



# POWER & NOISE FIGURE METERS

## Automatic Noise Figure Meter, Broadband Noise Source

Models 8970A, 346B

- Accurate and simple, swept or CW measurements.
- Automatic operation, 10 MHz—18 GHz.
- Second stage correction.
- Display of both noise figure and gain.
- Calibrated display on oscilloscope or recorder.
- Powerful special function enhancements.



8970A

### 8970A Noise Figure Meter

With the 8970A Automatic Noise Figure Meter, accurate and repeatable noise figure measurements are now easy. RF and microwave (with an external local oscillator) measurements from 10 MHz to at least 18 GHz are equally simple; any IF between 10 and 1500 MHz may be used. The ENR (Excess Noise Ratio) calibration table of the noise source may be stored in the 8970A, and a properly interpolated value is automatically used at each frequency. Automatic second stage correction makes accurate noise figure readings possible even for low gain devices. The 8970A's dynamic range allows it to measure either gain up to at least 40 dB (higher in some cases) or loss to -20 dB, with no external attenuation or amplification required.

### Microprocessor and Controller Functions

The 8970A takes the mystery out of noise figure measurement. It uses a microprocessor to make the myriad calculations and corrections necessary for truly accurate, convenient and flexible noise figure measurement. The 8970A also acts as a controller to external HP-IB local oscillators (such as the 8672A Synthesized Signal Generator or 8350A Sweep Oscillator) so that swept, broad-band microwave measurements of amplifiers, mixers, and transistors are essentially as simple as RF measurements.

In addition to acting as controller for an HP-IB local oscillator at microwave frequencies, the 8970A is fully programmable. Virtually all front panel buttons and functions are accessible over HP-IB, which is Hewlett-Packard's enhanced implementation of IEEE-488.

### Simple Calibration and Second Stage Correction

Accuracy is greatly enhanced because the 8970A measures its own noise figure (and that of the rest of the measurement system) at up to 81 points. It stores this information, interpolates if necessary, and corrects for it to remove second stage (measurement system) effects. The 8970A also measures the gain of the device under test (DUT).

### Display

The 8970A has an LED digital front panel display. For swept display of Noise Figure and gain on an oscilloscope, or x-y recorder, rear panel BNC Connectors are available. Either display mode is easily

and accurately scaled from the 8970A from the front panel. The swept oscilloscope display allows the design engineer to optimize his DUT in real time for both corrected noise figure and gain. The noise figure display is easily changed from noise figure to effective noise temperature ( $T_e$ ) if desired, or y factor.

### Front Panel and Special Functions

The 8970A front panel buttons control the number entry, calibration, and measurement functions. STORE, RECALL, and SEQ buttons allow up to 9 front panel settings to be stored and sequenced automatically or manually to save set-up time. Smoothing INCREASE and DECREASE buttons are used to average up to 512 readings before display, to eliminate flicker and increase accuracy.

The simple front panel control of the 8970A satisfies many noise figure measurement need. In addition, for those who may need even greater measurement power, there are more than 150 special functions that are easily selected via a numerical code and the SP button. Two examples are hot-cold measurements and automatic compensation for losses at the input of the DUT. One special function is a catalog that quickly indicates the current special function status. Three pull-out cards serve as a mini-reference manual to the instrument, including most of the special functions, the HP-IB formats and codes, and typical measurement setups. A complete set of service-oriented special functions can also be accessed.

### 346B Broadband Noise Source

The ideal companion to the 8970A is the 346B noise source, because of its broad 10 MHz to 18 GHz frequency range, low SWR, and accurate ENR calibration. The accurate calibration of ENR at 20 frequency points (nameplate plot and printout provided) and the low source SWR can reduce measurement uncertainty by several tenths of a dB, which is crucial in many measurements. The 346B output connector is available in APC 3.5 (compatible with SMA), Type N, and APC 7 styles. The drive voltage required for the 346B is 28 volts, and an internal regulator maintains performance despite power supply fluctuations.

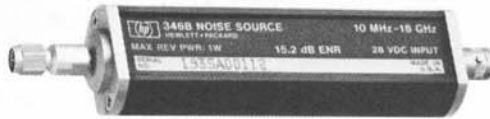


# POWER AND NOISE FIGURE METERS

Noise Figure Meters, Noise Sources

Models 340B, 342A, 343B, 347A, 11711A

455



346B



X347A



343A

## Noise Figure Measurement Repeatability and Accuracy

A very troublesome noise figure measurement problem is repeatability. For example, a vendor's system may not measure the same noise figure as his customer's. This is much less of a problem with the 8970A. Using randomly selected 8970A's, 346B's, mixers, and local oscillators, superimposed plots of a single DUT are routinely within 0.1 dB of each other.

The 8970A internal circuitry is so accurate and linear that instrumentation uncertainty is less than  $\pm 0.1$  dB. With the  $\pm 0.1$  dB ENR uncertainty of the 346B at most frequencies, and the uncertainties due to mismatch, total root-sum-square measurement uncertainties of less than  $\pm 0.25$  are easily attainable.

