

**346A
346B
346C
NOISE SOURCE**
(Including Options 001, 002, and 004)

SERIAL NUMBERS

This manual applies directly to instruments having the following serial number prefixes:

346A-2336A

346B-2401A

346C-3339A

With changes described in the MANUAL CHANGES appendix, this manual also applies to 346B Noise Sources prefixed 2330A and lower.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL.



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346B/C Error Analysis

Sources of Error:

1. AGMC Standard Noise Source (B&C)

Freq(GHz)	Error(dB)
0.01 - 10	0.16
10 - 26	0.19
26.5	0.23

2. Mismatch Error

As long as the SWR of the freq converter is on the same order as that of the power splitter, mismatch resulting from the noise source & converter can be ignored since coupling between the ports is 6-7 dB. Total mismatch error (that with the std connected & that with the DUT connected) is

$$MM (dB) = -20 * \text{SQRT}(2) * \log (1 - \text{GAMMA}_{PS} * \text{GAMMA}_{NS})$$

where GAMMA_{PS} = refl coef of power splitter & GAMMA_{NS} = refl coef of noise source

SWR Specs:

346B: .01 - .03 GHz, 1.3(.13); .03 - 5 GHz, 1.15(.07); 5 - 18 GHz, 1.25(.11)

346C: .01 - 18 GHz, 1.25(.11); 18 - 26.5 GHz, 1.35(.15)

11667A: DC - 4 GHz, 1.15(.07); 4 - 8 GHz, 1.25(.11); 8 - 18 GHz, 1.45(.18)

11667B: DC - 18 GHz, 1.22(.10); 18 - 26.5 GHz, 1.29(.13)

346B		346C	
Freq(GHz)	Mismatch Error(dB)	Freq(GHz)	Mismatch Error(dB)
0.01 - 0.03	0.11	0.01 - 18	0.14
0.03 - 4	0.06	18 - 26.5	0.24
4 - 8	0.15		
8 - 18	0.25		

3. Stability (jitter/repeatability)

Freq(GHz)	Stability(dB)
0.01 - 18	0.07
18 - 26.5	0.09

4. Detector Linearity: 0.03 dB

Total Error:

346B	
Freq(GHz)	Error(dB) RSS
0.01 - 0.03	0.21
0.03 - 4	0.19
4 - 8	0.23
8 - 10	0.31
10 - 18	0.32

346C	
Freq(GHz)	Error(dB) RSS
0.01 - 10	0.23
10 - 18	0.25
18 - 26	0.32
26.5	0.35

Combining ranges which are close,

346B	
Freq(GHz)	Error(dB) RSS
0.01 - 8	0.23
8 - 18	0.32

346C	
Freq(GHz)	Error(dB) RSS
0.01 - 18	0.25
18 - 26	0.32
26.5	0.35

Uncertainty of items calibrated using base stds:

Assuming SWR of test item is about the same as the 346B/C, total error is found the same way except that uncertainties from the tables above are substituted for the AGMC noise source uncertainties.

Type N	
Freq(GHz)	Error(dB) RSS
0.01 - 8	0.28
8 - 18	0.42

3.5 mm	
Freq(GHz)	Error(dB) RSS
0.01 - 18	0.30
18 - 26.5	0.43

Error Analysis for Noise Sources Other Than 346B/C

AFPSL Standard	Uncertainty (dB)	Used to calibrate:
8012	0.15	8012
346C	0.15	8013
8052	0.15	8052
8091	0.15	8091

Mismatch Error

$$\text{MM(dB)} = -20 * \text{SQRT}(2) * \log(1 - \text{GAMMA}(\text{source}) * \text{GAMMA}(\text{load}))$$

$$\text{where GAMMA} = (\text{SWR}-1)/(\text{SWR}+1)$$

SWR assumed to be 1.3 for both sides across the frequency range
since no data is available.

$$\text{MM(dB)} = 0.21$$

$$\text{Stability (estimate)} = 0.10 \text{ dB}$$

$$\text{Detector Linearity} = 0.05 \text{ dB}$$

$$\text{Total Error (RSS)} = 0.28 \text{ dB} \Rightarrow 0.30 \text{ dB}$$

GENERAL INFORMATION

This manual contains operating and service information for the Hewlett-Packard Model 346A, 346B, and 346C Noise Sources. Included in the manual is information necessary to operate the Noise Sources. On the title page of this manual below the manual part number is a "microfiche" part number. This number may be used to order a 10 x 15 cm (4 x 6 inch) microfilm transparency of the manual.

Specifications

Instrument specifications are listed in Table 1. These specifications are the performance stand-

ards, or limits against which the instrument can be tested. Supplemental characteristics in Table 2 are not specifications but are typical characteristics included as additional information for the user.

Instruments Covered By Manual

The Noise Sources covered by this manual have a two part serial number. The first four digits and letter constitute the serial number prefix. The last five digits form a sequential suffix that is unique to each Noise Source. The prefix is the same for all Noise Sources of a particular configuration. It will

Table 1. Specifications

ENR accuracy: calibrations at cardinal frequencies are printed on each noise source and on a separate report shipped with each 346 Noise Source to the accuracy shown in the following table.

Frequency (GHz)	Worst Case Uncertainty (dB)	Root-Sum-of-Squares Uncertainty (dB)
0.01 to 7	0.30	0.09
8 to 10	0.27	0.09
11 to 12	0.28	0.09
13 to 18	0.30	0.11
19 to 20	0.40	0.15
21	0.50	0.19
22 to 23	0.58	0.21
24 to 26.5	0.67	0.30

Frequency range: 10 MHz to 18 GHz for 346A and 346B; 10 MHz to 26.5 GHz for 346C.

Excess noise ratio (ENR) range: calibrated values at cardinal frequencies printed on label. Range of value is 4.5 through 6.5 dB for 346A, 14 to 16 dB for 346B, and 12 to 16 dB (10 MHz to 12 GHz) and 14 to 17 dB (12 to 26.5 GHz) for 346C.

Maximum SWR (reflection coefficient) for source ON and source OFF (50 ohm reference impedance):

346A/B: 10 to 30 MHz — 1.3 (0.13)
 30 to 5000 MHz — 1.15 (0.07)
 5 to 18 GHz — 1.25 (0.11)
 346C: 10 MHz to 18 GHz — 1.25 (0.11)
 18 to 26.5 GHz — 1.35 (0.15).

Maximum change in complex reflection coefficient between source ON and source OFF at all frequencies for 346A only: 0.01.

Power required: $28 \pm 1V$.

346A/B: 60 mA peak, 30 mA average for source ON.
 346C: 45 mA.

Operating temperature: 0 to 55° C.

Connectors: bias: BNC(f); noise output: APC-3.5(m)—also mates with female SMA connectors. See option information for other connector styles.

Maximum reverse power: 1W.

Dimensions: 140 x 21 x 31 mm (5.5 x 0.8 x 1.2 in.).

Net Weight: 0.1 kg (3.5 oz).

Table 2. Supplemental Characteristics

ENR variation with temperature: <0.01 dB/°C for 30 MHz to 26.5 GHz.

ENR variation with voltage: internal current regulator for <0.02 dB variation for $28 \pm 1V$.

Switching speed: for repetitive operation (in previous state for less than 5 seconds), turn-on: <20 μs ; turn-off: <80 μs . For single shot operation (in previous state more than 5 seconds), turn-on: <3 ms; turn-off: <80 μs .

