HEWLETT PACKARD

Carrier Noise Test Set 5 MHz to 18 GHz

HP 11729B

DESIGNED FOR HP-IB SYSTEMS

TECHNICAL DATA 15 APRIL 1984

Convenient phase and amplitude noise measurements on high quality sources

Flexibility and performance for technically demanding source characterization

5 MHz to 18 GHz

Testing microwave sources for AM and phase noise has now become easier. Just three instruments — the HP 11729B carrier noise test set, the HP 8662A synthesized signal generator[1], and a baseband spectrum analyzer — make a COMPLETE, broadband measurement system for spectral characterization of sources. Whether you need to test a low noise synthesized source or a free-running GUNN oscillator, at 5 MHz or 18 GHz, this test configuration can make your measurement.

If you're testing local oscillators for digital communications systems, an HP 11729B/8662A noise measurement system provides the necessary low phase noise <10 kHz from the carrier. Or, with low noise at offsets >100 kHz, this system can be used for measuring sources for microwave communications systems. And the stringent requirements of doppler radar local oscillators — low noise from as close as 1 Hz to as far as 10 MHz from the carrier — are also met by the HP 11729B/8662A.

Optimized for Microwave Measurements

The HP 11729B utilizes the low phase noise performance of the HP 8662A. The HP 11729B multiplies an HP 8662A RF reference signal to microwave, for low noise downconversion of the signal under test. The front panel signal of the HP 8662A can then be used as a reference for phase detection. The low specified absolute system noise floor of the HP 11729B and HP 8662A provide confidence in the measured results.

Complete Noise Measurement Solution

As well as providing the critical low noise microwave signal, the HP 11729B also provides all necessary hardware for two methods of phase noise measurement (phase detector and frequency discriminator) and optional direct AM noise analysis. This versatility often allows one system to replace several special-purpose noise measurement systems.

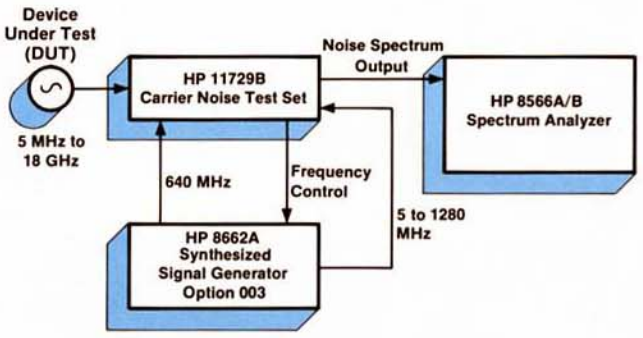

Figure 1. Complete carrier noise characterization system can be assembled from standard instruments.

[1]The HP 8663A may be substituted for the HP 8662A.

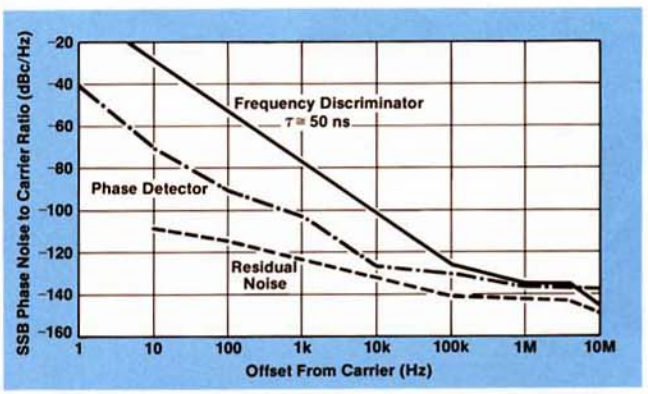

Figure 2. Typical HP 11729B/8662A system sensitivity using the phase detector and frequency discriminator methods at X-band. Typical HP 11729B residual noise.

Simpler and more convenient microwave carrier noise measurements.

Low Noise Floor

The wide frequency coverage and low system noise floor of an HP 11729B/8662A enable a single system to be used on a broad range of sources. For a 10 GHz carrier, the HP 11729B/8662A has typical system noise of –90 dBc/Hz at a 100 Hz offset and –123 dBc/Hz at a 10 kHz offset, allowing characterization of most high-performance sources.

Measurement of Stable Sources

For optimal measurement performance on synthesizers or stable free-running sources, the HP 11729B/8662A uses the phase detector method. All the hardware necessary to translate and phase detect a microwave signal for analysis, including the critical low noise microwave reference and the loop VCO, is included in the HP 11729B/8662A. The only additional equipment needed is the baseband spectrum analyzer and the device under test.

Wide Range of Offset Frequencies

The basic phase detector method has been limited in usefulness because it yields valid phase noise measurements only at offset frequencies greater than the phase lock loop bandwidth. Close-in phase noise characterization was possible only on synthesized sources. But in the HP 11729B, the loop characterization feature allows phase noise measurements to be corrected for loop response. This yields accurate spectral measurements over a broad range of offset frequencies, both inside and outside the loop bandwidth.

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*HP-IB is Hewlett-Packard's hardware, software, documentation, and support for IEEE-488 and IEC-625, worldwide standards for interfacing instruments.

