Keysight R347B and Q347B Noise Sources

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

This manual applies directly to instruments with serial numbers prefixed MY5823 and above, and serial numbers prefixed US and MY.

KEYSIGHT TECHNOLOGIES

Operating and Service Manual

Notices

Copyright Notice

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CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Environmental Conditions

The table below shows the general environmental requirements for this instrument.

Environmental condition	Requirement
Temperature	Operating condition – 0 °C to +55 °C
Humidity	< 95% RH

Regulatory Information

The R347B and Q347B Noise Sources comply with the following Electromagnetic Compatibility (EMC) compliances:

- IEC 61326-1/EN 61326-1
- Canada: ICES/NMB-001
- Australia/New Zealand: AS/NZS CISPR11

In order to preserve the EMC performance of the product, any cable which becomes worn or damaged must be replaced with the same type and specification.

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CE	The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.	ICES/NMB-001 ISM GRP 1-A	ICES/NMB-001 indicates that this ISM product complies with the Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada. ISM GRP.1 Class A indicates that this is an Industrial Scientific and Medical Group 1 Class A product.
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KC MSIP-REM-Kst-xxxxxxxxxxxxxx	This instrument is Class A suitable for professional use and is for use in electromagnetic environments outside of the home. A급 기기 (업무용 방송통신기자재) 이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.		This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

Product category

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is as shown below.

Do not dispose in domestic household waste.

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To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/mta
  (product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
  (worldwide contact information for repair and service)

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1 Introduction

This chapter provides an overview of the Keysight R347B and Q347B Noise Sources.

NOTE This manual contains operating and service information for both the R347B and the Q347B noise sources. Unless otherwise specified, the information in this manual applies to both noise sources.

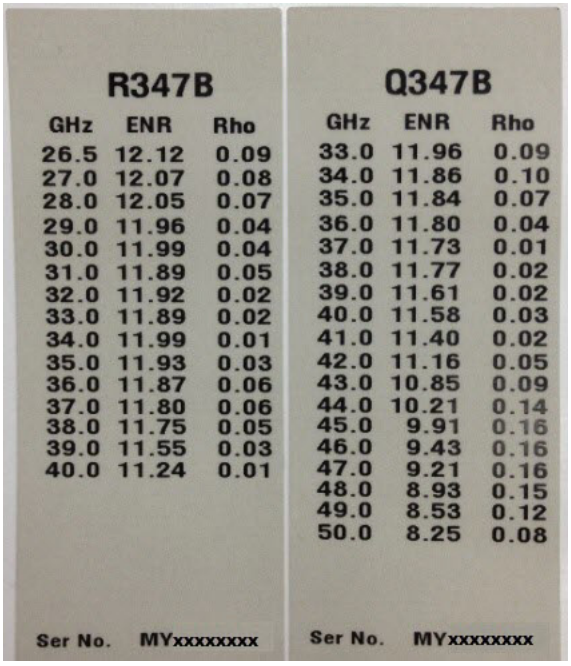
Product Overview

The Keysight R347B and Q347B noise sources produce noise output (power-on) when +28 V is applied. When they are off, there is residual noise due to thermal agitation in the noise sources (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 1-1. The numbers on the sample labels in Figure 1-1 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 +28 V power input. The waveguide output flange for the R347B is a type UG-599/U. The waveguide output flange for the 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.**



R347B

GHz	ENR	Rho
26.5	12.12	0.09
27.0	12.07	0.08
28.0	12.05	0.07
29.0	11.96	0.04
30.0	11.99	0.04
31.0	11.89	0.05
32.0	11.92	0.02
33.0	11.89	0.02
34.0	11.99	0.01
35.0	11.93	0.03
36.0	11.87	0.06
37.0	11.80	0.06
38.0	11.75	0.05
39.0	11.55	0.03
40.0	11.24	0.01

Ser No. MYxxxxxxxx

Q347B

GHz	ENR	Rho
33.0	11.96	0.09
34.0	11.86	0.10
35.0	11.84	0.07
36.0	11.80	0.04
37.0	11.73	0.01
38.0	11.77	0.02
39.0	11.61	0.02
40.0	11.58	0.03
41.0	11.40	0.02
42.0	11.16	0.05
43.0	10.85	0.09
44.0	10.21	0.14
45.0	9.91	0.16
46.0	9.43	0.16
47.0	9.21	0.16
48.0	8.93	0.15
49.0	8.53	0.12
50.0	8.25	0.08

Ser No. MYxxxxxxxx

Figure 1-1 Typical calibration labels

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2 Installation

This chapter provides you important information on how to check and prepare your instrument for operation.

CAUTION Do not drop the noise sources. Dropping can damage the unit or alter the calibration.

Initial Inspection

1. Unpack and inspect the shipping container and its contents throughly to ensure that nothing was damaged during shipment. If the shipping container or cushioning material is damaged, the contents should be checked both mechanically and electrically.
   - Check for mechanical damage such as scratches or dents.
   - Procedures for checking electrical performance are given under "Operator's check" on page 28.
2. If the contents are damaged or defective, contact your nearest Keysight Technologies Service and Support Office. Refer to "Sales and Technical Support" on page 5 of this manual. Keysight Technologies will arrange for repair or replacement of the damaged or defective equipment. Keep the shipping materials for the carrier's inspection.
3. If you are returning the instrument under warranty or for service, repackaging the instrument requires original shipping containers and material or their equivalents. Keysight Technologies can provide packaging materials identical to the original materials. Refer to "Sales and Technical Support" on page 5 of this manual for the Keysight Technologies nearest to you. Attach a tag indicating the type of service required, return address, model number, and serial number. Mark the container ***FRAGILE*** to insure careful handling. In any correspondence, refer to the instrument by model number and serial number.