Instruments Covered By Manual (cont'd)

change when a design modification occurs. The contents of this manual apply directly to those instruments having the same serial number prefixes listed under SERIAL NUMBERS on the title page.

A Noise Source manufactured after the printing of this manual may have a serial number prefix which is higher than the prefixes listed on the title page. This indicates that the Noise Source is different than those documented in this manual. The manual for these instruments is supplied with a yellow manual changes supplement that contains change information to document the differences. To keep this manual as current and accurate as possible, Hewlett-Packard suggests that you periodically request the latest copy of the MANUAL CHANGES supplement. Identify the supplement with the manual print date and part number, both of which appear on the title page. Complimentary copies of this supplement are available from Hewlett-Packard.

Model 346B Noise Sources which were manufactured before the printing of this manual will have a serial number prefix lower than the one listed on the title page. Manual changes for these older models are found in the appendix entitled MANUAL CHANGES at the back of this manual.

Description

The Noise Source produces noise output (power-on) when +28 V is applied. When it is off, there is residual noise due to thermal agitation in the Noise Source (power-off). These two noise levels are used to measure the gain and added noise of the device under test, and consequently, its noise figure.

The Excess Noise Ratio (ENR) for each Noise Source has been measured at major frequencies and recorded on a label attached to the Noise Source (see Figure 1). ENR references power-on to the noise power that exists at 290 Kelvins (17°C). In addition, a separate calibration sheet showing the complex reflection coefficient in both the on and off states is included with each instrument.

All 3 models are provided with a BNC female connector for power input. The output connector is a male APC-3.5 on the standard Noise Sources. Type-N and APC-7⁺ connectors are available as

options for the 346A and 346B Noise Sources. In addition to these general characteristics, certain characteristics apply to the specific models. These characteristics are listed in Table 3.

FREQ Ghz	ENR dB
.01	12.90
.10	13.34
1.0	13.09
2.0	13.29
3.0	13.22
4.0	13.38
5.0	13.59
6.0	13.81
7.0	13.98
8.0	14.27
9.0	14.54
10.0	14.82
11.0	14.88
12.0	15.04
13.0	15.27
14.0	15.33
15.0	15.28
16.0	15.29
17.0	15.29
18.0	15.27
19.0	15.35
20.0	15.39
21.0	15.59
22.0	16.12
23.0	16.20
24.0	16.27
25.0	16.38
26.0	16.17
26.5	15.99
SERIAL NO. 2037A00003	

Figure 1. Typical Calibration Label

Table 3. Individual Noise Source Model Characteristics

346A	1. Reflection coefficient differential between on and off states is specified to be no greater than 0.01. 2. Specified output noise spectrum from 10 MHz to 18 GHz. 3. Nominal ENR is 6 dB over the specified frequency range.
346B	1. Reflection coefficient differential between on and off states is not specified, but is less than 0.1 typically. 2. Specified output noise spectrum from 10 MHz to 18 GHz. 3. Nominal ENR is 15 dB over the specified frequency range.
346C	1. Reflection coefficient differential between on and off states is not specified, but is less than 0.1 typically. 2. Specified output noise spectrum from 10 MHz to 26.5 GHz. 3. Nominal ENR is 15 dB over the specified frequency range.

* A registered trademark of the Bunker Ramo Corporation.

Warranty

The Noise Sources are warranted and certified as indicated on the inside of the rear cover of this manual. Connector damage resulting from improper use is not covered under warranty.

Equipment Available But Not Supplied

The following equipment is available from Hewlett-Packard for use with the Noise Sources:

11711A Noise Source Adapter
5060-0343 3/4" Torque Wrench (APC-7)
5060-0344 9/16" Torque Wrench (APC-3.5)

The 11711A Adapter is used with the Hewlett-Packard Model 340B and 342A Noise Figure Meters to drive the 346A and 346B Noise Sources. The adapter does not provide enough current to drive the 346C Noise Source. Refer to the Operating and Service Manuals for the 340B, 342A, and 11711A for further information.

Options

The 346A and 346B Noise Sources are available with the following output connector options:

- Option 001, Type-N (male)
- Option 002, APC-7
- Option 004, Type-N (female)

Since the APC-7 and Type-N connectors do not operate up to 26.5 GHz, no output connector options are available for the 346C.

Recommended Test Equipment

Table 4 is a list of equipment that can be used to perform an operational verification check.

INSTALLATION

Handling Precautions

CAUTION

Do not disassemble the Noise Source. The diode module is static sensitive and can be damaged or the calibration can be altered.

CAUTION

Do not drop the Noise Source. Dropping can damage unit or alter the calibration.

Table 4. Recommended Test Equipment For Operator's Checks

Check No.	Instrument	Critical Specification	Recommended Model
1	Power Meter and Power Sensor	Minimum Sensitivity 0.1 nW Frequency range: 10 MHz to 18 GHz	HP 436A with HP 8484A
	Power Supply	Voltage: 28.0 $\pm$ 1.0V Current: 100 mA	HP 6218A
2	Noise Figure Meter	Voltage Output 28.0 $\pm$ 1.0V Input Noise Figure: <7.4 FdB @ 100 MHz	HP 8970A

Proper connector care is essential. See OPERATOR'S MAINTENANCE in the OPERATION section of this manual for more information.

Initial Inspection

Inspect the shipping container for damage. Inspect the Noise Source for mechanical damage incurred in transit. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the Noise Source has been mechanically and electrically checked. If the contents are incomplete, if there is mechanical damage or a defect, or if the Noise Source does not work electrically, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of unusual stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.

Original Packaging

Container and materials identical to those used in factory packaging are available through Hewlett-

Original Packaging (cont'd)

Packard offices. If the Noise Source is being returned to Hewlett-Packard for servicing, attach a tag indicating the name and address of the company, the technical contact person, phone number and extension, the model number, serial number, type of service being requested, and failure symptoms if applicable. For this purpose, blue service tags have been provided at the back of this manual. Mark the shipping container FRAGILE. In any correspondence, refer to the Noise Sources by model number and serial number.

Mating Connectors

The Noise Sources can be mated with other instrumentation having the connectors listed in Table 5.

Table 5. Connectors That Can Be Mated With the Noise Sources

Configuration	Mating Connector
Input: all units	BNC male*
Output: standard	APC-3.5 female SMA female
Opt. 001	Type-N female*
Opt. 002	APC-7
Opt. 004	Type-N male*

*Must comply with U.S. Military Standard MIL-C-39012.

Storage and Shipping Environment

The Noise Sources should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

Temperature: -55°C to $+75^{\circ}\text{C}$

Humidity: <95% relative

Altitude: <15 300 metres (50 000 feet)

OPERATION

This section refers to operation with noise figure meters. For more detailed operating instructions, refer to the operating manual for the noise figure meter used.

CAUTION

Use a dc blocking capacitor to protect the Noise Source from damage when connected to any system where a dc voltage is present on the output center conductor.

Noise figure measurements of devices (such as amplifiers, mixers, transistors, and receivers) can be made using the Noise Source with a noise figure meter. Figure 2 depicts a simple test setup for a noise figure measurement. Note that the noise figure meter must have a $+28 \pm 1\text{V}$ switched supply.