Measurement of Microphonic, Spurious, or Drifting Sources

The HP 11729B/8662A also provides an integrated measurement solution for sources with high drift, high spurious or microphonics, or very high level, low rate phase noise. The HP 11729/8662A implements a convenient frequency discriminator method, allowing sources to 18 GHz to be tested with a discriminator operating at an intermediate frequency <1.3 GHz. Everything needed for this method is included (including a phase detector and quadrature monitor), except for a simple user-supplied delay element. And this delay element can be as simple as a length of inexpensive 50 ohm coaxial cable.

Full Programmability for Easy System Configuration

The fully programmable HP 11729B/8662A is easily integrated into automatic systems with an appropriate programmable baseband spectrum analyzer. All functions on the HP 11729B/8662A can be set automatically over the HP-Interface Bus*, including phase lock loop bandwidth and lock acquisition (loop capture).

Flexible, Cost-Effective

The HP 11729B increases productivity with quicker, more convenient noise characterization, either manually or automatically. For an optimal match to the application, the HP 11729B can be ordered with full 5 MHz to 18 GHz coverage, or with a selected cost-effective 2.5 GHz wide band configuration. The HP 11729B also allows cost-effective utilization of general purpose lab spectrum analyzers for sensitive carrier noise measurements.

Three operating modes to match many source designs

The HP 11729B/8662A can be used in three operating modes for maximum flexibility. Two modes of phase noise measurement accommodate synthesized and free-running sources. The third measurement mode (optional) adds AM noise measurements.

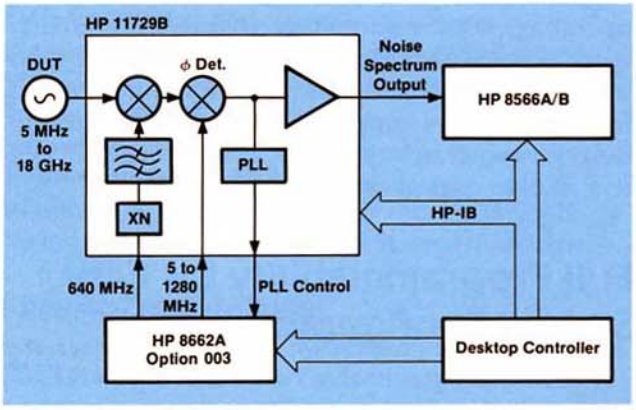


Figure 3. Phase noise measurement — phase detector method.

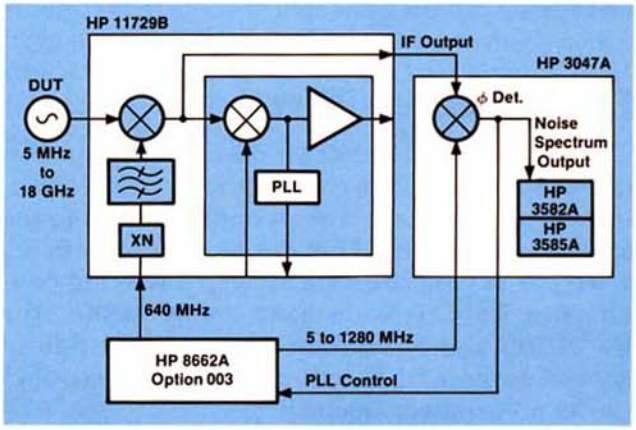


Figure 4. Automatic phase noise measurement with the HP 11729B/8662A/3047A.

Phase Noise Characterization — Phase Detector Method

Figure 3 shows the implementation of the phase detector method in the HP 11729B/8662A. (Product Note 11729B-1 "Phase Noise Characterization of Microwave Oscillators — Phase Detector Method" describes this method in detail.) The HP 8662A provides a low noise 640 MHz signal for multiplication to microwave, as well as a tunable 5 to 1280 MHz signal used as the low noise reference signal at the phase detector. The output of the phase detector contains the desired phase noise spectral distribution of the source under test.

The HP 11729B/8662A features internal phase-lock-loop capability with selectable bandwidths over a four decade range. This flexibility in method of phase locking and loop bandwidth allows measurement not only of synthesized sources, but also allows close-in analysis of stable free-running sources. The HP 8662A can be used as the phase lock loop VCO, either through its internal dc FM capability or its electronically tunable crystal oscillator.

Other HP 11729B features make measurements easier than ever before. The loop capture feature maximizes the loop bandwidth during acquisition, for easier phase locking. The front panel LED indicator confirms both phase-locked and quadrature conditions. No external quadrature monitor such as an oscilloscope is needed. In addition, convenient loop test input and output ports allow loop characterization, for measurements inside the loop bandwidth.

For a fully automated system solution, the HP 11729B/8662A can be used with the HP 3047A spectrum analyzer system (Figure 4). The HP 3047A system software provides step-by-step instruction and graphic hardcopy output. An HP 11729B/8662A/3047A combination yields measurement simplicity with extensive documentation, providing noise measurement capability to a broad range of users.