## 8970A Partial Specifications

(See technical data sheet for complete specifications.)

**Noise figure measurement range:** 0 to 30 dB.

**Noise figure instrumentation uncertainty:**  $\pm 0.1$  dB

**Noise figure resolution:** 0.01 dB.

**Gain measurement range:** -20 to 40 dB.

**Gain instrumentation uncertainty:**  $\pm 0.2$  dB.

**Gain resolution:** .01 dB.

**Frequency range:** tunable from 10 to 1500 MHz.

**Frequency resolution:** 1 MHz.

**Maximum operating input power:** -10 dBm.

**Maximum net external gain:** 80 dB between noise source and 8970A RF input.

**Noise source drive:** 28.0  $\pm$  0.1 volt

**HP-IB capability:** SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C1, 3, 28, E1.

**Dimensions:** 146 H x 425 W x 476 mm D (5.75 x 16.8 x 18.8 in).

**Weight:** net, 14.5 kg (32 lb); shipping, 17.7 kg (39 lb).

## 346B Partial Specifications

(See technical data sheet for complete specifications.)

**Frequency range:** 10 MHz to 18 GHz.

**Excess noise ratio (ENR) at 4 GHz and 17°C:** 15.2  $\pm$  0.3 dB.

**Maximum SWR (reflection coefficient) on or off:** 10 to 30 MHz—1.3 (0.13), 30 to 5000 MHz—1.15 (0.07), 5 to 18 GHz—1.25 (0.11).

**Power required:** 28  $\pm$  1 volt.

**Dimensions:** 140 x 21 x 30 mm (5.5 x 0.8 x 1.2 in).

**Weight:** net, 0.108 kg (3.5 oz); shipping, 0.5 kg (1 lb).

## Ordering Information

**8970A Noise Figure Meter**

**Option 907:** Front panel handle kit

**Option 908:** Rack mounting flange kit

**Option 909:** Both options 907 and 908

**Option 910:** Extra operating manual and service manual

**346B Noise Source**

**Option 001:** Type N (male) connector

**Option 002:** APC-7 connector

**Option 003:** Type N (female) connector

## Price

\$8500

add 32

add 25

add 55

add 25

1300

No charge

add 25

No charge

## Noise Figure Meters and Noise Sources

Model 340B Noise Figure Meter, when used with the appropriate HP noise source, automatically measures and continuously displays noise figure for equipment with IF frequencies of 30 and 60 MHz. Model 342A is similar, and operates on frequencies of 30, 60, 70, 105 and 200 MHz.

HP noise sources provide calibrated noise for measurements on various equipment from IF amplifiers to complete radar systems. Model 343A VHF source operates from 10 to 600 MHz with 50 ohm impedance.

The 347A waveguide sources are argon gas discharge tubes carefully mounted in waveguide sections for frequencies from 3.95 to 18 GHz.

## 340B and 342A Partial Specifications

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

**Accuracy (excluding source accuracy):** noise diode scale:  $\pm 0.5$  dB, 0 to 15 dB; gas tube scale:  $\pm 0.5$  dB, 10 to 25 dB,  $\pm 1$  dB, 3 to 10 dB and 25 to 30 dB.

**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:** 50 ohms nominal; -60 to -10 dBm signal level.

**Power input:** 115 or 230 volts  $\pm 10\%$ , 50 to 60 Hz, 435 watts, max.

**Size:** cabinet, 324 H x 527 W x 368 mm D (12.8 x 20.3 x 14.5 in.).

**Weights:** net, 19.4 kg (43 lb); shipping, 23.9 kg (53 lb).

## 343A, 346B Partial Specifications

HP Model	Freq. Range (MHz)	Excess Noise Ratio dB	Max. SWR 50 $\Omega$ Nominal	RF Connector	Price
343A	10-600	5.2 $\pm$ 0.5	1.3 ON or OFF	BNC (f)	\$360
346B	10-18000	$\approx 15.2^*$	1.25 ON or OFF	APC-3.5	\$1300

\*Individually calibrated at 20 frequencies.

## 347A Specifications

HP Model	Freq. Range (GHz)	Excess Noise Ratio dB	W/G WR	Equiv. Flange UG-( )/U	Price
G347A	3.95-5.85	15.2 $\pm$ 0.5	187	407	\$1200
J347A	5.30-8.20	15.2 $\pm$ 0.5	137	441	\$1200
H347A	7.05-10.0	15.6 $\pm$ 0.5	112	138	\$1250
X347A	8.20-12.4	15.7 $\pm$ 0.4	90	39	\$1050
P347A	12.4-18.0	15.8 $\pm$ 0.5	62	419	\$1100

Reflection coefficient for all models, fired or unfired, <0.091 (SWR 1.2) max.

## Ordering Information

**340B Noise Figure Meter (cabinet)**

**340BR Noise Figure Meter (rack mount)**

**342A Noise Figure Meter (cabinet)**

**342AR Noise Figure Meter (rack mount)**

**11711A Noise Source Adapter (adapts 346B to 340B and 342A)**

## Price

\$2650

\$2625

\$2700

\$2675

\$150