MICROWAVE TEST EQUIPMENT

NOISE FIGURE METERS; SOURCES

Automatic noise figure measurements to 18 GHz

Models 340B, 342A; 343A, 345B, 347A, 349A

In microwave communications, radar, etc., the weakest signal that can be detected is usually determined by the amount of noise added by the receiving system. Thus, any decrease in the amount of noise generated in the receiving system will produce an increase in the output signal-to-noise ratio equivalent to a corresponding increase in received signal. From a performance standpoint, an increase in the signal-to-noise ratio by reducing the amount of noise in the receiver is more economical than increasing the power of the transmitter.

The quality of a receiver or amplifier is expressed in a figure of merit, or noise figure. Noise figure is the ratio, expressed in dB, of the actual output noise power of the device to the noise power which would be available if the device were perfect and merely amplified the thermal noise of the input termination rather than contributing any noise of its own.

The Hewlett-Packard system of automatic noise figure measurement depends upon the periodic insertion of a known excess noise power at the input of the device under test. Subsequent detection of noise power results in a pulse train of two power levels. The power ratio of these two levels contains the desired noise figure information. Hewlett-Packard noise figure meters automatically measure and present this ratio directly in dB of noise figure.

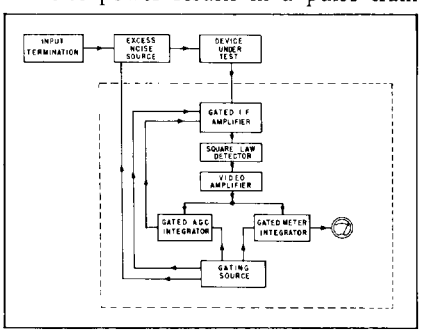


Figure 1. Automatic noise figure measurement system.

Noise figure is discussed in detail in Hewlett-Packard Application Note 57, which is available from your local Hewlett-Packard field office upon request. Application Note 57, "Noise Figure Primer," derives noise figure formulas, describes general noise figure measurements and discusses accuracy considerations. One of the measurement systems discussed in Application Note 57 is shown in Figure 1. The portion of the diagram within the dashed box is a simplified block diagram of the HP 340B and 342A Noise Figure Meters, and the excess noise source could be any of the noise sources described on these pages.

Advantages:

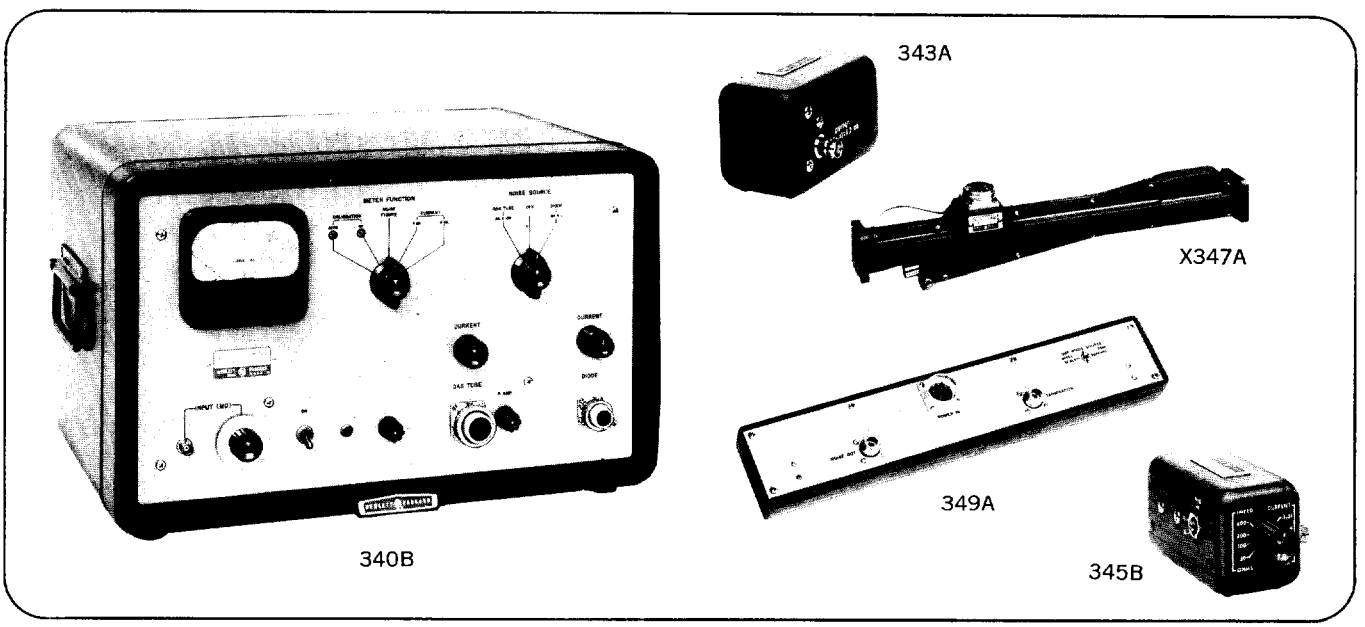
Reads noise figure directly in dB
Completely automatic measurement
Easily used by nontechnical personnel
No periodic recalibration needed
Fast response; ideal for recorder operation

