

- 10 kHz to 1280 MHz frequency range
- < -147 dBc/Hz SSB phase noise at 10 kHz offset
- 0.1 Hz frequency resolution



HP 8662A

- 100 kHz to 2560 MHz frequency range
- AM/FM/ΦM/pulse in one generator
- Internal variable modulation oscillator



HP 8663A



HP 8662A/HP 8663A Synthesized Signal Generators



Spectral purity is the key contribution of both the HP 8662A and 8663A, making them ideal for many radar, satellite communication, and phase noise measurement applications. Typical absolute phase noise performance of these generators at a 1 kHz offset is as low as -135 dBc/Hz, depending on the band of operation.

The frequency range of the HP 8662A is 10 kHz to 1280 MHz. It offers versatile AM/FM, using either internal 400 Hz and 1 kHz rates or externally applied modulating signals which can be either ac- or dc-coupled. It also has simultaneous modulation capability.

The HP 8663A and 8662A provide the U.S. Air Force MATE (Modular Automatic Test Equipment) capability, via Option 700. This option is an external translator that allows the signal generator to be controlled by the MATE language CIIL (Control Interface Intermediate Language).

HP 8662A Specifications

Frequency

Range: 10 kHz to 1280 MHz (1279.9999998 MHz)

Resolution: 0.1 Hz (0.2 Hz above 640 MHz)

Accuracy and Stability: Same as reference oscillator

Internal Reference Oscillator: 10 MHz quartz oscillator. Aging rate < 5 x 10⁻¹⁰/day after 10-day warmup (typically 24 hrs. in normal operating environment).

Spectral Purity

Front-Panel Absolute SSB Phase Noise (dBc/Hz):

Frequency range (MHz)	0.01 to 119.9 ¹		120 to 159.9 ²		160 to 319.9 ²	
	Spec	Typ	Spec	Typ	Spec	Typ
1 Hz	-68	-78	-66	-76	-60	-70
10 Hz	-98	-108	-96	-106	-90	-100
100 Hz	-116	-126	-115	-125	-109	-119
1 kHz	-126	-132	-129	-135	-124	-130
3 kHz	-126	-135	-129	-138	-124	-133
5 kHz	-128	-138	-131	-141	-126	-136
10 kHz	-132	-138	-142	-148	-136	-142
100 kHz	-132	-139	-142	-148	-136	-142

Frequency range (MHz)	320 to 639.9 ²		640 to 1279.9 ³		1280 to 2559.9 ⁴	
	Spec	Typ	Spec	Typ	Spec	Typ
1 Hz	-54	-64	-48	-58	-42	-52
10 Hz	-84	-94	-78	-88	-72	-82
100 Hz	-103	-114	-97	-108	-92	-102
1 kHz	-118	-125	-112	-119	-106	-113
3 kHz	-118	-127	-112	-121	-106	-115
5 kHz	-120	-130	-114	-124	-108	-118
10 kHz	-131	-136	-124	-130	-118	-124
100 kHz	-131	-136	-124	-130	-118	-124

Residual SSB Phase Noise (dBc/Hz):

Frequency range (MHz)	0.01 to 119.9 ¹		120 to 159.9 ²		160 to 319.9 ²	
	Spec	Typ	Spec	Typ	Spec	Typ
10 Hz	-108	-114	-112	-119	-106	-113
100 Hz	-121	-126	-122	-129	-118	-124
1 kHz	-128	-133	-131	-138	-127	-134
3 kHz	-128	-136	-131	-139	-127	-135
5 kHz	-129	-138	-133	-141	-129	-136
10 kHz	-132	-137	-142	-147	-136	-142
100 kHz	-132	-137	-142	-147	-136	-142

Frequency range (MHz)	320 to 639.9 ²		640 to 1279.9 ³		1.28 to 2559.9 ⁴	
	Spec	Typ	Spec	Typ	Spec	Typ
10 Hz	-100	-107	-93	-101	-88	-95
100 Hz	-112	-119	-105	-112	-100	-106
1 kHz	-121	-128	-115	-122	-109	-116
3 kHz	-121	-129	-115	-123	-109	-117
5 kHz	-123	-130	-117	-124	-111	-118
10 kHz	-131	-136	-124	-130	-118	-124
100 kHz	-131	-136	-124	-130	-118	-124

¹ HP 8663A band begins at 0.1 MHz; specifications extend up to and including 119.9999999 MHz.

² Specifications extend up to and including 0.1 Hz less than the starting frequency of the next band.

³ Specifications extend up to and including 1279.9999998 MHz.

⁴ This band available on HP 8663A only; specifications extend up to and including 2559.9999996 MHz.