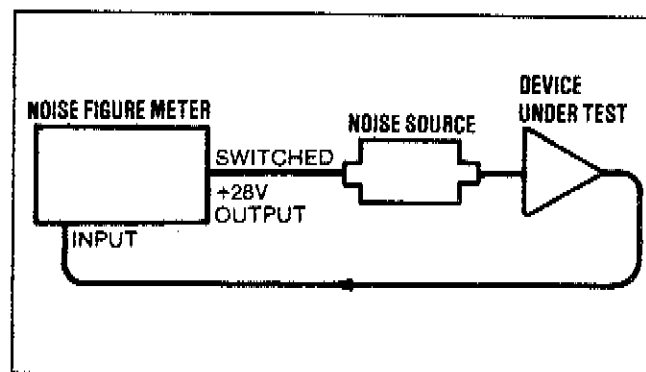


Figure 2. Typical Noise Figure Measurement Test Setup

Operating Environment

The operating environment of the Noise Sources should be within the following limitations:

Temperature: 0°C to $+55^{\circ}\text{C}$

Humidity: <95% relative

Altitude: <4600 metres (15 000 feet)

Operator's Checks

The operator's checks in this section should be performed if failure of the Noise Source is suspected. The checks can be used only to verify that the Noise Sources are producing a broadband noise spectrum. They can not be used to check the units against specifications. Only one of the checks is necessary to verify operation. Table 4 shows the recommended test equipment used for each check.

Operator's Check with Power Meter (Check No. 1). Connect the equipment as shown in Figure 3 and follow this procedure:

1. Turn power supply off and zero set the power meter.
2. Turn power supply on (+28V) and measure the power output with the Noise Source on.
3. If the result of the measurement is within the following limits, the Noise Source is operating correctly:
 - a. 346A Power output = $-66 \pm 4\text{ dBm}$
 - b. 346B Power output = $-56 \pm 4\text{ dBm}$
 - c. 346C Power output = $-56 \pm 4\text{ dBm}$.

Operator's Checks (cont'd)

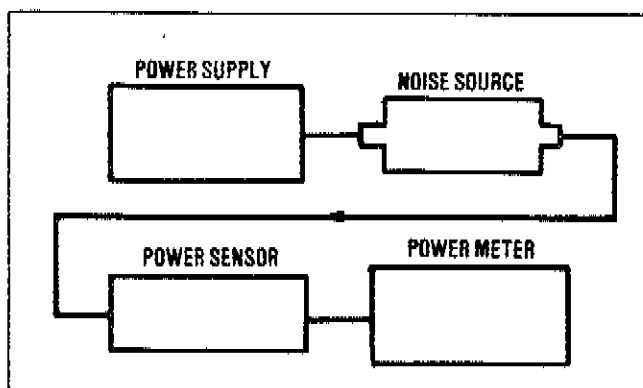


Figure 3. Operator's Check Test Setup 1

Operator's Check With HP Model 8970A Noise Figure Meter (Check No. 2)

1. Remove any cables from the noise figure meter input. Press PRESET. Verify Noise Figure display shows, "-FdB" and left display shows "30 MHz" after 5 seconds.

2. Connect the equipment as shown in Figure 4.

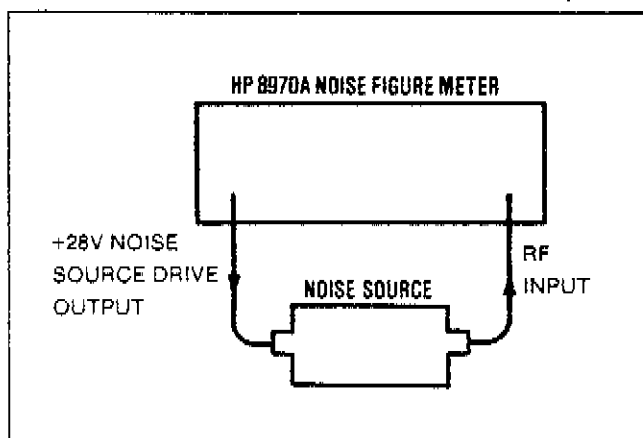


Figure 4. Operator's Check Test Setup 2

3. Enter a tuned frequency of 100 MHz. (See FIXED FREQUENCY TUNING in the 8970A Operating and Service Manual).

4. Enter special function 5.3 to enable the instrument for spot ENR entry. (See SPECIAL FUNCTIONS in the 8970A Operating and Service Manual).

5. Enter the ENR at 100 MHz from the Noise Source calibration label. (See SPOT ENR, T_{hot} , AND T_{cold} in the 8970A Operating and Service Manual).

6. The noise figure measurement of the noise figure meter will appear in the Noise Figure display.

If the result of the measurement is less than 7.4 FdB, the Noise Source is operating.

7. Press PRESET to return the instrument to preset conditions.

Operator's Maintenance

Proper connector care is a vital part of the maintenance which should be performed by the user. By following the general connector care practices outlined below, the life of the connector can be greatly extended.

1. Connectors should be properly torqued as shown in Table 6.

Table 6. Connector Torque Specifications

Connector Type	Torque Specifications
N	10 in · lb (1.1 N · m)
APC-7	12 in · lb (1.3 N · m)
SMA to APC-3.5	8 in · lb (0.9 N · m)
APC-3.5 to APC-3.5	8 in · lb (0.9 N · m)

2. Always tighten or loosen a connector by rotating only the nut. Never rotate the Noise Source body.

3. Use isopropyl or ethyl alcohol on a swab to clean connectors. Absorbent, lint-free paper wrapped around the end of tweezers is recommended. Carefully clean the conductive surfaces and dielectric. After cleaning, be sure connector is blown dry before re-assembly.

4. It is good practice to inspect a connector after cleaning. During the inspection, check for contaminants and worn plating. Also check for a misaligned center conductor or spread fingers on the APC-3.5 or Type-N connectors.

5. Support the cable or component attached to the connector.

6. When using APC-7 connectors, the nut of one connector should always be backed off completely and the nut on the mating connector should be tightened. Never set an APC-7 connector on its mating surface. Before storage, always screw the nut out to protect the surfaces.

Operator's Maintenance (cont'd)

7. Be sure connectors are axially aligned before the nut is tightened.

8. Use a connector gauge periodically to check the center pin depth. The shoulder of the center conductor must never extend beyond the plane of the outer conductor mating surface in an APC-3.5 connector.

For a more complete description of connector care, refer to application note 326-1 entitled "Connector Care and Maintenance". A copy of this note may be obtained through the nearest Hewlett-Packard office.

PERFORMANCE TESTS

Due to the complex test equipment involved, there are no recommended performance tests for the user to perform. Return the Noise Sources to Hewlett-Packard when tests are required to verify its performance and for periodic re-calibration. The suggested interval before initial re-calibration is one year.

ADJUSTMENTS

There are no adjustments that can be made on the Noise Sources by the user.

REPLACEABLE PARTS

If any parts need replacement, return the instrument to Hewlett-Packard.

SERVICE**Troubleshooting**

Check the connectors. If there is no apparent damage to the connectors, perform one of the operator's checks described in the OPERATION section of this Manual. If the Noise Source's output does not fall within the stated range, or if the connectors are damaged, return the unit to Hewlett-Packard for repair.

Repair

Repair by the user is not recommended because of the complex equipment required for test and calibration.

APPENDIX MANUAL CHANGES

INTRODUCTION

This section contains information for adapting this manual to Model 346B Noise Sources that have a serial number prefix which is 2330A and lower.

MANUAL CHANGES

To adapt this manual to your instrument, refer to Table 7 and make all of the manual changes listed opposite your instrument's serial number prefix. Perform these changes in the sequence listed.