Uses:

Measure noise figure in microwave or radar receivers, RF and IF amplifiers
Compare unknown noise sources against known noise levels
Adjust parametric amplifiers for optimum noise figure

HP noise figure meters and noise sources offer time-saving and cost-reducing advantages. Their ease of operation and continuous, automatic metering of noise figure reduce the time required for alignment and adjustment and simplify measurements so that they can be done by nontechnical personnel. No periodic recalibration of the meters is needed, and accurate alignment is easy, so high-level, on-line performance is assured.

In operation, a noise source is connected to the input of the device under test. The IF output of the device is connected to the 340B or 342A. The noise figure meter gates the noise source on and off. When the noise source is on, the noise level is that of the device plus the noise source. When the noise source is off, the noise level is that of the



device and its termination. The noise figure meter automatically compares the two conditions and displays noise figure directly in dB. Power to operate the noise source is supplied by the noise figure meter. Simply connect the noise source, adjust drive current using the controls and meter on the 340B or 342A, and the noise source is ready for operation.

Noise figure meters

Model 340B Noise Figure Meter, when used with an HP noise source, automatically measures and continuously displays noise figure for frequencies of 30 and 60 MHz. On special order up to four custom frequencies between 10 and 70 MHz, and some frequencies outside this range, can be supplied.

Model 342A is similar to Model 340B, except that it operates on five frequencies: 60, 70, 105, 200, and the basic tuned-amplifier frequency of 30 MHz. Up to six custom frequencies between 10 and 200 MHz, including 21.4 MHz, are available on special order.

Noise sources

Hewlett-Packard 343A VHF Noise Source: Specifically for IF and RF amplifier noise measurement, a temperature-limited diode source with broadband noise output from 10 to 600 MHz with 50-ohm source impedance and low SWR.

Hewlett-Packard 345B IF Noise Source: Operates at either 30 or 60 MHz, as selected by a switch; another selector permits matching 50-, 100-, 200-, and 400-ohm impedances.

Hewlett-Packard 347A Waveguide Noise Source: Argon gas discharge tubes mounted in waveguide sections; for waveguide bands 2.6 through 18 GHz, they provide uniform noise throughout the range; maximum SWR is 1.2.

Hewlett-Packard 349A UHF Noise Source: Argon gas discharge tubes in Type N coaxial configuration for automatic noise figure readings, 400 to 4000 MHz.

Specifications, 340B and 342A

Noise figure range: 5.2 dB noise source, 0 to 15 dB, indication to infinity; 15.2 dB noise source, 3 to 30 dB, indication to infinity.

Accuracy (excluding source accuracy): noise diode scale: ±0.5 dB, 0 to 15 dB; gas tube scale: ±0.5 dB, 10 to 25 dB; ±1 dB, 3 to 10 dB and 25 to 30dB; (for stated accuracy with 343A S, H, X and P347A and 349A Noise Sources, correction factor equal to the difference between specified excess noise and 15.2 dB must be applied to meter reading).

Input frequency: 340B; 30 or 60 MHz, selected by switch; 342A: 30, 60, 70, 105, and 200 MHz, selected by switch. Other frequencies available; prices and details on request.

Bandwidth: 1 MHz minimum.

Input requirements: −60 to −10 dBm (noise source on); corresponds to gain between noise source and input of approximately 50 to 100 dB for 5.2 dB noise source and 40 to 90 dB for 15.2 dB noise source.

