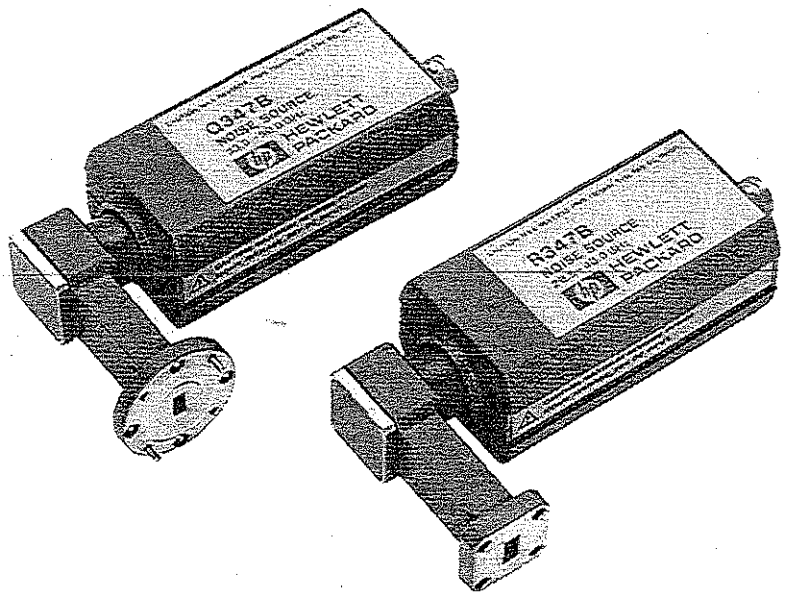


OPERATING AND SERVICE MANUAL

R347B Q347B NOISE SOURCE



Part No. 00347-90013



Agilent Technologies

HP R347B HP Q347B NOISE SOURCE

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2726A and above.

For additional important information about serial numbers, see "Instruments Covered By This Manual" under "General Information".



**HEWLETT
PACKARD**

**MANUAL PART NO. 00347-90013
Microfiche Part No. 00347-90014**

**GENERAL
INFORMATION**

This manual contains operating and service information for both the HP R347B and the HP Q347B Noise Sources. Unless otherwise specified, the information in this manual applies to both Noise Sources.

Description

The Noise Source produces noise output (power-on) when +28V 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) and the magnitude of the reflection coefficient (Rho) in the ON state has been measured at major frequencies and recorded on a label unique to each Noise Source. ENR references power-on noise power to the noise power that exists at 290 K (17°C). Sample Noise Source labels are provided in Figure 1. The numbers on the sample labels in Figure 1 may differ from the numbers on your Noise Source label because each Noise Source has been individually tested. In addition, a separate calibration sheet showing the complex reflection coefficient in both the ON and OFF states is included with each instrument.

The Noise Source is provided with a BNC female connector for +28V power input. The waveguide output flange for the HP R347B is a type UG-599/U. The waveguide output flange for the HP Q347B is a modified type UG-383/U.

Caution

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

HP R347B			HP Q347B		
GHz	ENR	RhoOn	GHz	ENR	RhoOn
26.5	12.3	0.101	33.0	11.4	0.068
27.0	12.2	0.093	34.0	11.4	0.075
28.0	12.0	0.078	35.0	11.5	0.069
29.0	11.9	0.084	36.0	11.6	0.064
30.0	11.8	0.097	37.0	11.7	0.075
31.0	11.8	0.103	38.0	11.6	0.098
32.0	11.8	0.096	39.0	11.8	0.131
33.0	11.8	0.079	40.0	11.9	0.140
34.0	11.7	0.047	41.0	11.7	0.141
35.0	11.7	0.032	42.0	11.8	0.125
36.0	11.7	0.042	43.0	11.7	0.079
37.0	11.8	0.043	44.0	11.3	0.042
38.0	11.8	0.033	45.0	10.8	0.014
39.0	11.6	0.014	46.0	10.0	0.032
40.0	11.6	0.015	47.0	10.1	0.059
Ser. No. 0000A00000			48.0	10.0	0.081
			49.0	9.8	0.082
			50.0	9.3	0.080
			Ser. No. 0000A00000		

Figure 1. Typical Calibration Labels

Microfiche Manual

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.

Instruments Covered by this Manual

The Noise Source has a two part serial number. 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. The contents of this manual apply directly to instruments having the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

Manual Changes Supplement

An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates that the instrument is different from those documented in this manual. The manual for this newer instrument is accompanied by a Manual Changes supplement. The supplement contains "change information" that explains how to adapt this manual to the newer instrument.

