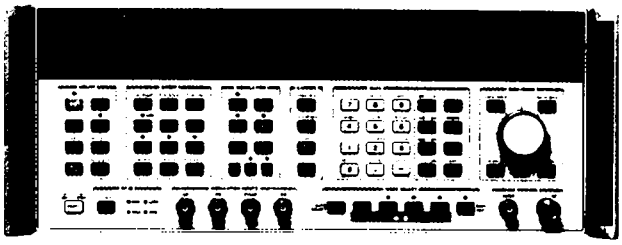
- 252 kHz to 1030 MHz frequency range with optional coverage to 2060 MHz
- 15 µs frequency switching
- Standalone control of frequency agility
- Specified performance while fast hopping
- FM rates to 10 MHz, deviations to 20 MHz
- Low spurious and phase noise

HP 8645A



HP 8645A

HP 8645A Agile Signal Generator

The HP 8645A agile signal generator combines high performance with frequency agility for new fast-switching test requirements. These capabilities are important for performance testing of such devices as frequency agile radios and surveillance receivers. Besides extending traditional receiver testing to agile applications, the HP 8645A can be used to create complex signal simulations involving several modulation types and frequency agility. These complex RF signals can quantitatively exercise a receiver's vulnerability to a jamming transmission. The HP 8645A can also be a fast-switching stimulus needed to decrease production test times. The high performance and frequency agility of the HP 8645A provide capability for both static and agile test requirements with just one calibrated signal generator.

Specified Agile Performance

The HP 8645A provides specified signal performance in both static and agile operation. Fully-synthesized outputs with high timebase accuracy are standard when not frequency hopping. The Fast Hop mode activates a frequency-lock loop to allow frequency switching as fast as 15 µs from 128 to 2060 MHz. Over the frequency range of 8 to 2060 MHz, the fastest switching time is 85 µs and outputs below 8 MHz require 500 µsec. Frequency accuracy of each output is better than ± 2 ppm while in Fast Hop mode. At each frequency, a specific amplitude can be assigned within a 20 dB range for performance tests versus amplitude while frequency hopping. For a full test of a receiver, up to 4000 frequencies can be entered and sequences of up to 8000 frequency settings can be specified. Performance parameters such as phase noise, spurious, amplitude accuracy, and modulation remain high-quality and are completely specified while fast hopping to insure confident test results.

Flexible, High-Performance Modulation

For receiver measurements, the HP 8645A offers independent or simultaneous FM and AM for both static and hopped frequency tests. The modulating signal can be the internal 0.1 Hz to 400 kHz synthesizer or an external input that allows FM deviations up to 20 MHz at rates up to 10 MHz. In Fast Hop operation, maximum deviation is 3.5 MHz with 10 MHz rates. AM is available with up to 100 kHz rates and 99% depth. Pulse modulation allows a 35 dB on/off ratio with 100 ns rise/fall times.

Complete Control of Frequency Hopping

The HP 8645A offers flexible and comprehensive control of the frequency hopping output. Parameters can be entered from the front panel, through the HP-IB port or using TTL inputs on the rear panel. Extensive hopped-frequency simulations including hop frequencies, amplitude, dwell times, hop rate, modulation, and so forth can be entered into nonvolatile memory from the front panel. Activating a hop sequence requires only a press of the Hop key. Agile control is available by a computer with the added advantage of using the Hewlett-Packard Systems Language (HP-SL). For real-time control, rear-panel inputs accept TTL signals for triggering, dwell time, and frequency selection to allow direct connection with the hardware under test. With this wide choice of control, use of the HP 8645A can be readily customized to a wide variety of test situations from benchtop use to ATE systems.