If your instrument (all models) has a serial number prefix which is higher in value than those listed on the title page of this manual, it may be documented in a yellow MANUAL CHANGES supplement. For additional information, refer to INSTRUMENTS COVERED BY MANUAL in the GENERAL INFORMATION section of this manual.

Table 7. Manual Changes by Serial Number

Serial Number Prefix	Make Manual Changes
1935A, 2015A	C, B, A
2037A	C, B
2330A	C

CHANGE A

Table 2. Supplemental Characteristics:

Change Switching Speed for both repetitive operation and single shot operation to read: Turn off
<140 μ s.

CHANGE B

Table 1. Specifications:

Change "Worst Case Uncertainty" and "Root Sum of Squares Uncertainty" for cardinal frequencies from 10 MHz through 18 GHz to read as follows:

Frequency (MHz)	Worst Case Uncertainty (dB)	Root Sum of Squares Uncertainty (dB)
10	0.34	0.10
100	0.34	0.10
1000	0.34	0.10
2000	0.34	0.10
3000	0.34	0.10
4000	0.34	0.10
5000	0.35	0.10
6000	0.35	0.10
7000	0.37	0.10
8000	0.37	0.10
9000	0.38	0.13
10000	0.39	0.13
11000	0.39	0.14
12000	0.40	0.14
13000	0.50	0.18
14000	0.51	0.18
15000	0.52	0.18
16000	0.54	0.18
17000	0.55	0.18
18000	0.57	0.19

CHANGE C

Figure 1. Typical Calibration Label:

Replace Figure 1 with Figure A-1.

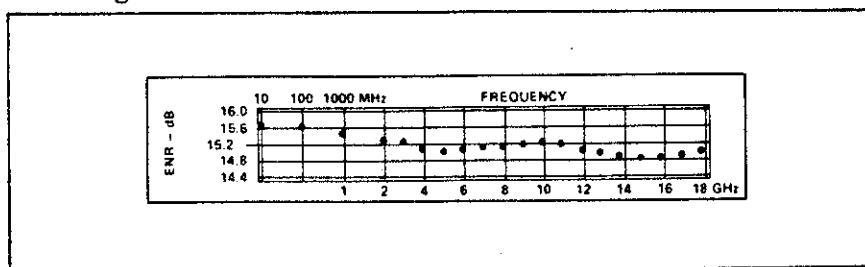


Figure A-1. Typical Calibration Label

Page 2, 2nd Paragraph under Description:

Change 1st sentence to read, "The Excess Noise Ratio (ENR) for each Noise Source has been measured at major frequencies and plotted on a label. . ."

Page 3, under Equipment Available But Not Supplied:
Delete, "5060-0344 9/16" Torque Wrench (APC-3.5)".

NOTE

Model 346B Noise Sources manufactured before the printing of this manual have an APC-3.5 connector of a different configuration (see Figure A-2). The 9/16" torque wrench will not fit these older connectors.

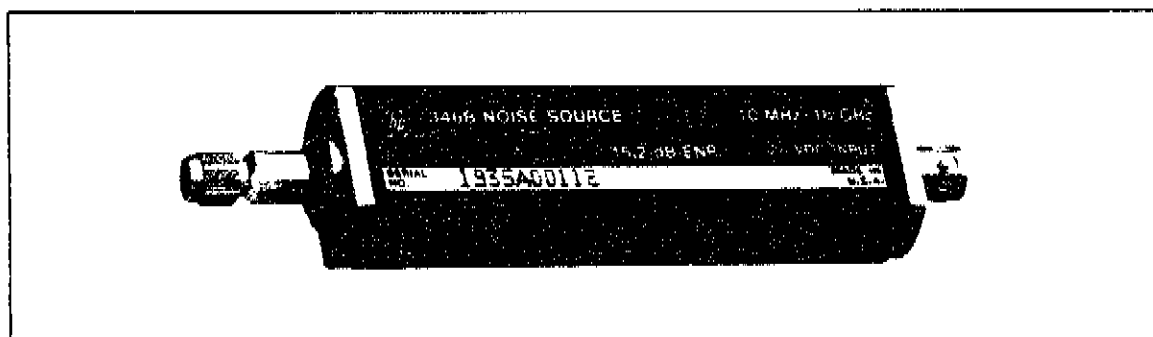


Figure A-2. HP Model 346B Noise Source with Older Configuration APC-3.5 Connector

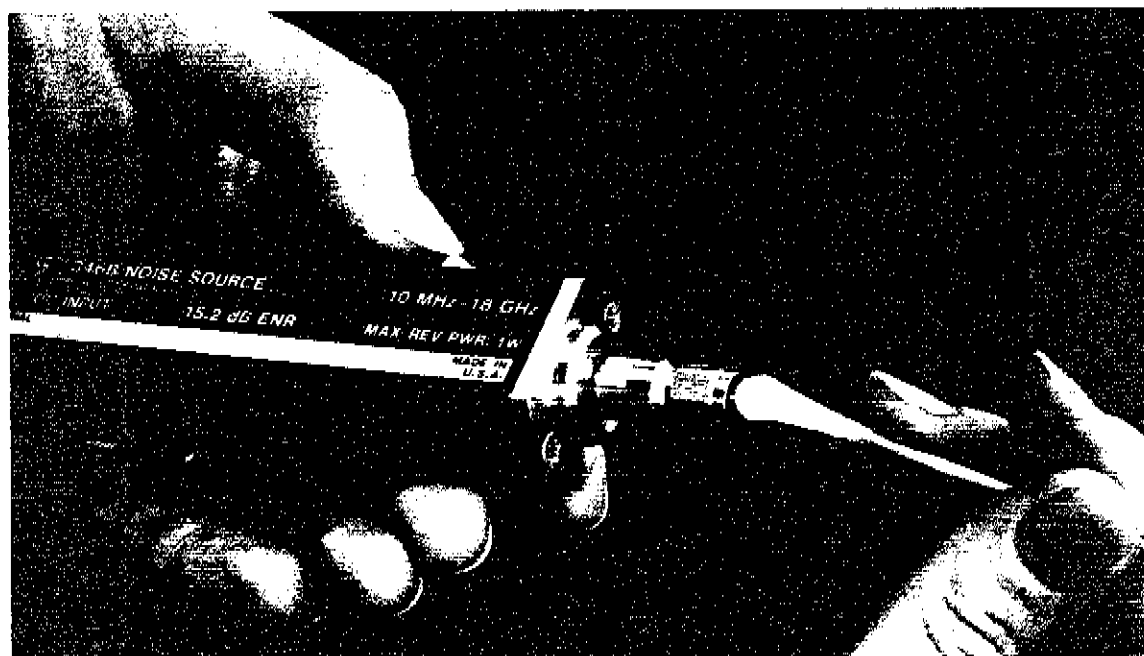
SERVICE NOTE

Supersedes:
None

HP 346B NOISE SOURCE

All Serials

RF CONNECTOR CARE



This note covers several major areas to help you preserve your connectors, save you money, and increase the accuracy and repeatability of your measurements.