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep the manual as current and as accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement is identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

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

Warranty

The Noise Source is warranted and certified as indicated on the inside cover of this manual. Do not open the Noise Source. Any attempt to disassemble the Noise Source will void warranty.

Specifications

Instrument specifications are listed in Table 1. These specifications are the performance standards or limits against which the instruments may be tested.

Table 1. Specifications

Characteristics and Conditions	Limits	Comments
Frequency Range: HP R347B HP Q347B	26.5 GHz to 40 GHz 33.0 GHz to 50 GHz	
Operating Temperature Range Variation	0 to 55 °C < 0.009 dB/°C	
Connectors: Input Bias Output Noise: HP R347B HP Q347B	BNC Female UG-599/U Flange UG-383/U Flange (Modified)	Mates to standard UG-383/U
Power Requirements: Noise ON Noise OFF Maximum Reverse Power	28.0V ± 1V; 6.0 mA 0V 100 mW	
Net Weight: HP R347B HP Q347B	0.21 kg (0.46 lb) 0.23 kg (0.51 lb)	
Dimensions: HP R347B HP Q347B	52x108x60 mm (2.1x4.3x2.4 in) 53x108x62 mm (2.1x4.3x2.5 in)	
Maximum Reflection Coefficient (Rho) and Standing Wave Ratio (SWR): HP R347B 0-55 °C: Source ON Source OFF HP Q347B 0-55 °C Source ON Source OFF	Rho (SWR) 0.13 (1.31) 0.17 (1.42) 0.19 (1.46) 0.22 (1.57)	See Noise Source calibration label for RhoOn at cardinal frequencies
ENR (Excess Noise Ratio): HP R347B: 26.5-40 GHz HP Q347B: 33 GHz to 42 GHz 42 GHz to 50 GHz	 10 dB to 13 dB 10 dB to 13 dB 6 dB to 12.5 dB	See Noise Source calibration label for ENR at cardinal frequencies.

Table 1. Specifications (Cont.)

Characteristics and Conditions	Limits	Comments
ENR Uncertainties:	Worst Case (Root Sum of Sq)	See Table 2 for typical ENR uncertainties at cardinal frequencies.
HP R347B 26.5-40 GHz, 0-55 °C	±0.7 dB (±0.4 dB)	
HP Q347B 33-42 GHz, 0-55 °C	±0.7 dB (±0.4 dB)	
42-50 GHz, 0-55 °C	±0.8 dB (±0.5 dB)	

Supplemental Characteristics

The data listed in Table 2 are not specifications; that is they are not covered by the certification and warranty at the beginning of this manual. They are typical or nominal characteristics included as additional information for the user.

Note

Temperature ranges in Table 2 assume the following environments:

23 ±2 °C indicates typical room temperature operation, vibrationless, at less than 60% humidity.

0-55 °C indicates full temperature range operation with random vibration at less than 95% humidity.

Table 2. Supplemental Characteristics

Measurement	Typical Results	
Maximum Reflection Coefficient (Rho) and Standing Wave Ratio (SWR) HP R347B 23±2 °C: (26.5-40 GHz) Source ON Source OFF HP Q347B 23±2 °C (33-42 GHz) Source ON Source OFF (42-50 GHz) Source ON Source OFF	Rho	(SWR)
	0.125	(1.29)
	0.165	(1.40)
	0.177	(1.43)
	0.210	(1.53)
	0.130	(1.30)
	0.170	(1.41)
ENR Uncertainties HP R347B, 23 ±2 °C 26.5 GHz 27 GHz 28 GHz 29 GHz 30 GHz 31 GHz 32 GHz 33 GHz 34 GHz 35 GHz 36 GHz 37 GHz 38 GHz 39 GHz 40 GHz	Worst Case (Root Sum of Squares)	
	0.31 dB	(0.17 dB)
	0.25 dB	(0.12 dB)
	0.27 dB	(0.14 dB)
	0.32 dB	(0.18 dB)
	0.25 dB	(0.13 dB)
	0.29 dB	(0.16 dB)
	0.26 dB	(0.14 dB)
	0.26 dB	(0.15 dB)
	0.26 dB	(0.13 dB)
	0.26 dB	(0.14 dB)
	0.27 dB	(0.14 dB)
	0.25 dB	(0.13 dB)
	0.30 dB	(0.15 dB)
	0.27 dB	(0.14 dB)
	0.25 dB	(0.12 dB)

Table 2. Supplemental Characteristics (Cont.)