HP 8645A Specifications

Frequency
Range: 251.46485 kHz to 1030 MHz; 251.46485 kHz to 2060 MHz with Option 002 or with HP 11845A 2 GHz retrofit kit installed
Frequency Bands: The exact endpoints of each frequency band can be determined by dividing the 1030 to 2060 MHz band by two for each band decrease. The specifications use approximate endpoints.
Phase Offset: Adjustable in 1 degree increments
Reference Oscillator Stability, Option 001: < 5 x 10^{-10}/day aging

Fast-Hop Operation
Frequency Switching Time: 128 to 1030 MHz: < 15 µs, 8 to 1030 MHz: < 85 µs, 0.25 to 1030 MHz: < 500 µs. Option 002: add 5 µs.
Frequency Hop Range: 0.25 to 2060 MHz. With FM on, limited to any three consecutive frequency bands.
Frequency Accuracy[1]: ± 2 ppm of carrier frequency
Amplitude Accuracy: ± 1 dB, > −127 dBm output
(± 1.5 dB, > −127 dBm output when amplitude level is varied up to −5 dB from the constant learned value during Fast Hop)
Channel and Sequence Tables: In Fast Hop, each specific frequency and amplitude to be output is entered into a Channel Table. The order of channels to be output is entered into a Sequence Table.
Maximum Number of Channels: 4000
Maximum Number of Channels in Sequence Table: 8000
Hop-Rate Range: Fixed rates from 8 Hz to 50 kHz using internal timer. An external input allows more range and variable rates.
Dwell-Time Range: Fixed times of 6.4 µsec to 99 ms using the internal timer. External input allows longer and variable dwell.
Learn-Cycle Time: Typically, 10 seconds to 3.5 minutes, depending on sequence size
Fast-Hop Bus: Allows real-time selection of any channel for output. Typically, frequency switching time increases by 5 µs.
Modulation: Internal or external AM, FM, or simultaneous AM/FM
Output Level: Allowed amplitude variation of all channels entered is 0 to 20 dB. Output level is reduced by > 60 dB while switching between channels. External dc AM can be used to shape the output.

Spectral Purity
SSB Phase Noise (CW, AM, or FM[2] operation):

Carrier frequency (MHz)	Standard operation 20 kHz (dBc/Hz)	100 kHz (dBc/Hz)	Fast Hop 20 kHz (dBc/Hz)
1030 to 2060	−120	−127	−116
515 to 1030	−127	−134	−123
257 to 515	−132	−137	−128
128 to 257	−136	−140	−133
64 to 128	−139	−141	−137
32 to 64	−141	−141	−139
16 to 32	−142	−142	−141
8 to 16	−143	−143	−142
4 to 8	−144	−144	−143
Less than 4 MHz	−144	−144	−144

Harmonics: < −30 dBc, output ≤ 10 dBm. Option 002, output > 8 dBm: < −30 dBc, 0.25 to 1030 MHz; < −25 dBc, 1030 to 2060 MHz.
Subharmonics: None, < 515 MHz; < −60 dBc, 515 to 1030 MHz; < −40 dBc, > 1030 to 2060 MHz
Nonharmonics: > 20 kHz offset[3]: < −100 dBc, < 1030 MHz; < −94 dBc, > 1030 to 2060 MHz

[1] Typically, + 2 ppm of carrier frequency multiplied by the temperature change in °C must be added if ambient temperature changes occur between the learn operation and the conclusion of frequency hopping. FM at minimum deviation.
[2] FM at minimum deviation.
[3] Typically, nonharmonic spurs at all offsets are < 30 dB above the instrument's phase noise level as measured in a 1 Hz bandwidth.

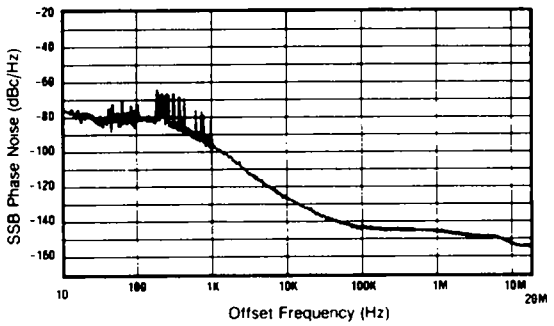
Signal Sources

Frequency Agile/Complex Signal Simulation (cont'd)