GENERAL CONNECTOR CARE PRACTICES

1. Always tighten or loosen a connector by rotating only the nut. Never rotate the connector body when tightening or loosening. This applies to all connector types. Failure to observe this precaution can lead to unscrewing of the center conductor on Type-N connectors and severe damage of whatever the center conductor mates to on all types of connectors.
2. Cleanliness is very important; use pure isopropyl, ethyl alcohol or liquid freon on a swab to clean connectors. Cotton swabs may leave filaments of cotton in the connector so check for residue after using swabs; absorbent, lint-free paper wrapped around the end of tweezers is a better choice. Carefully clean the center conductor, outer conductor, dielectric and the surface where the outer conductors butt together. After cleaning, be sure the connector is blown dry before re-assembly. It is good practice to inspect the connector under magnification after cleaning to be sure all contaminants are removed and to check for wear. Never use acetone, methanol, denatured alcohol, or other solvents as they can damage the dielectric.

I/NS/WN

4.84-04/ST

HP 00346-90023



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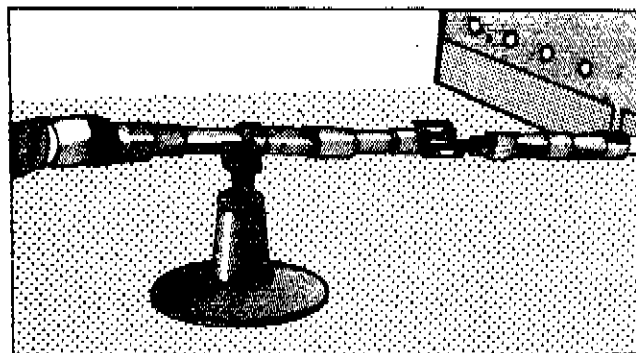
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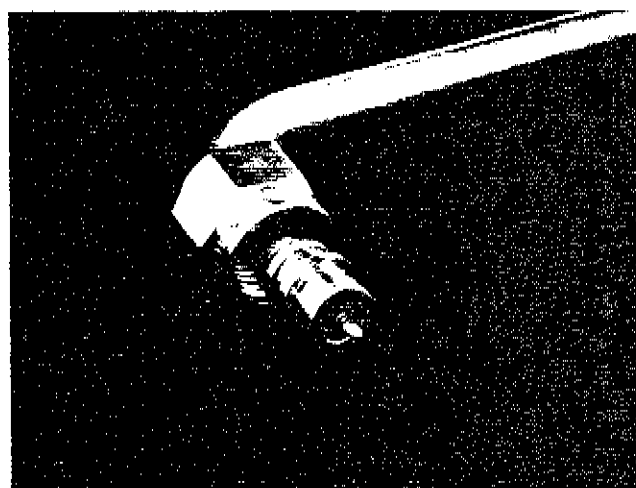
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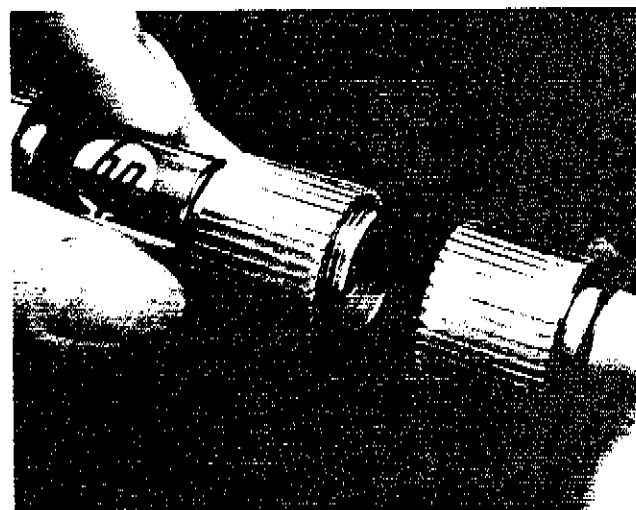
3. A small amount of dirt on the mating surfaces of APC-7® connectors can keep the outer conductor from making good contact.
4. A connector with worn plating on the inner or outer conductors should be replaced since there is a good possibility of loose, intermittent connections. If you can see the metal that underlies the plating, the connector is excessively worn. Intermittent problems with SWR variation and RF leakage can sometimes be observed even before the plating is worn all the way through.
5. Lateral forces applied to connectors should be minimized, otherwise distortion of the connector outer shell can result. This is especially important with SMA connectors. You can minimize lateral forces on a connector by supporting the cable or component attached to the connector.
6. If the center conductor fingers of APC-3.5 connectors spread apart, even a little bit, a power hole several dB deep can occur at about 22 GHz. This same thing can also happen to Type-N connectors with the power hole occurring at 12 GHz. This condition can be caused by several factors.
 - (a) a misaligned center conductor on the male connector
 - (b) rocking a cable to get it in or out, or
 - (c) having the connector misaligned when tightening the nut. This is especially likely to occur when the connector is in tight quarters (such as inside equipment). Be sure connectors are axially aligned before the nut is tightened.
7. Center pin depth is critical on male and female connectors for SMA and APC-3.5. Basically, the center conductor shoulder should just reach the plane of the outer conductor mating surface and should not extend beyond it. The specifications are +0.000, -0.003 inches or 0.076 mm.
8. On SMA and APC-3.5 male connectors the outer nut retaining ring can be removed to facilitate the proper seating of the center conductor when used with semi-rigid cables. Otherwise, it is easy to drive the center pin into the dielectric, completely missing the female center pin.



Minimize lateral force by bracing.



Remove outer nut retaining ring to make center conductor seating easier.



Tighten only one APC-7 nut. The other one should spin freely.

APC-7® is U.S. registered trademark of the Bunker Ramo Corporation.

9. When using APC-7 connectors, the nut of one connector should always be backed off completely and the nut on the mating connector should be tightened. Never tighten the nuts to one another. The center conductor collets are subject to wear and sometimes become deformed due to overtightening. Also, never set an APC-7 connector on its mating surface as you can damage both the inner and outer mating surfaces. Before storage, always screw the nut out to protect the surfaces or use a protective cap.

TORQUE LIMITS

Be careful not to overtighten any connector. A properly torqued connector will not leak excessively unless it is either damaged or dirty. Connections with low and repeatable SWR and attenuation require that the center conductors be properly positioned with one another. Type-N and APC-7 connectors should be tightened firmly to make sure there is good RF contact around the entire outer conductor.