Measurement	Typical Results	
ENR Uncertainties	Worst Case (Root Sum of Squares)	
HP R347B, 0-55 °C		
26.5 GHz	0.70 dB	(0.39 dB)
27 GHz	0.56 dB	(0.31 dB)
28 GHz	0.61 dB	(0.35 dB)
29 GHz	0.58 dB	(0.34 dB)
30 GHz	0.51 dB	(0.31 dB)
31 GHz	0.63 dB	(0.37 dB)
32 GHz	0.5 dB	(0.30 dB)
33 GHz	0.62 dB	(0.37 dB)
34 GHz	0.69 dB	(0.38 dB)
35 GHz	0.62 dB	(0.35 dB)
36 GHz	0.63 dB	(0.36 dB)
37 GHz	0.54 dB	(0.31 dB)
38 GHz	0.53 dB	(0.32 dB)
39 GHz	0.58 dB	(0.32 dB)
40 GHz	0.55 dB	(0.30 dB)
HP Q347B, 23 ±2 °C		
33 GHz	0.31 dB	(0.16 dB)
34 GHz	0.34 dB	(0.17 dB)
35 GHz	0.35 dB	(0.18 dB)
36 GHz	0.33 dB	(0.19 dB)
37 GHz	0.30 dB	(0.15 dB)
38 GHz	0.35 dB	(0.18 dB)
39 GHz	0.34 dB	(0.17 dB)
40 GHz	0.33 dB	(0.17 dB)
41 GHz	0.55 dB	(0.35 dB)
42 GHz	0.50 dB	(0.33 dB)
43 GHz	0.45 dB	(0.30 dB)
44 GHz	0.47 dB	(0.31 dB)
45 GHz	0.53 dB	(0.32 dB)
46 GHz	0.49 dB	(0.33 dB)
47 GHz	0.49 dB	(0.31 dB)
48 GHz	0.52 dB	(0.34 dB)
49 GHz	0.58 dB	(0.36 dB)
50 GHz	0.53 dB	(0.35 dB)

Table 2. Supplemental Characteristics (Cont.)

Measurement	Typical Results	
ENR Uncertainties	Worst Case (Root Sum of Squares)	
HP Q347B, 0-55 °C		
33 GHz	0.62 dB	(0.34 dB)
34 GHz	0.48 dB	(0.27 dB)
35 GHz	0.52 dB	(0.29 dB)
36 GHz	0.50 dB	(0.30 dB)
37 GHz	0.41 dB	(0.21 dB)
38 GHz	0.46 dB	(0.25 dB)
39 GHz	0.44 dB	(0.22 dB)
40 GHz	0.48 dB	(0.27 dB)
41 GHz	0.66 dB	(0.41 dB)
42 GHz	0.62 dB	(0.40 dB)
43 GHz	0.63 dB	(0.42 dB)
44 GHz	0.60 dB	(0.39 dB)
45 GHz	0.71 dB	(0.45 dB)
46 GHz	0.65 dB	(0.43 dB)
47 GHz	0.67 dB	(0.42 dB)
48 GHz	0.72 dB	(0.48 dB)
49 GHz	0.75 dB	(0.46 dB)
50 GHz	0.71 dB	(0.45 dB)

Recommended Test Equipment

Table 3 lists the test equipment recommended for use in testing the Noise Source.

The Critical Specification column describes the essential requirements for each piece of test equipment. Other equipment can be substituted if it meets or exceeds these critical specifications. The Recommended Model column may suggest more than one model. The first model shown is usually the least expensive, single-purpose model. Alternate models are suggested for additional features that would make them a better choice in some applications.

Table 3. Recommended Test Equipment

Instrument Type	Critical Specifications	Suggested Model	Use
Detector	Output polarity: negative Frequency: 26.5 to 40 GHz Frequency: 33 to 50 GHz	HP R422A HP Q422A	Operator's Check
Directional Coupler	20 dB Frequency: 26.5 to 40 GHz Frequency: 33 to 50 GHz	HP R752D HP Q752D	Operator's Check
Isolator (two required)	Frequency: 26.5 to 40 GHz Frequency: 33 to 50 GHz Isolation: > 25 dB Insertion loss: < 1.6 dB VSWR: < 1.4	HP R365A HP Q365A	Operator's Check
LO Amplifier	Frequency: 10 to 20 GHz Output Power: 16 dBm Harmonics: < -20 dBc	HP 8349B	Operator's Check
LO Multiplier	Frequency: 26.5 to 40 GHz Frequency: 33 to 50 GHz Output Power: > 3 dBm Harmonics: < -20 dBc	HP 83554A HP 83555A	Operator's Check
Mixer-Preamplifier	DSB NF: < 7 dB Gain: 25 dB (nominal) Input LO power required: +1 dBm minimum AM noise rejection > 15 dB	Honeywell A5100U for R band, or B6900U for Q band	Operator's Check
Noise Figure Meter	NF: < 7.4 dB @ 100 MHz Switched +28 \pm 1V Output	HP 8970B	Operator's Check
Signal Generator	Frequency: 10 to 20 GHz Output Power: > +4 dBm Harmonics and Subharmonics: < -25 dBc	HP 8673B	Operator's Check

INSTALLATION

Caution

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

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, and 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 Source by model number and serial number.