Input impedance: 50 ohms nominal.

AGC output: nominal 0 to −6 V from rear binding posts.

Recorder output: 1 mA maximum into 2000 ohms maximum.

Power input: 115 or 230 volts ±10%, 50 to 60 Hz, 185 to 435 watts, depending on noise source and line voltage.

Power output: sufficient to operate 343A, 345B, 347A or 349A Noise Sources.

Dimensions: cabinet: 20¾" wide, 12¾" high, 14½" deep (527 x 324 x 368 mm); rack mount: 19" wide, 10-15/32" high, 13⅞" deep behind panel (483 x 266 x 353 mm).

Weight: net 44 lb (19,8 kg), shipping 55 lb (24,8 kg) (cabinet); net 37 lb (16,7 kg), shipping 51 lb (22,9 kg) (rack rount).

Accessories furnished: one 340A-16A Cable Assembly, connects noise figure meter to 347A or 349A Noise Source.

Price: HP 340B, $815 (cabinet); HP 340BR, $800 (rack mount); HP 342A, $915 (cabinet); HP 342AR, $900 (rack mount); not available in all countries.

Specifications, 343A

Frequency range: 10 to 600 MHz.

Excess noise ratio[1]**:** 10 to 30 MHz, 5.20 dB ±0.20 dB; 100 MHz, 5.50 dB ±0.25 dB; 200 MHz, 5.80 dB ±0.30 dB; 300 MHz, 6.05 dB ±0.30 dB; 400 MHz, 6.30 dB ±0.50 dB; 500 MHz, 6.50 db ±0.50 dB; 600 MHz, 6.60 dB ±0.50 dB.

Source impedance: 50 ohms.

Reflection coefficient: <0.091 (1.2 SWR), 10 to 400 MHz; <0.13 (1.3 SWR), 400 to 600 MHz.

Noise generator: temperature-limited diode.

Dimensions: 2¾" wide, 2½" high, 5" deep (70 x 63 x 127 mm).

Weight: net ¾ lb (0,34 kg); shipping 2 lbs (0,9 kg).

Price: HP 343A, $125.

Option 01.: spare noise diode(s) calibrated and supplied with instrument, add $40 each.

Specifications, 345B

(same weight and dimensions as 343A)

Spectrum center: 30 or 60 MHz, selected by switch.

Excess noise ratio[1]**:** 5.2 dB.

Source impedance: 50, 100, 200 or 400 ohms, ±4%, as selected by switch; less than 1 pF shunt capacitance.

Noise generator: temperature-limited diode.

Price: HP 345B, $125 (operation at any two frequencies between 10 and 60 MHz in lieu of 30 and 60 MHz available on special order).

Specifications, 347A

HP Model	Range (GHz)	Excess noise ratio[1,2]	Approx. length (in.)	Approx. length (mm)	Price
G347A	3.95— 5.85	15.2 ±0.5	19	483	$310
J347A	5.30— 8.20	15.2 ±0.5	19	483	$300
H347A	7.05—10.0	15.6 ±0.5	16	406	$275
X347A	8.20—12.4	15.7 ±0.4	14¾	375	$225
P347A	12.4 —18.0	15.8±0.5	14¾	375	$275

Reflection coefficient for all models, fired or unfired, 0.091 (SWR 1.2) max. (source terminated in well-matched load).

Specifications, 349A

Frequency range: 400 to 4000 MHz, wider with correction.

Excess noise ratio[1]**:** 15.6 dB ±0.6 dB, 400 to 1000 MHz; 15.7 dB ±0.5 dB, 1000 to 4000 MHz.

SWR: <1.35 (fired), <1.5 (unfired) up to 2600 MHz; <1.5 (fired or unfired), 2600 to 3000 MHz; <2.0 (fired), <3.0 (unfired) 3000 to 4000 MHz.

Dimensions: 3" wide, 2" high, 15" long (76 x 51 x 381 mm).

Weight: net 3¼ lb (1,4 kg); shipping 6 lb (2,7 kg).

Price: HP 349A, $325.

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[1] $\text{ENR (dB)} = 10 \log \frac{k(T - T_o)B}{kT_oB}$

where kTB = available noise power,
and kT_oB = available noise power 315 with noise source at 290° K.

[2] Includes factor for insertion loss.