Option 003 Specified SSB Phase Noise for Rear-Panel 640 MHz Output:

Frequency range (MHz)	Spec	Typ
1 Hz	-54	-64
10 Hz	-84	-94
100 Hz	-104	-114
1 kHz	-121	-126
3 kHz	-121	-127
5 kHz	-129	-138
10 kHz	-145	-149
100 kHz	-157	-159

SSB Broadband Noise Floor in 1 Hz BW at 3 MHz Offset From Carrier:

< -146 dBc for fc between 120 and 640 MHz at output levels above +10 dBm.

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Spurious Signals:

	Frequency Range (MHz)				
	0.01 to 120	120 to 160	160 to 320	320 to 640	640 to 1280
Spurious non-harmonically related ^{1,2}	-90 dBc	-100 dBc	-96 dBc	-90 dBc	-84 dBc
Sub-harmonically related ($\frac{1}{2}, \frac{3f}{2}$, etc.)	none	none	none	none	-75 ³ dBc
Power-line (60 Hz) related or microphonically generated (within 300 Hz) ⁴	-90 dBc	-85 dBc	-80 dBc	-75 dBc	-70 dBc
Harmonics	< -30 dBc				

Output

Level Range: +13 to -139.9 dBm (1V to 0.023 μ V_{rms} into 50 Ω)

Resolution: 0.1 dB

Absolute Level Accuracy: (+15° to +45° C): ± 1 dB between +13 and -120 dBm; ± 3 dB between -120 and -130 dBm

SWR: Typically from 1.5 to 1.8, depending on output level and frequency

Reverse Power Protection: Typically up to 30 W or ± 8 Vdc

Amplitude Modulation

Depth: 0 to 95% at output levels of +8 dBm and below (+10 dBm in uncorrected mode). AM available above these output levels but not specified.

Resolution: 1%, 10 to 95% AM; 0.1%, 0 to 9.9% AM

Incidental PM: (at 30% AM): 0.15 to 640 MHz, < 0.12 radian peak; 640 to 1280 MHz, < 0.09 radian peak

Incidental FM: (at 30% AM): 0.15 to 640 MHz, < 0.12 \times f_{mod}; 640 to 1280 MHz, < 0.09 \times f_{mod}

Indicated Accuracy: $\pm 5\%$ of reading $\pm 1\%$ AM. Applies for rates given in table below, internal or external mode, for depths $\leq 90\%$.

Rates and Distortion with Internal or External Modulating Signal:

Frequency Range	AM Distortion			
	AM Rate	0 to 30% AM	30 to 70% AM	70 to 90% AM
0.15 to 1 MHz	dc to 1.5 kHz	2%	4%	5.75%
1 to 10 MHz	dc to 5 kHz	2%	4%	5.75%
10 to 1280 MHz	dc to 10 kHz	2%	4%	5.75%

Frequency Modulation

FM Rates: (1 dB bandwidth): External ac, 20 Hz to 100 kHz; external dc, dc to 100 kHz

FM Deviation: 25 to 200 kHz, depending on carrier frequency

Indicated FM Accuracy: $\pm 8\%$ of reading plus 10 Hz (50 Hz to 20 kHz)

FM Resolution: 100 Hz for deviations < 10 kHz, 1 kHz for deviations ≥ 10 kHz

Incidental AM: (AM sidebands at 1 kHz rate and 20 kHz deviation): < -72 dBc, f_c < 640 MHz; < -65 dBc, f_c \geq 640 MHz

FM Distortion: < 1.7% for rates < 20 kHz, < 1% for rates < 1 kHz

Center Frequency Accuracy and Long-Term Stability in AC Mode: Same as CW mode

Supplemental Characteristic

Frequency-Switching Speed:⁵ From 420 μ s to 12.5 ms, depending on the programming mode

HP 8663A Specifications

The HP 8663A signal generator is related to the HP 8662A in both concept and structure. Like the HP 8662A, the HP 8663A is an extremely low phase noise signal source, incorporating signal generator modulation capabilities and output characteristics. The HP 8663A also offers increased frequency range to 2560 MHz, increased output level to +16 dBm, and the addition of phase and pulse modulation while maintaining high spectral purity. The result is a highly flexible and powerful signal generator that uses and extends the proven circuitry of the HP 8662A. Thus, the HP 8662A and HP 8663A share many of the same specifications.

Frequency

Range: 100 kHz to 2560 MHz (2559.9999996 MHz)

Resolution: 0.1 Hz (f_c < 640 MHz);
0.2 Hz (640 MHz to 1280 MHz);
0.4 Hz (f_c \geq 1280 MHz)

Accuracy, Stability, and Internal Reference Oscillator: Identical to HP 8662A

Spectral Purity

(See HP 8662A specifications)

Spurious Signals: Identical to HP 8662A, except that for f_c between 1280 and 2560 MHz the spurious non-harmonics are -78 dBc; the sub-harmonically related (f/2, 3f/2, etc.) between 640 and 1280 MHz are -70 dBc and between 1280 and 2560 MHz are -40 dBc; and the power-line (60 Hz) or microphonically generated spurious are -65 dBc.