Mating Connectors

The HP R347B Noise Source can connect to other instrumentation compatible with waveguide flange type UG-599/U. The HP Q347B Noise Source can connect to other instrumentation compatible with waveguide flange type UG-383/U. Both Noise Sources will accept input via a BNC male connector complying with U.S. Military Standard MIL-C-39012.

OPERATION

This section provides a simple Operator's Check and an Operating Procedure to be used with noise figure meters. For more detailed operating instructions, refer to the operating manual for the noise figure meter used.

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 3 depicts a simple test setup for a noise figure measurement. Figure 2 is a similar setup to verify the Noise Source is operational. Note that the noise figure meter must have a $+28 \pm 1\text{V}$ switched output.

Caution

Damage may occur to the waveguide flange of the Noise Source if the following procedure is not followed:

Torque the waveguide flange screws to no more than 60 inch-ounces (0.42 N·M) maximum. Insert the screws and tighten until just finger tight. Use a calibrated torque wrench. Alternate between screws that are opposite each other, tightening by small increments until reaching the desired torque. Do not fully torque one screw before tightening the others.

Replace the plastic waveguide flange cover when not using the instrument.

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

Operator's Check

The operator's check described here should be performed if failure of the Noise Source is suspected. The check can be used to verify that the Noise Source is producing a broadband noise spectrum. It can not be used to check the unit against specifications. The purpose of this check is to verify operation with the simplest possible test setup. Table 3 shows the recommend test equipment used for this check.

Connect the equipment as shown in Figure 2 and follow this procedure:

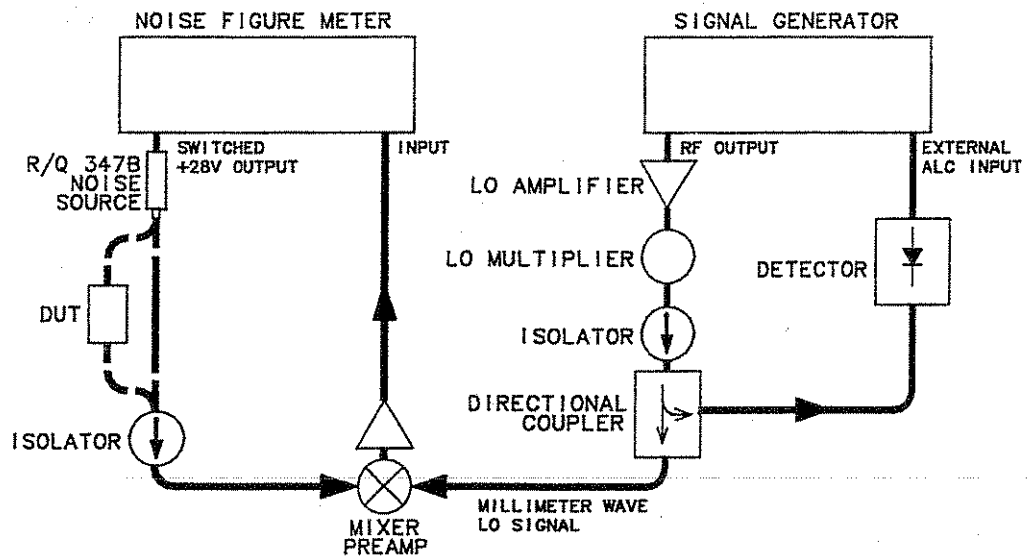


Figure 2. Noise Source Functional Test Setup

1. Remove the device under test (DUT) and connect the Noise Source directly to the isolator input.
2. Connect the switched +28V output of the noise figure meter to the input of the Noise Source.
3. Increase the noise figure smoothing factor to 16. A smoothing factor of 16 is the average derived from 16 noise figure measurements.

Note

The millimeter wave LO signal entering the mixer preamp must have a power level greater than +1 dBm.

