Operating and Service Manual

HP 346A/B/C Noise Source (Including Options 001, 002, & 004)

SERIAL NUMBERS

Attached to the rear panel of the instrument is a serial number plate. The serial number is in the form: 0000A00000. The first four digits and the letter are the serial number prefix. The last five digits are the suffix. The prefix is the same for identical instruments; it changes only when a configuration change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument.

This manual applies directly to the following serial number prefixes.

HP 346A — 3228A
HP 346B — 3228A
HP 346C — 3228A

With changes described in the Manual Changes Appendix, this manual also applies to Noise Sources with prefixes listed below.

HP 346A — 2336A and 2614A
HP 346B — 2614A and below
HP 346C — 2339A

HP Part No. 00346-90032

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Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes/System angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

Zusatzinformation für Meß- und Testgeräte:

Werden Meß- und Testgeräte mit ungeschirmten Kabeln und/oder in offenen Meßaufbauten verwendet so ist vom Betreiber sicherzustellen, daßdie Funkentstörbedingungen unter Betriebsbedingungen an seiner Grundstücksgrenze eingehalten werden.

Manufacturer's Declaration

This is to certify that this equipment is in accordance with the Radio Interference Requirements of Directive FTZ 1046/1984. The German Bundespost was notified that this equipment was put into circulation, and has been granted the right to check the equipment type for compliance with these requirements.

Note: If test and measurement equipment is operated with unshielded cables and/or used for measurements in open setups, the user must ensure that under these operating conditions, the radio frequency interference limits are me at the border of his premises.

1

General Information

Introduction

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.

Specifications

Instrument specifications are listed in Table 1-1. These specifications are the performance standards, or limits against which the instrument can be tested. Supplemental characteristics in Table 1-2 are not specifications but are typical characteristics included as additional information for the user.

Table 1-1. Specifications

ENR accuracy: Calibrations at cardinal frequencies are printed on each noise source and on a separate report shipped with each HP 346 Noise Source to the accuracy shown below.

Instrument Model	Frequency (GHz)	Worst Case Uncertainty (dB)	Root-Sum-of-Squares Uncertainty (dB)
346A	0.01-9	0.24[1]	0.13
	10-18	0.29[1]	0.14
346B	0.01-9	0.22[1]	0.12
	10-18	0.27[1]	0.13
346C	0.01-9	0.22	0.12
	10-18	0.27	0.13
	19-20	0.31	0.13
	21-26.5	0.38	0.14

Frequency range:

HP 346A/B:	10 MHz – 18 GHz
HP 346C:	10 MHz – 26.5 GHz

Excess noise ratio (ENR) range:

Calibrated values at cardinal frequencies printed on label.

HP 346A:	4.5 – 6.5 dB
HP 346B:	14 – 16 dB
HP 346C:	
10 MHz to 12 GHz	12 – 16 dB
12 to 26.5 GHz	14 – 17 dB

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

HP 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)
HP 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 HP 346A only: 0.01

1 If the Noise Source has an Option 002 (APC-7) connector; lower by 0.03 dB (ex. 0.24 to 0.21).

Table 1-1. Specifications (continued)

Power required:	28 ±1 V
HP 346A/B:	60 mA peak, 30 mA average for source ON
HP 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 1-2. 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 ±1 V
Switching speed:	
For repetitive operation (in previous state for less than 5 seconds):	
	Turn-on: <20 μs Turnoff: <80μs
For single shot operation (in previous state more than 5 seconds):	
	Turn-on: <3 ms Turn-off <80 μs

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 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 not listed on the title page. This unlisted serial number prefix indicates the noise source is different than those documented in this manual. If manual changes are

needed, the manual for this newer noise source is accompanied by a Manual Changes supplement. The supplement contains "change information" that explains how to adapt this manual to the newer noise source.

In addition to change information, the supplement may contain information for correcting errors in the manual. The supplement is identified with the manual print date and part number, both of which appear on the manual back cover.

For information concerning a serial number prefix that is not listed on the title page in the Manual Change supplement, contact your nearest Hewlett-Packard office.

Model HP 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 1-1). 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 three 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 HP 346A and HP 346B Noise Sources. In addition to these general characteristics, certain characteristics apply to the specific models. These characteristics are listed in Table 1-3.