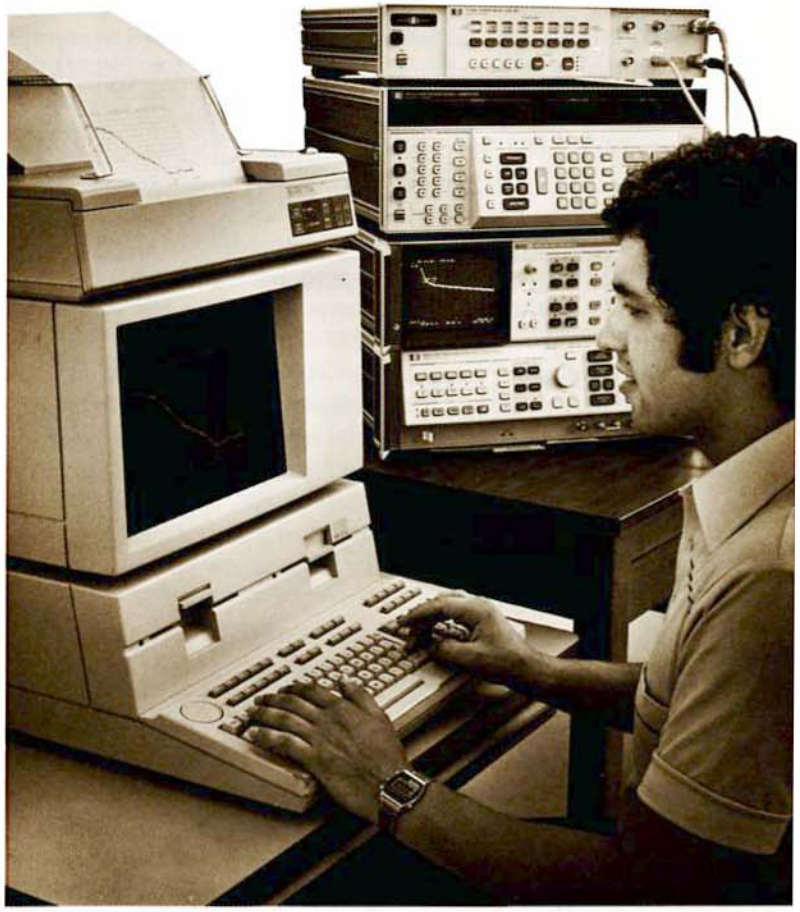
Phase Noise Characterization — Frequency Discriminator Method

The frequency discriminator method of phase noise characterization does not require phase locking, and therefore is typically better suited for characterization of sources with high-level, low-rate phase noise, or high close-in spurious sidebands (often line related). Microphonic or drifting sources (often difficult to phase lock) are also typically easier to characterize with the frequency discriminator method.

Frequency discriminators have been widely used to characterize sources. The HP 11729B makes this method even easier by first downconverting the microwave source with the HP 8662A-derived low noise microwave signal (Figure 6). The frequency discriminator then operates at the intermediate frequency, always less than 1.3 GHz, yielding an output voltage directly proportional to the short-term frequency fluctuations of the source under test.

In the HP 11729B/8662A implementation, a delay-line/mixer is used as the frequency discriminating element. With an internal phase detector already supplied, only a simple user-supplied delay element (as simple as a length of coaxial cable) is required. Since the delay element is at the intermediate frequency, it is free from many of the problems of delay lines at microwave frequencies, such as insertion loss and microphonics, and cost.

The HP 11729B/8662A is easily integrated into a fully-automatic system.



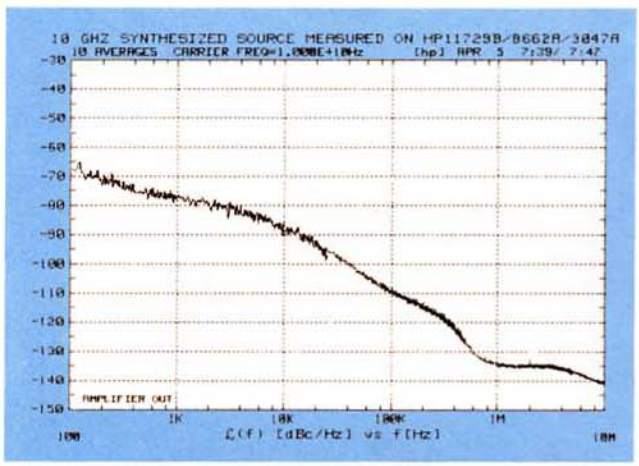


Figure 5. Sample hardcopy output from an HP 11729B/8662A/3047A system taken on a 10 GHz source using the phase detector method.

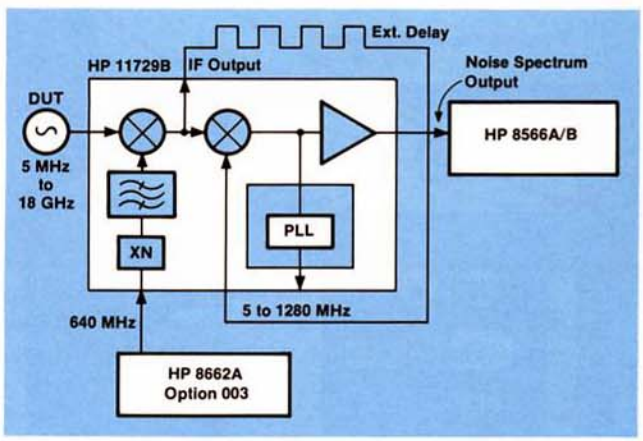


Figure 6. Phase noise measurement — frequency discriminator method.