4. Perform a Y factor measurement according to the directions for your noise figure meter. The Y factor refers to the ratio of noise power output of the system when the Noise Source is ON (equivalent to "hot") divided by the noise power output of the system when the Noise Source is OFF (equivalent to "cold"). (For more information about theory and method of noise figure measurements see HP Application Note 57-1 "Fundamentals of RF and Microwave Noise Figure Measurements" Part Number 5952-8255)
5. For the HP R347B set the signal generator frequency so the millimeter wave LO signal is 26.5 GHz. For the Q347B set the signal generator frequency so the millimeter wave LO signal is 33.0 GHz.
6. If the noise figure for your system is less than 25 dB AND the Y factor is greater than 1.025, then the noise source is functional. If the noise

figure is greater than 25 dB, send the Noise Source back to the nearest Hewlett-Packard service center.

Operating Procedure

This procedure describes a double side band noise measurement in R-band (26.5 GHz to 40.0 GHz) and Q-band (33 GHz to 50 GHz). Refer to Table 3 for the recommended instruments and critical specifications used in this procedure.

1. Connect the equipment as shown in Figure 3 with the device under test (DUT) removed. Most of this equipment is described in Table 3.

Note

Individual noise figure measurement setups differ. If you choose to use a bandpass filter, make sure the millimeter wave LO signal entering the mixer preamp has a power level greater than +1 dBm.

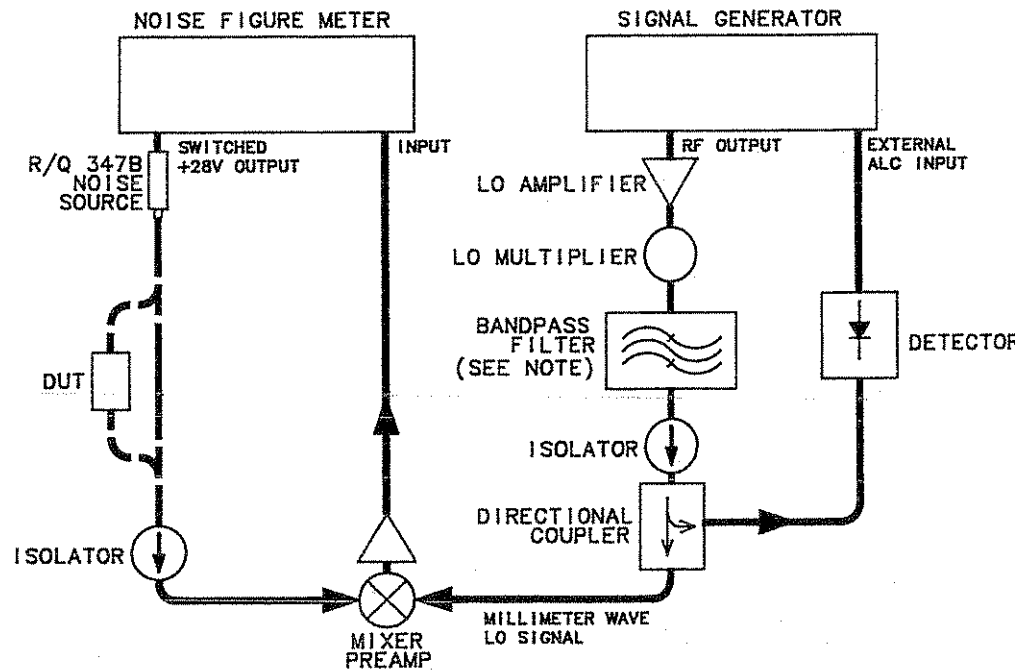


Figure 3. Noise Figure Measurement Setup

2. Connect the Noise Source directly to the isolator input.
3. Enter the ENR data on the Noise Source label into the noise figure meter.

4. Calibrate the system according to the instructions for the noise figure meter.
5. Connect the DUT and perform noise figure and gain measurements.

PERFORMANCE TESTS

Due to the complex test equipment involved, there are no recommended performance tests for the user to perform. Return the Noise Source 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.

Note

The Operator's Check procedure in this manual gives a simple verification that the Noise Source is simply functioning. Remember, the Operator's Check should never be considered a test of specifications.

REPLACEABLE PARTS

If any parts need replacement, return the complete Noise Source to Hewlett-Packard.

REPAIR AND ADJUSTMENTS

Do not attempt to repair or adjust the Noise Source. User repair or adjustment is not recommended because of the complex equipment required for test and calibration. If the Noise Source should fail or need calibration, return it to Hewlett-Packard. The recommended interval between calibrations is one year. If the Noise Source is dropped, calibration may be required.

Caution

Do not disassemble the Noise Source. The diode module is extremely static sensitive and can be easily damaged or the calibration may be altered. If the Noise Source shows evidence of attempted customer repair, the warranty may be voided.