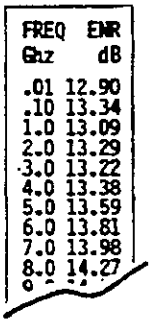

Figure 1-1. A Partial View of Typical Calibration Label

Table 1-3. Model Characteristics of Individual Noise Sources

HP 346A	HP 346B	HP 346C
Reflection coefficient differential between on and off states is specified to be no greater than 0.01.	Reflection coefficient differential between on and off states is not specified, but is less than 0.1 typically.	Reflection coefficient differential between on and off states is not specified, but is less than 0.1 typically.
Specified output noise spectrum from 10 MHz to 18 GHz.	Specified output noise spectrum from 10 MHz to 18 GHz.	Specified output noise spectrum from 10 MHz to 26.5 GHz.
Nominal ENR is 6 dB over the specified frequency range.	Nominal ENR is 15 dB over the specified frequency range.	Nominal ENR is 15 dB over the specified frequency range.
Not directly useable for HP 8970A IF attenuator calibration (Special Function 33). 10 dB of gain is required.	Suitable for HP 8970A IF attenuator calibration (Special Function 33).	Suitable for HP 8970A IF attenuator calibration (Special Function 33).
Not directly useable for HP 8970B IF attenuator calibration. Refer to "Calibration, IF Attenuators" in the *HP 8970B Operating Manual.*	Not useable for HP 8970B IF attenuator calibration. Refer to "Calibration, IF Attenuators" in the *HP 8970B Operating Manual.*	Suitable for HP 8970B IF attenuator calibration (refer to "Calibration, IF Attenuators" in the *HP 8970B Operating Manual*)

Warranty

The noise sources are warranted and certified as indicated in 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:

5060-0343 ..... 3/4" Torque Wrench (APC-7)

5060-0344 ..... 9/16" Torque Wrench (APC-3.5)

Options

The HP 346A and HP 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 HP 346C.

Recommended Test Equipment

Table 1-4 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 the unit or alter the calibration.

Proper connector care is essential. See Operator's Maintenance in the Operation section of this manual for more information.

Table 1-4.
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 ±1.0 V Current: 100 mA	HP 6218A
2	Noise Figure Meter	Voltage Output: 28.0 ±1.0 V Input Noise Figure: <7.4 FdB at 100 MHz	HP 8970B

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-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 1-5.

Table 1-5.
Connectors That Can Be Mated With the Noise Sources

Configuration	Mating Connector
Input: all units	BNC male[1]
Output: standard	APC-3.5 female SMA female
Opt. 001	Type-N female[1]
Opt. 002	APC-7
Opt. 004	Type-N male[1]

1 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°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 1-2 depicts a simple test setup for a noise figure measurement.

Note

The noise figure meter must have a +28 ±1 V switched supply.

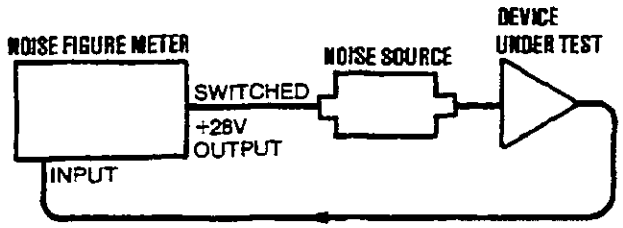

Figure 1-2. Typical Noise Figure Measurement Test Setup

Operating Environment

The operating environment of the noise sources should be within the following limitations:

Temperature: 0°C to +55°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 1-4 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 1-3 and follow this procedure:

1. Turn power supply OFF. Zero the power meter.
2. Turn power supply ON (+28 V). 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. HP 346A Power output = −66 ±4 dBm
   b. HP 346B Power output = −56 ±4 dBm
   c. HP 346C Power output = −56 ±4 dBm.