AM Noise Characterization

AM noise measurements can be important for two reasons. First, to verify specified AM noise on a microwave source. Second, to determine if a phase noise measurement has been degraded by the presence of AM noise in the measured noise spectrum. (The frequency discriminator method provides no AM noise suppression, and the phase detector method has typically 20—30 dB of AM suppression.) The HP 11729B Option 130 offers convenient direct AM noise measurements with typical sensitivity to –165 dBc/Hz. The HP 8662A provides a convenient calibration signal, and the same spectrum analyzer used for phase noise measurements can be used for AM noise measurements. Thus, the same system, HP 11729B/8662A/ spectrum analyzer, can be used for both AM and phase noise characterization of microwave sources.

System Considerations

All three components of the carrier noise measurement system affect the overall system performance. The HP 11729B and HP 8662A determine the system noise floor, the lowest phase noise floor for microwave signals offered by HP.

The baseband analyzer and the measurement procedure determine the offset frequencies measured, and the accuracy of the measurement. With the HP 11729B/8662A providing detection to baseband and low noise baseband amplification, general purpose lab spectrum analyzers can be used for phase noise measurements to levels below –140 dBc/Hz, and AM noise measurements to levels below –160 dBc/Hz.

A popular choice for the baseband analyzer is the HP 8566A/B spectrum analyzer (100 Hz to 22 GHz), also useful for direct measurements on the microwave source. The HP 3561A dynamic signal analyzer (dc to 100 kHz) is particularly useful when noise characterization is required at very low offset frequencies. Other spectrum analyzers covering the offset frequencies of interest, such as the HP 8568A/B, 3585A, or 3582A, can also be used.

The method of phase noise measurement chosen depends on the properties of the source measured. As shown in the graph of typical system sensitivities (Figure 8), the phase detector method provides the best overall performance. By contrast, the sensitivity of the frequency discriminator method follows the typical noise spectra of free-running sources (rises as f^{-2}). Thus, stable source or low noise free-running sources are best characterized by the phase detector method; less stable sources may be more conveniently measured using the frequency discriminator method.

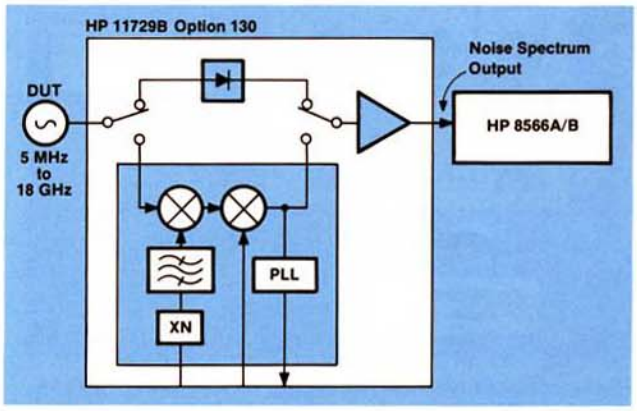


Figure 7. The HP 11729B Option 130 provides AM noise measurement capability.

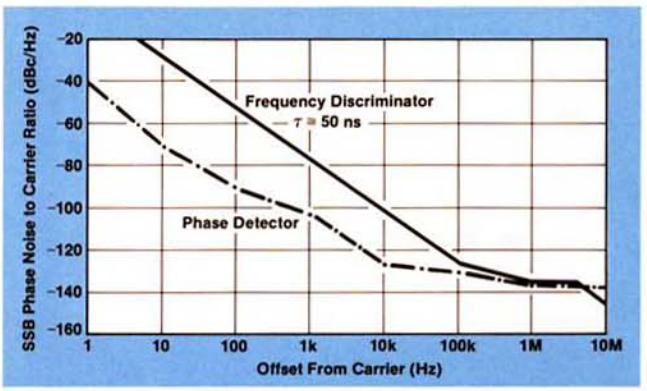


Figure 8. Typical HP 11729B/8662A system sensitivity in the phase detector and frequency discriminator methods at X-band.

HP 11729B/8662A System Specifications

Specifications describe the instruments' warranted performance. *Supplemental characteristics (in italics)* are intended to provide information useful in applying the instrument by giving typical, but not warranted performance parameters. These are denoted as "typical", "nominal", or "approximate."

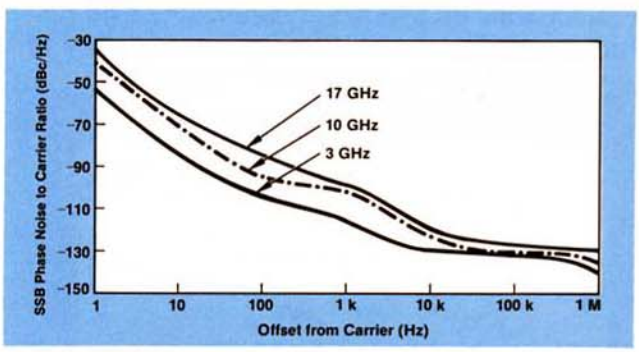
Absolute System Noise Floor

System noise is specified only when the HP 11729B is used with an HP 8662A Option 003[1].