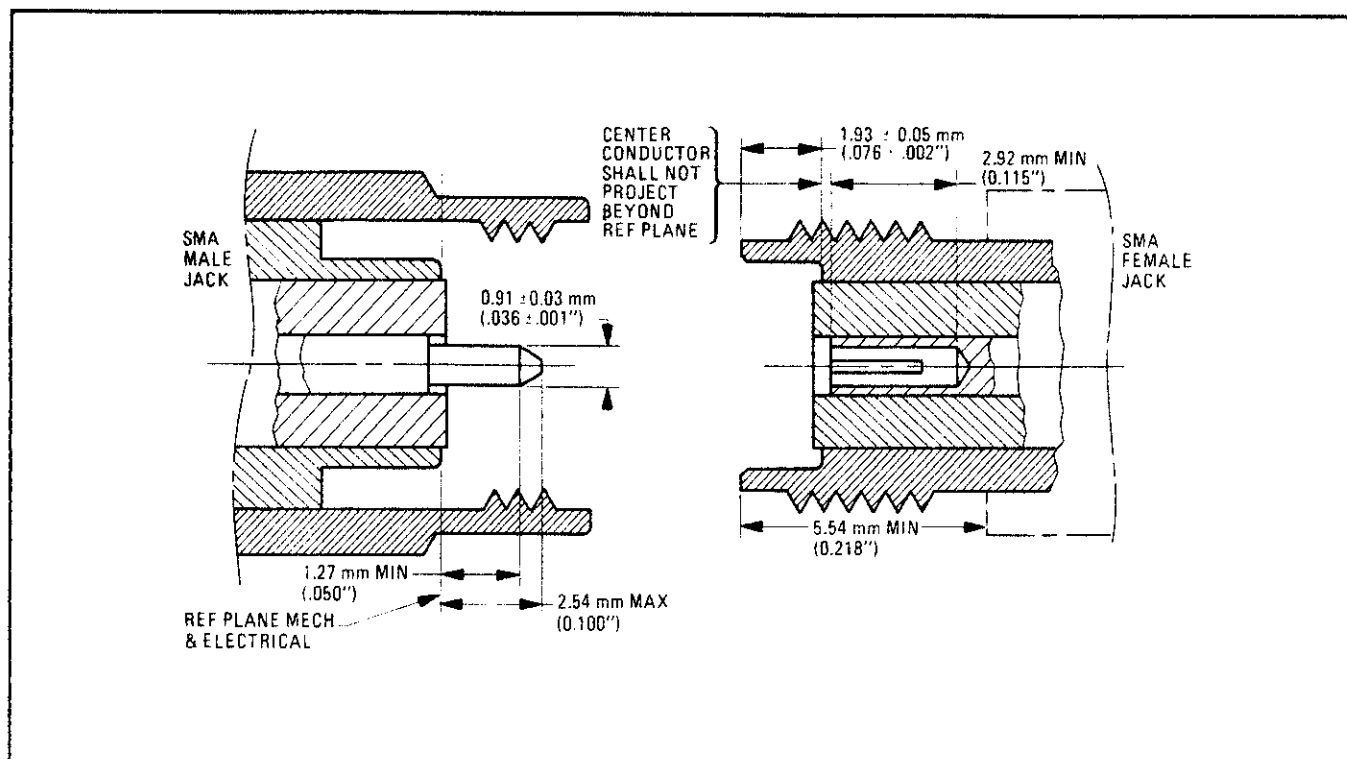
Connector Type	Torque Specifications	Damage Level
N	12 in-lb (1.3 N·m)	25 in-lb (2.8 N·m)
APC-7	12 in-lb (1.3 N·m)	
SMA to SMA	5 in-lb (0.6 N·m)	10 in-lb (1.1 N·m)
SMA to APC-3.5	5 in-lb (0.6 N·m)	10 in-lb (1.1 N·m)
APC-3.5 to APC-3.5	8 in-lb (0.9 N·m)	

Remember, even when you observe these limits, a connector will not last forever but it will last a lot longer than if the limits are exceeded. HP sells torque wrenches. HP part number 5060-0343, 3/4" wrench for APC-7 nuts and 5060-0344, 9/16" wrench for the improved HP 346B APC-3.5 nut.

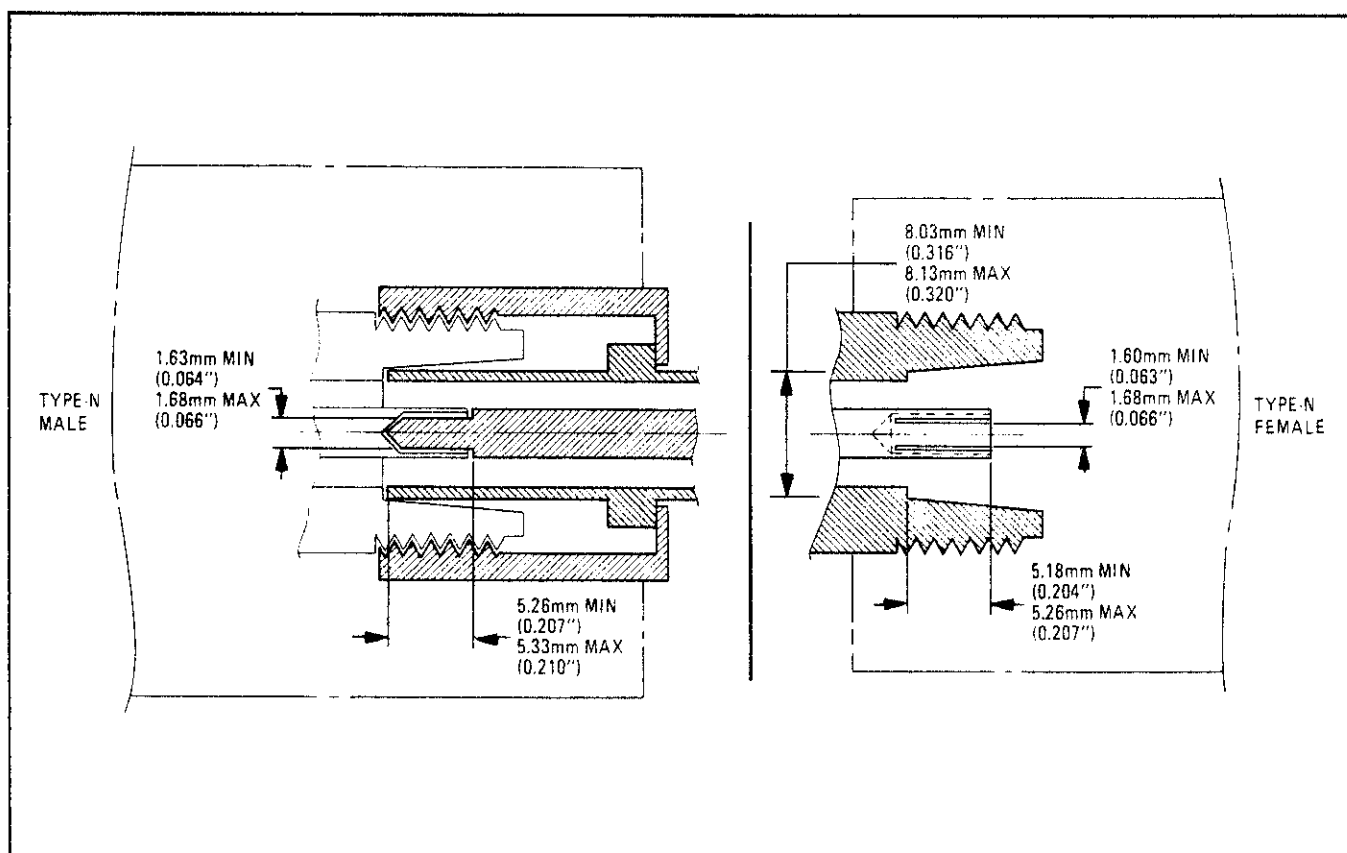
1. Use an extender-adapter to save difficult-to-replace connectors. That way you only have to replace the adapter when it wears out.