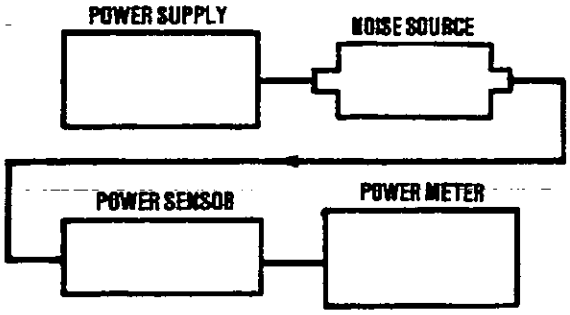

Figure 1-3. Operator's Check Test Setup 1

Operator's Check with HP 8970B Noise Figure Meter

(Check No. 2).

1. Remove any cables from the noise figure meter input. Press (PRESET). After 5 seconds, verify the noise figure display shows --FdB and left display shows 30 MHz.
2. Connect the equipment as shown in Figure 1-4.

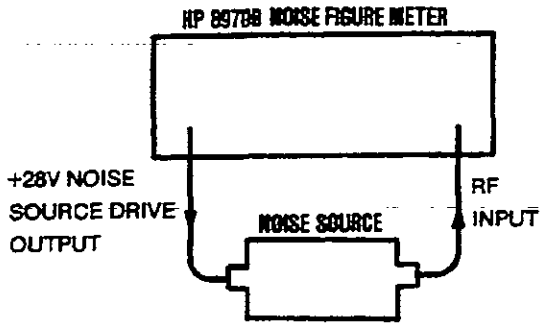

Figure 1-4. Operator's Check Test Setup 2

3. Enter a tuned frequency of 100 MHz. (See "Fixed Frequency Tuning" in the *HP 8970B Operating Manual*).
4. Enter special function 5.3 to enable the instrument for spot ENR entry. (See "Special Functions" in the *HP 8970B Operating Manual*).
5. Enter the ENR at 100 MHz from the noise source calibration label. (See "Spot ENR, T_{hot}, and T_{cold}" in the *HP 8970B Operating 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 1-6.

Table 1-6. 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.
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.

2

Manual Changes

Introduction

This section contains information for adapting this manual to HP 346A/B Noise Sources that have a serial number prefix which is 2614A and below. For Model HP 346C serial number prefix 2339A and below.

Manual Changes

To adapt this manual to your instrument, refer to Table 2-1. Make all of the manual changes listed opposite your instrument's serial number prefix. Perform these changes in the sequence listed.

Table 2-1. Manual Changes by Serial Number

Instrument	Serial Number Prefix	Make Manual Changes
346A	2336A, 2614A	D
346B	1935A, 2015A	C, B, A
	2037A	C, B
	2330A	C
	2401A	D
	2614A	D
346C	2339A	D

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.

Change A

Table 1-2. Supplemental Characteristics.

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

Change B

Table 1-1. 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 1-1. Typical Calibration Label.

Replace Figure 1-1 with Figure 2-1.

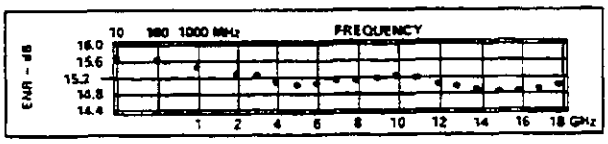

Figure 2-1. Typical Calibration Label

Page 2, 2nd Paragraph under Description.

Change first 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 HP 346B Noise Sources manufactured before the printing of this manual have an APC-3.5 connector of a different configuration (see Figure 2-2). The 911611 torque wrench will not fit these older connectors.

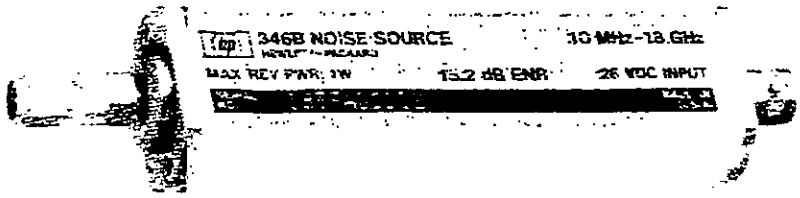

Figure 2-2.
HP 346B Noise Source with Older Configuration APC-3.5 Connector

Change D

Table 1-1. Specifications.

Change "Worst Case Uncertainty " and "Root Sum of Squares Uncertainty" table with 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	0.40	0.17
22 to 23	0.45	0.17
24	0.45	0.22
25 to 26.5	0.47	0.22

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