Phase Detector Method (locking via EFC):
HP 11729B/8662A Absolute System Noise[2,3] (dBc/Hz):

Offset from Carrier (Hz)	Band 1 5 to 1280 MHz		Band 2 1.28 to 3.2 GHz		Band 3 3.2 to 5.76 GHz		Band 4 5.76 to 8.32 GHz	
	Typ.	**Spec.**	*Typ.*	**Spec.**	*Typ.*	**Spec.**	*Typ.*	**Spec.**
1	*-58*	-48	*-53*	-43	*-47*	-37	*-43*	-33
10	*-88*	-78	*-83*	-73	*-77*	-67	*-73*	-63
100	*-108*	-98	*-103*	-93	*-97*	-87	*-93*	-83
1k	*-119*	-115	*-115*	-110	*-109*	-104	*-105*	-100
10k	*-130*	-125	*-129*	-124	*-127*	-123	*-125*	-121
100k	*-130*	-126	*-130*	-126	*-130*	-126	*-129*	-125
1M	*-140*		*-140*		*-138*		*-135*	

Offset from Carrier (Hz)	Band 5 8.32 to 10.88 GHz		Band 6 10.88 to 13.44 GHz		Band 7 13.44 to 16.0 GHz		Band 8 16.0 to 18.0 GHz	
	Typ.	**Spec.**	*Typ.*	**Spec.**	*Typ.*	**Spec.**	*Typ.*	**Spec.**
1	*-40*	-30	*-38*	-28	*-37*	-27	*-35*	-25
10	*-70*	-60	*-68*	-58	*-67*	-57	*-65*	-55
100	*-90*	-80	*-88*	-78	*-87*	-77	*-85*	-75
1k	*-102*	-97	*-100*	-95	*-99*	-94	*-97*	-92
10k	*-123*	-119	*-122*	-118	*-121*	-116	*-119*	-115
100k	*-129*	-125	*-128*	-125	*-127*	-124	*-127*	-123
1M	*-134*		*-132*		*-131*		*-129*	



Typical HP 11729B/8662A system noise (phase detector method, locking via EFC).

[1]The HP 8663A Option 003 (operated below 1280 MHz) may be used in place of the HP 8662A with no change in system performance.

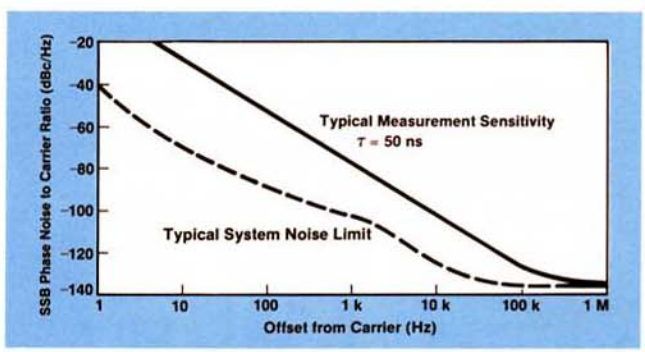
[2]These system noise floor specifications apply for locking via the EFC of the HP 8662A crystal oscillator. Locking via HP 8662A dc FM changes the noise on the tunable HP 8662A signal, and therefore total system noise. Use system noise equation on pg. 10 to determine system noise when locking via HP 8662A dc FM.

Frequency Discriminator Method:

HP 11729B/8662A System Noise and Sensitivity: in the frequency discriminator mode, the lower limit of the measurement system sensitivity is set by the noise contribution of the HP 11729B/8662A. Typical system noise contribution of the HP 11729B/8662A is shown in the table below.

Offset from Carrier (Hz)	*Typical System Noise* (dBc/Hz) (frequency discriminator)		
	1.26 to 3.2 GHz	8.32 to 10.88 GHz	16.0 to 18.0 GHz
1	*-54*	*-40*	*-35*
10	*-84*	*-70*	*-65*
100	*-104*	*-90*	*-85*
1k	*-116*	*-102*	*-97*
10k	*-139*	*-125*	*-120*
100k	*-149*	*-135*	*-130*
1M	*-149*	*-135*	*-130*

The actual HP 11729B/8662A measurement sensitivity in the frequency discriminator method largely depends on the delay line (delay time) used. The longer the delay time, the closer the measurement sensitivity approaches the system noise limit. The graph shows the HP 11729B/8662A noise contribution, and a typically obtainable system sensitivity. A 34 foot section of flexible RF cable (RG 225) was used as the external time delay element $\tau \cong 50$ ns.



Typical noise contribution of HP 11729B/8662A (frequency discriminator method) at X-band and typical system sensitivity using a 50 ns delay line discriminator.

[3]Dependent on the test frequency, actual system noise may be lower than specified. Since the noise contribution of the HP 8662A front panel signal is a function of frequency selected, the overall system noise may improve for test frequencies <640 MHz from band centers. For example, for frequencies over the narrow range of 8.96 to 10.24 GHz, typical system noise at a 100 kHz offset is -134 dBc/Hz. (To determine system noise for any test frequency, see the system noise equation on pg. 10.)

HP 11729B/8662A
Supplemental Operating Characteristics

Phase Lock Loop Function

Loop characteristics when using HP 8662A EFC input for phase lock (HP 8662A front panel output at 0 dBm):

Loop holding range (LHR): $\frac{\pm f_{dut}}{10^7}$ *(Hz) nominal*

Loop bandwidth (LBW):

$$\frac{11729B\ LBF \times f_{dut}}{10^{10}}\ \textit{(Hz) nominal.}$$

(LBF = Lock Bandwidth Factor set on HP 11729B)

Loop bandwidth maximum: *2 kHz typical.*

Loop characteristics when using HP 8662A dc FM modulation input for phase lock (with HP 8662A front panel output at at 0 dBm):

Loop holding range (LHR):

±FM deviation set on HP 8662A (Hz) nominal.