Connector	HP Part Number
N	1250-0597
APC-7	NA
SMA	1250-1681 or -1758 or -1462 or -1605
APC-3.5	NA

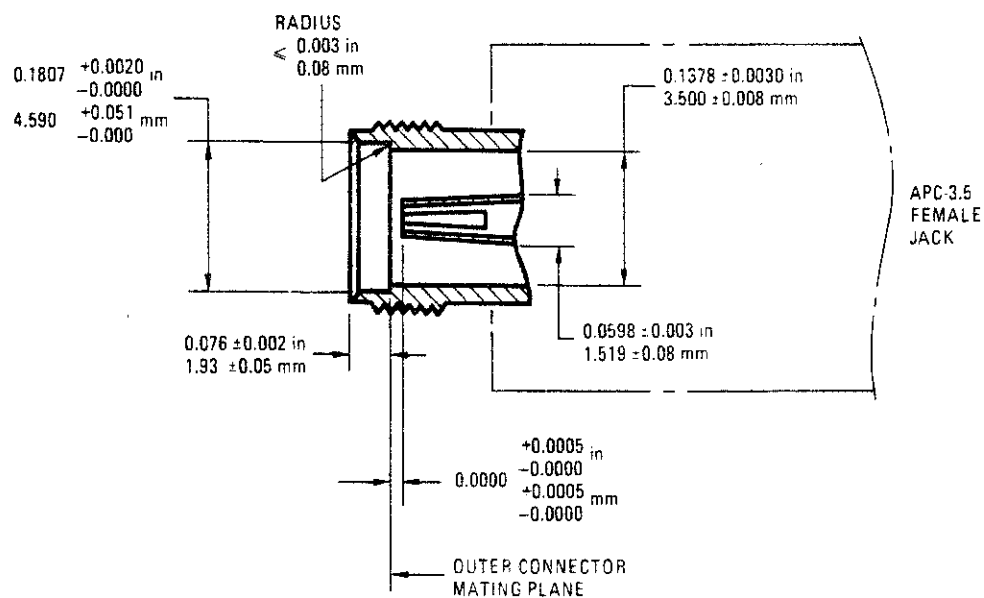
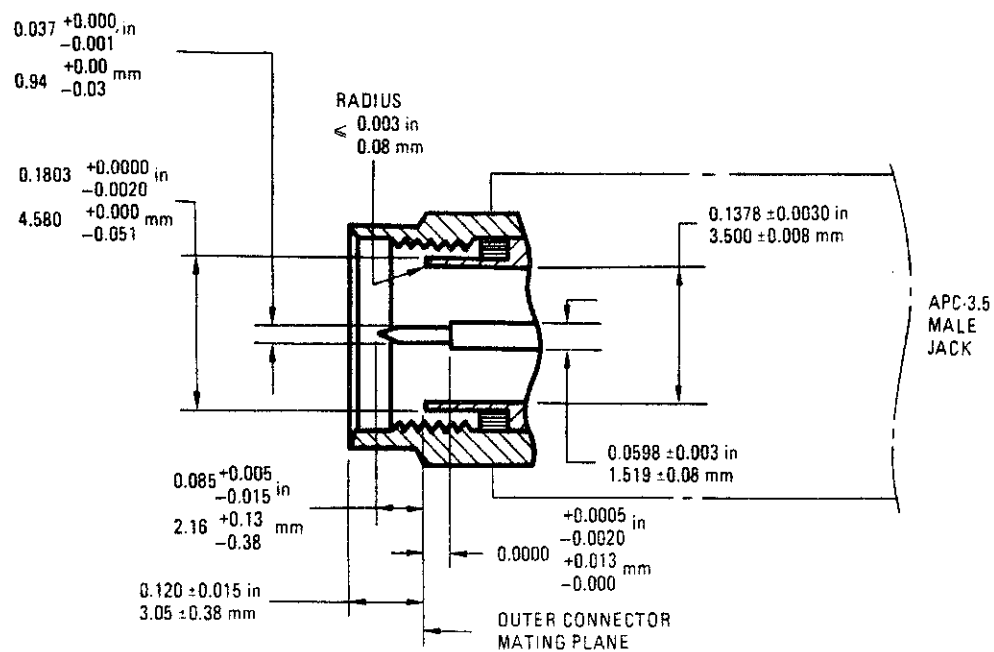
2. Throw away damaged connectors. They will damage any good connectors that are attached to them. So, don't take any chances by leaving them around.
3. Some Type-N and APC-3.5 female connectors have such strong retention force that they can pull the center pin of their mates out beyond the specification limits. Upon subsequent matings with other connectors, the male connector can cause considerable damage by pushing the female center conductor back too far.
4. Use a connector gauge before mating a connector to an expensive component. The cost of a gauge may prevent damaging the component. Gauges can be obtained from most connector manufacturers.
5. SMA connectors have a very limited number of connect and disconnect cycles before they show appreciable wear. This can be as low as 4 or 5 cycles; certainly no more than 100, even with great care. Generally speaking the SMA connector is not designed for use in environments where it will be frequently connected and disconnected.
6. APC-3.5 connectors last longer (maybe 1000 cycles), but this life can be shortened greatly by mating with SMA connectors. This is especially true for the APC-3.5 female connector being mated to an SMA male since the outer conductor of the SMA male is sharp and tends to wear the APC-3.5 mating surface rather quickly. Damage is aggravated by overtightening the connector or by rotating the connector body instead of the nut while tightening or loosening the connector. A worn SMA connector (such as on a mixer) can destroy a good APC-3.5 connector attached to it just once.
7. APC-3.5 connectors that are out of specifications can destroy the hermeticity of a mating connector or damage female center conductors and cause frequency response degradation. This can lead to very expensive repairs due to internal damage to an item that is designed to be sealed.



SMA Connector Dimensions



Type-N Connector Dimensions



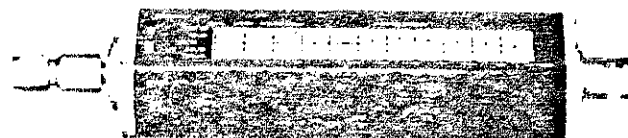
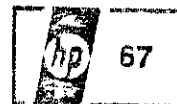
APC-3.5 Connector Dimensions

346 B

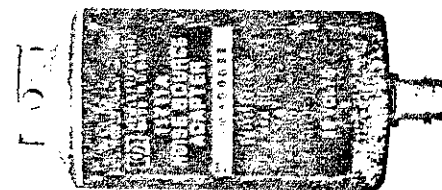
Enclosure 1 to Page 2

70076-16-2040

NOISE FIGURE METERS & SOURCES

Noise source
Solid-state coaxial

346B



11711A

346B Noise source

The principal purpose of this solid-state noise source is to conveniently improve the accuracy of noise figure measurements in existing and new systems. The largest accuracy improvements come about by decreased mismatch effects, due to the exceptionally low SWR of the noise source, and by easily correcting for ENR variations with frequency. This source can simply be inserted into most measurement systems that accommodate solid-state sources. It also works with the HP 340B and 342A Noise Figure Meters by use of the 11711A Noise Source Adapter.

Low SWR reduces the mismatch uncertainty and assures that the device under test (DUT) noise figure will be close to its 50 ohm value. If, for example, a DUT with an input SWR of 2 is used with a noise source having a SWR of 1.3, mismatch uncertainty alone could cause a 10 dB noise figure to measure as 10.48 dB. With a 1.15 SWR for the noise source, however, the mismatch uncertainty could cause a 10 dB noise figure to be at most 10.24 dB.

The noise figure of a DUT generally varies with the source impedance seen by the input of the DUT. This occurs because noise launched by the DUT toward the input can reflect from the input termination and reenter the DUT. Low noise source SWR means lower reentrant noise and more consistent DUT noise figures.

The 346B Noise Source has easily used ENR calibration data at about 20 frequencies plotted directly on each noise source body. Suppose, for example, that a 9.0 dB noise figure is measured by considering a noise source to have the usual ENR of 15.2 dB. If the calibrated ENR is 15.4 dB (0.2 dB higher than nominal), then simply add 0.2 dB for a proper noise figure of 9.2 dB.

