulation (with Option 001)

Rate: 0 Hz to 50 kHz (up to 600 kHz for DSBSC)

Summation (with Option 001)

Two, three, or four channels may be summed.
Channel to Channel Phase Accuracy (equal amplitude sine waves)**:** Larger of ± 0.1° or 30 ns, 0.1 Hz to 100 kHz

FM Stereo Composite Mode (with Option 001)

Test Modes: Left = Right, Left = –Right, Left Only, Right Only
Composite Signal Level: Up to 10 V_{p-p} into 50 Ω
Pre-Emphasis Modes: Off, 25 μs, 50 μs, and 75 μs
Channel Separation: Typically > 65 dB, 20 Hz to 15 kHz rates

Tone Sequence Mode (with Option 001)

Number of Frequencies: 16 tones each with user-definable frequency, on-time and off-time
On/Off Time Duration Range: 0 ms, 0.80 ms to 655.35 ms
Timing Accuracy: ± 0.02 ms (± 20 μs)
Sequence Length: 750 steps, user-definable

DTMF Sequence Mode (with Option 001)

Number of Tone Pairs: 16 standard DTMF tone pairs (0-9, A-D, #, *) with user-definable on-time and off-time
On/Off Time Duration Range: 0 ms, 1.00 ms to 655.35 ms
Timing Accuracy: ± 0.02 ms (± 20 μs)
Sequence Length: 750 steps, user-definable

Digital Sequence Mode (with Option 001)

User Definable: On level, off level, and bit period
Bit Period Duration Range: 0.10 ms to 655.35 ms
Timing Accuracy: ± 0.02 ms (± 20 μs)
Sequence Length: Up to 3000 bits, user-definable

Hop Ram Sequence Mode (with Option 001)

Number of Frequencies: 16 tones each with user-definable frequency, phase, and amplitude
Sequence Clock Frequency Range: 0.1 Hz to 10 kHz
Sequence Length: 750 steps (all 16 tones used) or 3000 steps (tones 0 and 1 used), user-definable

Option 002 Specifications (50 Ω outputs)

Output 1 to Output 2 Phase Accuracy (sine waves at the same frequency)**:** ± 0.1° or 30 ns, 0.1 Hz to 100 kHz, whichever is greater

Option 003 Specifications (Fast Hop)

Direct Hopping of Channel A: 16 phase-frequency-amplitude states may be addressed with four TTL-compatible inputs
Switching Speed (via digital port)**:** Typically < 20 μs

Option 005 Specifications (50 Ω outputs)

Unit-to-Unit Phase Accuracy (sine waves only)**:** Larger of ± 0.1° or 60 ns, 0.1 Hz to 100 kHz
Maximum Number of Synchronized Units: 8 units

Option 006 Specifications (sine wave)

All specifications for the standard 50 Ω output HP 8904A are degraded by the accuracy, flatness, and distortion specifications of the Option 006, 600 Ω transformer coupled output.
Output Type: Fully floating/balanced transformer-coupled output
Usable Frequency Range: Typically 30 Hz to 200 kHz
AC Amplitude Range: 0 to 10 Vrms into 600 Ω
AC Amplitude Accuracy (> 40 mVrms into a balanced 600 Ω load)**:**
6% (0.5 dB), 30 Hz to 20 kHz
12% (1.0 dB), 30 Hz to 100 kHz
Flatness (> 40 mVrms into a balanced 600 Ω load)**:** + 0.15 dB, – 0.75 dB, 30 Hz to 100 kHz
THD + Noise (including spurs, > 140 mVrms into a balanced 600 Ω load)**:** – 63 dB (0.07%), 7.5 kHz to 20 kHz, 80 kHz BW

General

Store Recall: 35 non-volatile registers
Output Type (standard unit)**:** 50 Ω electronic floating or grounded output, HP-IB programmable
Maximum Float Voltage (50 Ω output, signal + float)**:** 10 V peak maximum from high or low output to chassis ground
External Timebase Input: 10 MHz accepted at a nominal level of 0.1 to 5 V peak, automatic switching
Operating Temperature Range: 0° to 50° C
Storage Temperature Range: – 20° to 70° C
Remote Operation: HP-IB
Size: 213 mm W x 133 mm H x 513 mm D (8.36 in x 5.25 in x 20.2 in)
Weight: Net, 5.9 kg (12.8 lb); shipping, 13 kg (28.6 lb)

Ordering Information

HP 8904A Multifunction Synthesizer[1]
Opt 001 Adds three (two when ordered with Option 002) internal channels, Channel A modulation, summation, FM stereo mode, and sequence capability
Opt 002 Adds second internal synthesizer and output
Opt 003 Adds fast hop and digital modulation
Opt 004 Connectors on rear panel only (not available with Option 005 or 006)
Opt 005 Adds unit to unit phase synchronization
Opt 006 Changes output 1 from a 50 Ω output to a transformer-coupled, 600 Ω balanced output
Opt 910 Provides an additional operation and calibration manual (08904-90007) and two service manuals (08904-90008)
Opt 915 Adds Service Manual (08904-90008)
Opt W30 Extended Repair Service (see page 592)
Opt W32 Calibration Service (see page 592)
08904-61024 Rack-mount Kit for a single HP 8904A
08904-61025 Rack-mount Kit for mounting two HP 8904A's side by side

HP 8904A Retrofit Kits (customer retrofittable)
HP 11816A Retrofit Kit for Option 001
HP 11817A Retrofit Kit for Option 002
HP 11818A Retrofit Kit for Option 003
HP 11827A Retrofit Kit for Option 005[2]
HP 11837A Retrofit Kit for Option 006[2]

[1]HP-IB cables not included. For description and price see page 75.
[2]Not available for units with serial prefix less than 2948A.

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