Loop bandwidth (LBW):

$$\frac{\textit{(8662A FM deviation set)} \times \textit{11729B LBF}}{10^3}\ \textit{(Hz) nominal.}$$

Loop bandwidth maximum: *100 kHz typical.*

System Spurious

Spurious signals in the HP 11729B/8662A arise in two ways. First, any line-related or other spurious on the 640 MHz reference signal or the 5 to 1280 tunable signal are translated to the noise spectrum output. Second, the downconversion process on the test signal gives rise to system spurious signals. The frequency and the level of these spurious signals are determined by the relation between the test signal frequency and the frequency of the appropriate HP 11729B band center. The presence of system spurious does not affect the typical measurement of random noise. However, if spurious information on the source under test is desired, many system spurious can be mathematically determined and disregarded.

Achievable Carrier Noise Measurement Accuracy

The accuracy of a carrier noise measurement system configured with the HP 11729B largely depends on the accuracy of the baseband analyzer and the procedure used. *Typical achievable system accuracies are given for reference.*

Accuracy with HP 3047A: *±2 dB to a 1 MHz offset from the carrier (if absolute noise of the HP 11729B/8662A is at least 10 dB below the noise of the source under test).*

Accuracy with HP 8566A/B: *typically <±2.5 dB (dependent on measurement procedure and noise of test source relative to noise of HP 11729/8662A).*

HP 11729B General Specifications

Reference source independent

Specifications describe the instruments' warranted performance. *Supplemental characteristics (in italics)* are intended to provide information useful in applying the instrument by giving typical, but not warranted performance parameters. These are denoted as "typical", "nominal", or "approximate."

Frequency

Measurement frequency range: 5 MHz to 18 GHz in 8 bands, excluding ±5 MHz around band center frequencies. External low-pass filtering may be required for test signals <20 MHz and ±20 MHz around band centers.[4]

Band center frequencies: 1.92 GHz, 4.48 GHz, 7.04 GHz, 9.6 GHz, 12.16 GHz, 14.72 GHz, 17.28 GHz.

Test Signal Requirements

Level:

For test frequencies >1.28 GHz: +7 dBm minimum to +20 dBm maximum.

Typically usable down to -15 dBm with potential noise floor degradation.

For test frequencies <1.28 GHz: -5 dBm minimum to +10 dBm maximum.

Typically usable down to -15 dBm with potential noise floor degradation; optimal level from -2 to +3 dBm.

Signal Processing

IF output:

Bandwidth: 5 to 1280 MHz

Typically usable to 1500 MHz dependent on test frequency.

Level: +7 dBm minimum.

Noise spectrum outputs:

<1 MHz noise spectrum output:

Bandwidth: *dc to 1 MHz. (3 dB BW: dc to 1.5 MHz typical.)*

Flatness: *±1 dB typical, dc to 1 MHz.*

Impedance: *600 ohms nominal.*

<10 MHz noise spectrum output:

Bandwidth: 10 Hz to 10 MHz. *(3 dB BW: 10 Hz to 15 MHz typical.)*

Flatness: *±1 dB typical, 50 Hz to 10 MHz.*

Impedance: *50 ohms nominal.*

Gain: *nominal 40 dB gain over <1 MHz noise spectrum output.*

Auxiliary noise spectrum output:

Bandwidth: *dc to 1 MHz typical.*

Impedance: *600 ohms nominal.*

Phase Lock Loop Function

Frequency control outputs (dc coupled):

Crystal oscillator control output: *±10V max. nominal; 100Ω output impedance.*

DC FM control output: *±1V max.nominal; 50Ω nominal output impedance.*

Lock bandwidth factor (LBF): *nominal 1, 10, 100, 1k, 10k,* selectable by front panel pushbuttons.

Loop characteristics: dependent on method of phase lock used and loop VCO chosen.

Loop Test Ports

Loop test input:

Type: random noise source, tracking generator, or sinusoidal input.

Bandwidth: *dc to 100 kHz typical.*

Input level: *less than 0.1V peak, typical.*

Input impedance: *dc coupled, 10 kΩ nominal.*

Loop test output:

Output level: gain outside loop bandwidth = 1.

Output impedance: *dc coupled, 1kΩ nominal.*

HP 11729B Residual Noise(dBc/Hz)

Offset from carrier (Hz)	<1.28 GHz		5 GHz	10 GHz		18 GHz
	Typ.	**Spec.**	*Typ.*	*Typ.*	**Spec.**	*Typ.*
10	*-125*	-115	*-108*	*-106*	-90	*-97*
100	*-133*	-126	*-120*	*-116*	-105	*-109*
1k	*-140*	-135	*-130*	*-125*	-115	*-119*
10k	*-147*	-142	*-137*	*-132*	-127	*-126*
100k	*-156*	-151	*-146*	*-141*	-137	*-135*
1M	*-160*	-156	*-148*	*-142*	-137	*-137*

[4]The HP 11729B/8662A operates from 5 MHz to 18 GHz, excluding ±5 MHz around each band center. These "windows" at each band center are necessary to avoid saturation of the baseband amplifier or baseband spectrum analyzer by low frequency feedthrough signals. In most applications, the source under test can be tuned to avoid these ±5 MHz windows.