Residual FM[1] (CW, AM, FM[2] operation):

Carrier Frequency (MHz)	Post Detection Bandwidth 0.3 to 3 kHz (Hz rms)	0.05 to 15 kHz (Hz rms)
0.25 to 257	< 1	< 1.2
257 to 515	< 1.2	< 2
515 to 1030	< 2	< 4
1030 to 2060	< 4	< 8

Typical SSB Phase Noise and Spurs at 1 GHz:



Residual AM: < 0.01% AM rms, 0.3 to 3 kHz post detection BW
Typical SSB AM Noise Floor, Offsets > 100 kHz: < −157 dBc/Hz at + 16 dBm output, 0.25 to 1030 MHz. < −150 dBc/Hz at + 13 dBm output, 1030 to 2060 MHz.

Output
Maximum Level: + 16 dBm, 0.25 to 1030 MHz; Option 002: + 14 dBm, 0.25 to 1030 MHz. + 13 dBm, above 1030 MHz.
Minimum Level: −137 dBm
Absolute Accuracy: ± 1 dB, output ≥ −127 dBm
Reverse Power Protection: 50 watts from a 50 Ω source, 25 Vdc
Typical Third Order Intermodulation: < − 50 dBc, outputs < 8 dBm
Typical Output Level Overrange: 2 dB more than maximum level
Typical SWR and Output Impedance: < 1.7:1 at < − 2 dBm; 50 Ω

Modulation
External Modulation Input: Coupling is ac or dc for AM, FM, and phase modulation. Pulse modulation input is dc coupled. Displayed deviation or depth corresponds to ± 1 V external input.
Simultaneous Modulation: AM/FM, AM/Phase, AM/Pulse, FM/Pulse, Phase/Pulse, AM/FM/Pulse, AM/Phase/Pulse
Simultaneous Internal/External Modulation: FM and Phase

Amplitude Modulation
Depth: 0 to 99.9%, for output < ± 7 dBm
AM Indicator Accuracy: ± (6% of setting + 2%, AM), up to 90% depth and 1kHz rate for carrier frequencies > 1 MHz. When amplitude level is varied up to − 5 dB from the constant learned value during Fast Hop: ± (7% of setting + 1% AM) up to 80% depth, 1 kHz rate.

Distortion, at 400 Hz and 1 kHz Rates:

Depth	Carrier Frequency 0.25 to 1030 MHz	1030 to 2060 MHz
0 to 30%	< 2%	< 5%
30 to 70%	< 3%	< 5%
70 to 90%	< 5%	< 8%

3 dB Bandwidth[3]: > 5 kHz, 0.25 to 8 MHz. > 50 kHz, 8 to 128 MHz; > 100 kHz, 128 to 2060 MHz
Incidental Phase Modulation: < 0.2 rad peak, at 30% depth and1 kHz
Typical External Input Impedance: 600 Ω

Frequency Modulation
FM Deviation and Rate: In the highest frequency band of 1030 to 2060 MHz, the maximum FM peak deviation is 20 MHz for standard operation and 3.52 MHz for Fast Hop. Maximum FM rate (3 dB bandwidth) in the 515 to 1030 MHz band and above is 10 MHz. Divide rate and deviation by two for each frequency band decrease.
FM Indicator Accuracy: ± 10%, < 50 kHz rate and < 10% of maximum deviation (< 50% of maximum deviation in Fast Hop)
FM Distortion: Rates 20 Hz to 100 kHz: < 2.7%, deviation < 2% of maximum available (Fast Hop: < 10% of maximum deviation)
Carrier Frequency Accuracy in FM: ± 0.4% of deviation setting, ac- or dc-coupled. Typically add 1% of deviation in Fast Hop.
Incidental AM: < 0.5%, deviation limited to < 6% of max. or 20 kHz
Typical External FM Group Delay: 30 µs for rates 20 Hz to 20 kHz, decreases to < 1 µs at rates > 200 kHz. Fast Hop: < 1 µs.
Typical External FM Input Impedance: 50 or 600 Ω

Pulse Modulation
On/Off Ratio: > 35 dB
Rise/Fall Time: < 100 ns, between 10% and 90% response points
Maximum Pulse Repetition Frequency: 1 MHz
Minimum Pulse Width: 0.5 µs
Typical Output Level Accuracy: ± 2 dB
Typical External Input Levels and Impedance: On: > 3.0 V peak; Off: < 0.8 V peak. Damage level: ≥ ± 10 V peak. 600 Ω.

