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

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): 60 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
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 DSBC Modulation (with Option 001)**
  - Rate: 0 Hz to 50 kHz (up to 600 kHz for DSBC)
- **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 rms into 60 Ω
- **Pre-Emphasis Modes:** Off, 25 μs, 50 μs, and 75 μs
- **Channel Separation:** Typically > 63 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 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):
  - ± 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 Input Voltage:** (to 5 V peak, automatic switching
- **Operating Temperature Range:** 0˚ C to 50˚ C
- **Storage Temperature Range:** -20˚ C 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 Multi-function Synthesizer**
  - **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 Service 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
  - **HP 11837A** Retrofit Kit for Option 006

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