Some care must also be taken for test signals within ±20 MHz of a band center. The low pass filters in the HP 11729B will adequately reject feedthrough in most situations. However, some measurements might require re-tuning to be outside ±20 MHz of band center, or require customer-supplied post-filtering.

AM Noise Detection (Option 130)

Frequency: 5 MHz to 18 GHz.
Input level: 0 dBm minimum to +18 dBm maximum.
AM noise floor (at +10 dBm input level, dBc/Hz):

Offset from Carrier (Hz)	*Typical*	Specified
1k	*-147*	-138
10k	*-152*	-145
100k	*-161*	-155
1M	*-165*	-160

General

Power requirements: 100, 120, 220, 240V, +5%, -10%, 48 to 66 Hz; <75 VA max.
Operating temperature range: 0 to +55°C.
EMI: Conducted and radiated interference is within the requirements of CE03 and RE02 called out in MIL-STD 461, and within the requirements of VDE 0871 and CISPR Publication 11.
Net weight: 10.4 kg (23 lb).
Shipping weight: 13.6 kg (30 lb).
Dimensions: 425 W x 551 D x 99 mm H (16.8 x 21.7 x 3.9 in.). 1 MW x 20 D x 3-1/2 H System II Module.

Remote Programming

Interface: HP-IB (Hewlett-Packard's implementation of IEEE-488).
Functions controlled: All front panel functions with the exception of the line switch are HP-IB programmable. The HP 11729B can also output over the interface bus the phase locked/unlocked condition, option configuration, and learn mode strings. Learn mode strings allow manually entered front panel settings to be transferred to the system controller and stored for use at a later time.
Interface functions: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DC1, DT0, C0.

Reference Source Requirements

640 MHz signal source:

Frequency: 640 MHz ±50 ppm.
Level: +1 dBm minimum, +4 dBm maximum.
Frequency control: required if used as loop VCO; dc coupled input accepting ±1V or ±10V, with needed deviation dependent on source under test.

5 to 1280 MHz tunable source (not required for frequency discriminator mode):

Frequency: 5 to 1280 MHz.
Level: *0 dBm ±1 dB. Typically usable to -10 dBm with change in loop bandwidth and system noise floor.*
Frequency control: required if used as loop VCO; dc coupled input accepting ±1V or ±10V, with necessary deviation dependent on source under test.

Absolute System Noise Floor (general case)

Measurement system noise floor is dependent on the RF reference source(s) used. For the frequency discriminator method, system noise is a composite of the noise on the multiplied 640 MHz signal plus the residual noise of the HP 11729B. For the phase detector method, system noise has the additional noise of the RF tunable source at the phase detector input. System noise can be described by

$$\mathcal{L}_{system} = 10 \log \left(N^2 \times 10^{\frac{\mathcal{L}_1}{10}} + 10^{\frac{\mathcal{L}_2}{10}} + 10^{\frac{\mathcal{L}_3}{10}} \right)$$

where N = center frequency of selected filter/640 MHz

$\mathcal{L}_1$ = absolute SSB phase noise of the 640 MHz reference signal (dBc/Hz)

$\mathcal{L}_2$ = absolute SSB phase noise of the 5 to 1280 MHz tunable signal dBc/Hz

$\mathcal{L}_3$ = residual noise of the HP 11729B (dBc/Hz)

Ordering Information

Model Number and Description

HP 11729B Carrier Noise Test Set
5 MHz to 18 GHz

(Note: Options 003 thru 027 also include 5 to 1280 MHz coverage. Only ONE of Options 003 thru 027 may be selected.)

Option 003: 1.28 to 3.20 GHz coverage
007: 3.20 to 5.76 GHz coverage
011: 5.76 to 8.32 GHz coverage
015: 8.32 to 10.88 GHz coverage
019: 10.88 to 13.44 GHz coverage
023: 13.44 to 16.00 GHz coverage
027: 16.00 to 18.00 GHz coverage

130: AM noise detection
140: Rear panel outputs
160: Chassis slide kit
907: Front panel handle kit
908: Rack mounting flange kit
909: Front panel handle kit plus rack mounting flange kit
910: Extra operating and service manual

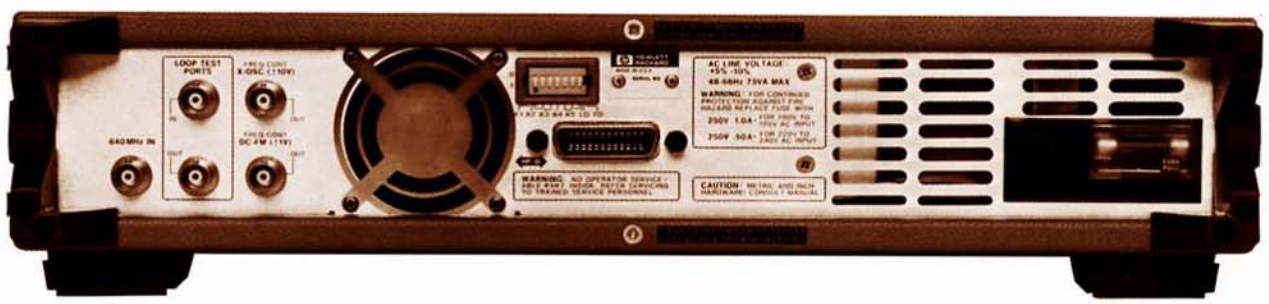
Model Number and Description

HP 8662A Synthesized Signal Generator
Option 003: Specified SSB phase noise for rear panel 640 MHz output (required for use with HP 11729B)

For more information on the HP 8662A see the technical data sheet.