Harmonics: < -30 dBc, $\leq +13$ dBm output; < -25 dBc, +13 dBm to +16 dBm output, f_c < 1280 MHz; < -25 dBc, f_c \geq 1280 MHz

Output

Level Range: +16 dBm to -129.9 dBm

Resolution: 0.1 dB

Absolute Level Accuracy: (+15° to +45° C): ± 1 dB, +16 dBm to -119.9 dBm; ± 3 dB, -120 dBm and below

SWR: < 1.5

Amplitude Modulation

Depth: 0 to 95% at levels of +10 dBm and below

Resolution: 0.1%

Incidental FM: (at 30% AM): Identical to HP 8662A except: < 0.3 \times f_{mod} for 1280 \leq f_c < 2560 MHz

Indicated Accuracy: $\pm 6\%$ of reading $\pm 1\%$ AM (400 Hz and 1 kHz, depth 90%)

AM Bandwidth: (1dB): dc to > 1.5 kHz, 0.15 MHz \leq f_c < 1 MHz; dc to > 5 kHz, 1 MHz \leq f_c \leq 10 MHz; dc to > 10 kHz, f_c > 10 MHz;

external dc coupling. External ac coupling or internal;

low-frequency coupling is 20 Hz.

Distortion: (400 Hz and 1 kHz): < 2% (0 to 30% AM); < 3% (30 to 70% AM); < 4% (70 to 90% AM)

Frequency Modulation

FM Rates: (1 dB bandwidth): External ac, 20 Hz to 100 kHz, external dc, dc to 100 kHz

Maximum Allowable Peak Deviation: Identical to HP 8662A for f_c between 100 kHz and 1280 MHz. Up to 400 kHz for f_c between 1280 and 2560 MHz.

Indicated FM Accuracy: (50 Hz to 20 kHz): $\pm 7\%$ of setting +10 Hz

FM Resolution: 100 Hz to 1 kHz, depending on f_c and deviation setting

Incidental AM: (AM sidebands at 1 kHz rate and 20 kHz deviation): < -72 dBc (10 \leq f_c < 2560 MHz)

FM Distortion: < 1% (400 Hz and 1 kHz rates); < 1.7% (rates less than 20 kHz)

¹ In the remote mode it is possible to have microprocessor clock-related spurious signals spaced 3 MHz apart at an absolute level of typically less than -145 dBm.

² Spurious signals can be up to 3 dB higher in the dc FM mode.

³ f/2 spurs not specified for carrier frequencies above 850 MHz.

⁴ At a 50 Hz line frequency, power-line or microphonically-related spurious signals may be up to 3 dB higher and appear at offsets as high as 1 kHz from the carrier.

⁵ Due to automatic leveling loop bandwidth changes, brief (30 ms) level inaccuracies may occur when switching through 150 kHz and 1 MHz RF output frequencies.

Phase Modulation (Option 002)

Maximum Peak Phase Deviation: From $\pm 25^\circ$ for f_c between 120 and 160 MHz to $\pm 400^\circ$ for f_c between 1280 and 2560 MHz
Maximum Rate: From 10 kHz for f_c between 0.15 and 10 MHz to 10 MHz for f_c between 640 and 2560 MHz
Phase Deviation Resolution: 1° ($0.1 \leq f_c < 640$ MHz); 2° ($640 \leq f_c < 1280$ MHz); 4° ($1280 \leq f_c < 2560$ MHz)
Phase Modulation Distortion: 10% at maximum rate

Biphase Modulation (BPSK)

Biphase modulation is available on the standard HP 8663A for f_c less than 640 MHz and available for all f_c with Option 002.

Deviation: $\pm 90^\circ$

Carrier Null when Modulated with 1 MHz, 50% Duty Cycle

Square Wave: > 25 dBc

Modulation Input Required: TTL positive true. The internal modulation oscillator can be used for 50% duty-cycle modulation. External input is on rear panel.