Although the 346B requires 28 V bias like other solid-state noise sources, it has built-in bias regulation circuitry. Most designs of solid-state noise sources without built-in regulation exhibit a change in ENR.

The 346B is also free of turn-on transients that are characteristic of many gas discharge noise sources. Such transients often cause spurious effects—sometimes even burning out sensitive, high frequency transistors.

11711A Noise source adapter

This noise source adapter is needed for using the 346B Noise Source with the 340B and 342A Noise Figure Meters. The 11711A converts the bias from the 340B or 342A, that was required for vacuum diode sources, to the 28 V needed for the 346B.

346B Solid-state noise source specifications

Frequency Range: 10 MHz to 18 GHz.

Excess Noise Ratio (ENR) at 4.0 GHz: 15.2 ± 0.3 dB (346B).

ENR vs. Frequency: Cardinal frequencies are graphed on each noise source to the accuracy shown on the following table.

Frequency (MHz)	Worst case Uncertainty (dB)	RSS Uncertainty (dB)
2000	± 0.32	± 0.20
4000	± 0.33	± 0.20
6000	± 0.34	± 0.20
8000	± 0.35	± 0.20
10000	± 0.36	± 0.23
12000	± 0.37	± 0.23
14000	± 0.47	± 0.27
16000	± 0.49	± 0.27
18000	± 0.51	± 0.27

Maximum SWR for Source ON and Source OFF (reference impedance of 50 Ω): 1.30 from 10 MHz to 30 MHz; 1.15 from 30 MHz to 5 GHz; 1.25 from 5 GHz to 18 GHz.

Power Required: 28 ± 1 V, 60 mA peak, 30 mA average for "NOISE ON."

Operating Temperature Range: 0 to 55°C.

Bias Connector: BNC(f).

Noise Output Connector: Standard, APC-3.5 (m); options Type N (m or f) or APC-7.

Maximum Reverse RF Power: 1 W.

346B Supplemental characteristics

ENR Variation with Frequency: Example variations are shown on the label of the noise source pictured above.

ENR Variation with Temperature: < 0.01 dB/°C (< 0.05 dB/°C for 10 MHz - 30 MHz over 0 to 15°C).

Switching Speed: For repetitive operation (in previous state less than 5 seconds): Turn-on < 20 μ s;

Turn-off < 140 μ s.

For single shot operation (in previous state more than 5 seconds): Turn-on < 3 ms.

Turn-off < 140 μ s.

Dimensions: 140 mm x 21 mm x 30 mm (5.5 in. x 0.3 in. x 1.2 in.).

Weight: Net, 0.128 kg (4.5 oz); shipping, 0.5 kg (1 lb).

11711A Noise source adapter specifications

Power Input: Supplied by HP 340B and 342A Noise Figure Meters.

Power Output: Will operate the HP 346B Noise Sources.

Connectors: Input connects to HP 340B and 342A Noise Figure Meters; output, BNC (f).

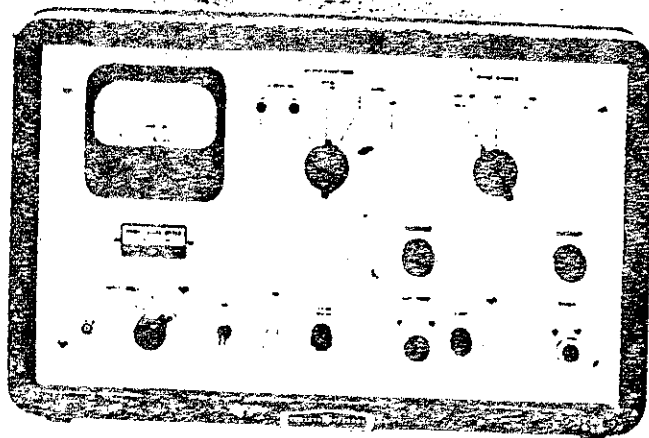
Dimensions: 100 mm x 40 mm (3.9 in. x 1.6 in.).

Weight: Shipping, 0.5 kg (1 lb).

POWER & NOISE FIGURE METERS

Noise figure meters; sources

Models 340B, 342A, 343A, 345B, 346B, 347A, 349A, 11711A



340B

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. 345B IF source is tuned for 30 or 60 MHz with 50, 100, 200, or 400 ohm outputs.

The 347A waveguide sources are argon gas discharge tubes carefully mounted in waveguide sections for frequencies from 3.95 to 18 GHz. Model 349A also uses an argon tube in a coaxial configuration for frequencies from 400 to 4000 MHz.

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: ± 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 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. Dimensions: cabinet, 324 mm H, 527 mm W, 368 mm D, (12.8" x 20.3" x 14.5").

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

346B Broadband Noise Source

Model 346B solid state noise source offers an extremely broadband coverage of 10 MHz to 18 GHz at an economical price. With its wide frequency coverage and improved performance, the 346B can replace several narrowband noise sources.

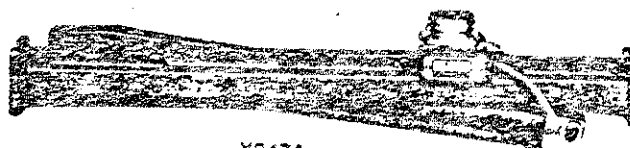
The 346B features very low SWR, ON/OFF, (1.25 at 18 GHz) which lowers the mismatch uncertainty considerably; thus improving the overall measurement uncertainty.

Each 346B is provided with a printout of the actual ENR and the ON/OFF reflection coefficient at one GHz intervals.

The DC biasing voltage for the 346B is 28 volts. The 11711A Noise Source Adapter enables the 346B to work with the Hewlett-Packard 340B and 342A Noise Figure Meters.



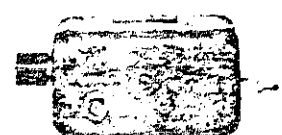
349A K4/11



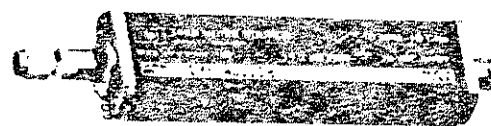
X347A



343A NCR



345B NCR



346B

343A, 345B, 346B, 349A Partial Specifications

HP Model	Freq. Range (MHz)	Excess Noise Ratio dB	Max. SWR 500 Nominal	RF Connector	Price
343A	10-600	5.2 ± 0.5	1.3 ON or OFF	BNC (I)	\$290
345B	30 or 60 selectable by switch	5.2	Variable Z ₀ , 50, 100, 200, 400	BNC (I)	\$435
346B	10-18000	15.2 ± 0.5	1.25 ON or OFF	APC-3.5	\$1200
349A	400-4000	15.6 ± 0.6	2.0 ON 3.0 OFF	Type N (I)	\$575

347A Specifications

HP Model	Freq. Range (GHz)	Excess Noise Ratio dB	W/G WR	Equip. Flange UG-11/U	Price
G347A	2.95-5.85	15.2 ± 0.5	187	407	390
J347A	5.30-8.20	15.2 ± 0.5	137	441	950
H347A	7.05-10.0	15.6 ± 0.5	112	138	1050
X347A	8.20-12.4	15.7 ± 0.4	90	39	755
P347A	12.4-18.0	15.8 ± 0.5	62	419	940

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

Coaxial & Waveguide Catalog & Microwave Measurement Handbook: 96 pages with over 350 measurement accessories. Request card at back of this catalog.