An HP 11729B-compatible transit case is available under HP Part Number 9211-2654.

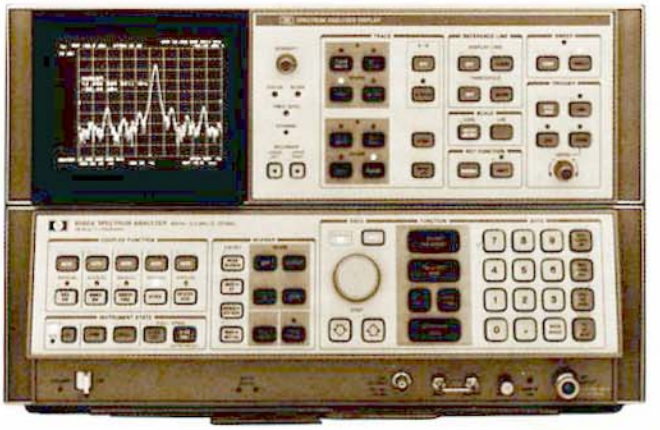
Data subject to change



Associated Equipment

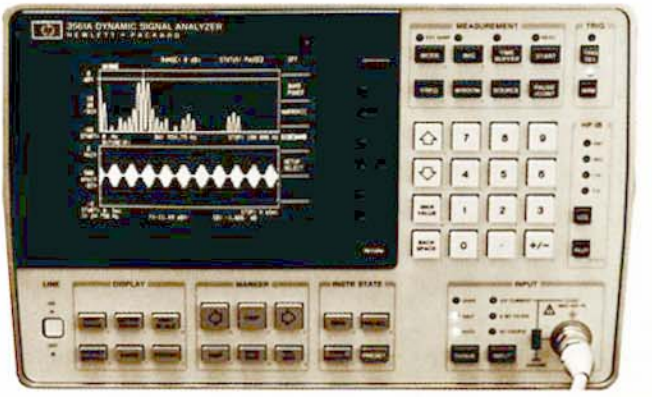
HP 8566A/B (8568A/B) Spectrum Analyzers

For manual systems or customer-configured automatic systems, the HP-IB programmable HP 8566A/B (100 Hz to 22 GHz) and HP 8568A (100 Hz to 1.5 GHz) are ideal for baseband analysis. In addition, they can be used to measure other qualities of the microwave signal directly (HP 8566A/B), or used to examine the general stability of the source under test at the HP 11729B IF output (HP 8566A/B or HP 8568A/B). Both analyzers have a number of features — such as automatic normalization to a 1 Hz noise bandwidth — which make noise characterization simpler and faster. With the standard 40 dB of low noise amplification in the HP 11729B, these analyzers can be used to examine noise as low as –160 dB below the carrier in a 1 Hz bandwidth.



HP 3561A (3582A, 3585A) Spectrum Analyzers

For close-in analysis, the HP 3561A (20 mHz to 100 kHz), the HP 3582A (20 mHz to 25 kHz), or HP 3585A (20 Hz to 40 MHz) are good choices. The HP 3561A and HP 3582A are FFT analyzers offering faster measurements at low offset frequencies. The HP 3585A is an analog analyzer with broader frequency coverage. These analyzers have a number of features useful for noise characterization with the HP 11729B. For example, for characterizing the HP 11729B phase lock loop, the HP 3561A and the HP 3582A have random noise sources, and the HP 3585A has a tracking generator. They also feature digital and analog averaging, for higher repeatability in measuring random noise characteristics.



HP 3047A Spectrum Analyzer System

When configured with an HP 11729B/8662A, the HP 3047A is a total measurement solution for fully calibrated, automatic measurement of phase noise, amplitude noise, spurious signals, and close-in analysis on sources from 5 MHz to 18 GHz. The HP 3047A system measures noise from 20 mHz to 40 MHz offsets, and includes complete system software for fully automatic system calibration, testing, and documentation. Noise measurements with an HP 11729B/8662A/3047A system can be made with ±2 dB accuracy for offsets from 20 mHz to 1 MHz.

For more information, call your HP Sales Office listed in the telephone directory white pages. Ask for the Electronic Instruments Department. Or write to Hewlett-Packard: **U.S.A.** P.O. Box 10301, Palo Alto, CA 94303-0890. **Europe:** P.O. Box 999, 1180 AZ Amstelveen, The Netherlands. **Canada:** 6877 Goreway Drive, Mississauga, L4V 1M8, Ontario. **In Japan:** Yokogawa-Hewlett-Packard Ltd., 3-29-21, Takaido-Higashi, Suginami-ku, Tokyo 168. **Elsewhere** in the world, write Hewlett-Packard Intercontinental, 3495 Deer Creek Road, Palo Alto, CA 94304 USA.

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