Pulse Modulation¹

Pulse On/Off Ratio: > 80 dB (50 to 2560 MHz)

Pulse Rise/Fall Time: < 250 ns (50 to 120 MHz); < 800 ns (120 to 640 MHz); < 100 ns ($f_c \geq 640$ MHz)

Pulse Repetition Frequency (50% duty cycle):

Internal: 10 Hz to 99.9 kHz

External: 10 Hz to 2 MHz, 50 MHz $< f_c < 640$ MHz;
10 Hz to 5 MHz, $f_c > 640$ MHz

Internal Modulation Oscillator

Rates: 10 Hz to 99.9 kHz

Frequency Resolution: 3 digits

Frequency Accuracy: Same as reference oscillator

Output Level (available on rear panel): 1 V peak into 600 Ω

Output Impedance: 600 Ω

Flatness (referenced to 1 kHz): $< \pm 1\%$

Distortion: $< 1\%$

Other HP 8662A and HP 8663A Information

Remote Programming: The HP-IB interface is standard on the HP 8662A and HP 8663A signal generators. All functions controlled from the front panel, with the exception of the line switch, are programmable with the same accuracy and resolution as in manual mode.

Operating Temperature Range: 0° to $+55^\circ$ C

Leakage: Meets radiated and conducted limits of MIL-STD-461A methods RE02 and CE03 as well as BVDE 0871

Power Requirements: 115 (90 to 126) V or 230 (198 to 252) V;
48 to 66 Hz; 450 VA max

Size:

HP 8662A: 425 mm W x 178 mm H x 572 mm D (16.75 in x 7 in x 22.5 in)

HP 8663A: 425 mm W x 178 mm H x 642 mm D (16.75 in x 7 in x 25.3 in)

Note: depth includes front panel depth of 45 mm (1.75 in).

Weight: HP 8662A: net, 30 kg (65.5 lb); shipping, 36 kg (80 lb)

HP 8663A: net, 33.8 (74 lb); shipping, 40 kg (88 lb)

Key Literature

Synthesized Signal Generator 10 kHz to 1280 MHz
Technical Data, p/n 5953-8402

Synthesized Signal Generator 100 kHz to 2.56 GHz
Technical Data, p/n 5953-8376

Ordering Information

HP 8662A 1280 MHz Signal Generator²

Opt 001 RF Connectors on Rear Panel Only

Opt 003 Specified SSB Phase Noise for 640 MHz Output

Opt 700 External MATE Translator

Opt 907 Front Handle Kit (5062-3990)

Opt 908 Rack Flange Kit (5062-3978)

Opt 909 Rack Flange Kit w/Front Handles(5062-3984)

Opt 910 Two Sets of Operating and Service Manuals (08662-90069)

Opt W30 Extended Repair Service (see page 70)

Opt W32 Calibration Service (see page 70)



HP 11721A

HP 8663A 2560 MHz Signal Generator²

Opt 001 RF Connectors on Rear Panel Only

Opt 002 Wideband Linear Phase Modulation

Opt 003 Specified SSB Phase Noise for 640 MHz Output

Opt 700 External MATE Translator

Opt 907 Front Handle Kit (5061-9690)

Opt 908 Rack Flange Kit (5061-9678)

Opt 909 Rack Flange Kit w/Front Handles (5061-9684)

Opt 910 Additional Operation and Calibration Manual (08663-90069) and Service Manuals (08663-90071)

Opt 915 Add Service Manual (08663-90071)

Opt W30 Extended Repair Service (see page 70)

Opt W32 Calibration Service (see page 70)

HP 11714A Service Support Kit (required for servicing HP 8662A/8663A)

¹ Pulse modulation is available for $f_c < 50$ MHz but is unspecified.

² HP-IB cables not supplied. For description and price, see page 588.

Indicates QuickShip availability.

HP 11721A Frequency Doubler

The HP 11721A doubler is an ideal accessory for extending the usable frequency range of signal generators, frequency synthesizers, or other signal sources. Operating on input frequencies of 50 MHz to 1300 MHz, it provides a doubled output in the range of 100 MHz to 2600 MHz. The HP 11721A will work well with any RF source with an output in the range of 50 to 1300 MHz.

The 50 Ω passive circuit of the HP 11721A offers low conversion loss, low spurious, and excellent flatness over its entire frequency range when operated above +10 dBm.

HP 11721A Specifications

Input Frequency Range: 50 to 1300 MHz

Output Frequency Range: 100 to 2600 MHz

Conversion Loss (+13 dBm input, 50 to 1280 MHz): < 15 dB

Spurious Referenced to Desired Output Frequency f:

(+ 13 dBm input with harmonics < -50 dBc, 50 to 1280 MHz):

$f/2$, -15 dB; $3f/2$, -15 dB

Input SWR: 1.5 typical

Input/Output Impedance: 50 Ω nominal

Operating Temperature Range: 0° to 50° C

Connectors: Input, type-N male; output, type-N female

Size: 161 mm L x 30 mm W x 20.5 mm H (6.38 in x 1.19 in x .81 in)

Weight: Net, .02 kg (0.5 lb); shipping, 0.4 kg (1 lb)

Ordering Information

HP 11721A Frequency Doubler

Opt W30 Extended Repair Service (see page 584)