Internal Modulation Source
Waveforms: Sine, square, sawtooth, and white Gaussian noise
Frequency Range: Sine, white Gaussian noise: 0.1 Hz to 400 kHz. Square, sawtooth: 0.1 Hz to 50 kHz.
Frequency Accuracy: Same as internal reference oscillator
Output Level: Typically, 1 V_{pk} max. into 600 Ω. Accuracy: ± 20 mV.
Output Level Resolution: 2 mV. Typical impedance: 600 Ω.
Distortion: < 0.1%, output at 1 V peak and ≤ 15 kHz

Frequency Sweep
Phase Continuous Sweep: Linear sweep with times from 10 ms to10 s, not dependent on span. Maximum span is 40 MHz from 1030 to 2060 MHz frequency band, divided by two for each band decrease.
Fast Hop Sweep: Linear or log stepped with times from 10 ms to100 s. Number of steps varies with time selected. Typical time per step is 30 µs for outputs within 128 to 2060 MHz, 170 µs for 8 to 2060 MHz, and 650 µs for 0.25 to 2060 MHz.
Sweep Control and Markers: X-axis: 0 to + 10 V. Z-axis: + 5 V retrace, + 1 V trace, 0 V markers. Three markers available.

General
Remote Control: HP-IB (IEEE-488.2-1987). The control language used is the Hewlett-Packard Systems Language (HP-SL). All front-panel functions except power switch and knob. A unique Fast Hop bus interface accepts TTL levels for frequency agile control.
Operating Temperature Range: 0° to +55° F
Leakage: Meets MIL-STD-461B-RE02 and FTZ 1046
Storage Registers: 10 full function and 40 freq./ampl. locations
Memory Erasure: All memory contents according to MIL-STD-380-380
Size: 426 mm W x 177 mm H x 624 mm D (16.8 in x 7 in x 24.6 in)
Weight: Net, 31 kg (69 lb); shipping, 42 kg (95 lb)

Key Literature

HP 8645A Agile Signal Generator Data Sheet, p/n 5953-8498E
HP 8645-1 Communications-Agile Operation of the HP 8645A Product Note, p/n 5951-6711

Ordering Information

	Price	
HP 8645A Agile Signal Generator[4]	$39,050	
Opt 001 High-Stability Timebase	+$1,745	
Opt 002 2 GHz Output	+$8,050	
Opt 003 RF Connectors on Rear Panel Only	+$459	
Opt 907 Front Handle Kit (5062-3990)	+$67	🚚
Opt 908 Rack Flange Kit (5062-3978)	+$37	🚚
Opt 909 Rack Flange Kit with Front Handles (5062-3984)	+$94	🚚
Opt 910 Provides an additional operation/calibration manual (08645-90023) and 2 service manuals	+$198	
Opt 915 Add Service Manual (08645-90104)	+$67	
08645-61116 Service Kit	$1,150	
9211-2662 Transit Case	$700	
1494-0059 Non-Tilting Rack Slide Kit	$115	
1494-0063 Tilting Rack Slide Kit	$200	

[1] Specified for 48 to 63 Hz power line. Typical for 400 Hz power line and Fast Hop operation.
[2] Deviation < 0.1% of maximum available.
[3] Lower 3 dB bandwidth limit is 0 Hz for dc coupling and typically 20 Hz for ac coupling.
[4] HP-IB cables not included. For description and price, see page 80.

🚚 Indicates QuickShip availability.