Mating Connectors

The R347B noise source can connect to other instrumentation compatible with waveguide flange type UG-599/U. The 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.

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3 Specifications

This chapter provides the specifications of the R347B and Q347B noise sources.

General Specifications

Specifications

The specifications in Table 3-1 are performance standards or limits against which the noise sources may be tested.

Table 3-1 R347B and Q347B specifications

Specifications	R347B	Q347B
Frequency range	26.5 GHz to 40 GHz	33.0 GHz to 50 GHz
Operating temperature		
– Range	0 to 55 °C	0 to 55 °C
– Variation	< 0.009 dB/°C	< 0.009 dB/°C
Connectors		
– Input bias	BNC female	BNC female
– Output noise	UG-599/U flange	UG-383/U flange (modified)[a]
Power requirements		
– Noise ON	28.0 V ± 1 V; 6.0 mA	28.0 V ± 1 V; 6.0 mA
– Noise OFF	0 V	0 V
– Maximum reverse power	100 mW	100 mW
Maximum reflection coefficient (Rho) and standing wave ratio (SWR)[b]	Rho (SWR)	Rho (SWR)
– Source ON (0 to 55 °C)	0.13 (1.31)	0.19 (1.46)
– Source OFF (0 to 55 °C)	0.17 (1.42)	0.22 (1.57)
Excess noise ratio (ENR)[c]		
– 26.5 to 40 GHz	14 dB to 17 dB	–
– 33 to 42 GHz	–	14 dB to 17 dB
– 42 to 50 GHz	–	9 dB to 16 dB
ENR uncertainties[d]	Worst case (root sum of squares)	Worst case (root sum of squares)
– 26.5 to 40 GHz, 0 to 55 °C	±0.7 dB (±0.4 dB)	–
– 33 to 42 GHz, 0 to 55 °C	–	±0.7 dB (±0.4 dB)
– 42 to 50 GHz, 0 to 55 °C	–	±0.8 dB (±0.5 dB)

[a] Mates to standard UG-383/U

[b] See Noise Source calibration label for RhoOn at cardinal frequencies

[c] See Noise Source calibration label for ENR at cardinal frequencies

[d] See Table 3-2 for typical ENR uncertainties at cardinal frequencies

Supplemental characteristics

The data listed in Table 3-2 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.

NOTE

Temperature ranges in Table 3-2 assume the following environments:

- *23 ± 2 °C* indicates typical room temperature operation, vibrationless, at less than 60% humidity.
- *0 to 55 °C* indicates full temperature range operation with random vibration at less than 95% humidity.

Table 3-2 R347B and Q347B supplemental characteristics

Characteristics	R347B	Q347B
Maximum reflection coefficient (Rho) and standing wave ratio (SWR), 23 ± 2 °C	Rho (SWR)	Rho (SWR)
– Source ON (26.5 to 40 GHz)	0.125 (1.29)	–
– Source OFF (26.5 to 40 GHz)	0.165 (1.40)	–
– Source ON (33 to 42 GHz)	–	0.177 (1.43)
– Source OFF (33 to 42 GHz)	–	0.210 (1.53)
– Source ON (42 to 50 GHz)	–	0.130 (1.30)
– Source OFF (42 to 50 GHz)	–	0.170 (1.41)

Table 3-2 R347B and Q347B supplemental characteristics

Characteristics	R347B	Q347B
ENR uncertainties, 23 ± 2 °C	Worst case (root sum of squares)	Worst case (root sum of squares)
– 26.5 GHz	0.31 dB (0.17 dB)	–
– 27 GHz	0.25 dB (0.12 dB)	–
– 28 GHz	0.27 dB (0.14 dB)	–
– 29 GHz	0.32 dB (0.18 dB)	–
– 30 GHz	0.25 dB (0.13 dB)	–
		–
– 31 GHz	0.29 dB (0.16 dB)	–
– 32 GHz	0.26 dB (0.14 dB)	–
– 33 GHz	0.26 dB (0.15 dB)	0.31 dB (0.16 dB)
– 34 GHz	0.26 dB (0.13 dB)	0.34 dB (0.17 dB)
– 35 GHz	0.26 dB (0.14 dB)	0.35 dB (0.18 dB)
– 36 GHz	0.27 dB (0.14 dB)	0.33 dB (0.19 dB)
– 37 GHz	0.25 dB (0.13 dB)	0.30 dB (0.15 dB)
– 38 GHz	0.30 dB (0.15 dB)	0.35 dB (0.18 dB)
– 39 GHz	0.27 dB (0.14 dB)	0.34 dB (0.17 dB)
– 40 GHz	0.25 dB (0.12 dB)	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 3-2 R347B and Q347B supplemental characteristics

Characteristics	R347B	Q347B
ENR uncertainties, 0 to 55 °C	Worst case (root sum of squares)	Worst case (root sum of squares)
– 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)	0.62 dB (0.34 dB)
– 34 GHz	0.69 dB (0.38 dB)	0.48 dB (0.27 dB)
– 35 GHz	0.62 dB (0.35 dB)	0.52 dB (0.29 dB)
– 36 GHz	0.63 dB (0.36 dB)	0.50 dB (0.30 dB)
– 37 GHz	0.54 dB (0.31 dB)	0.41 dB (0.21 dB)
– 38 GHz	0.53 dB (0.32 dB)	0.46 dB (0.25 dB)
– 39 GHz	0.58 dB (0.32 dB)	0.44 dB (0.22 dB)
– 40 GHz	0.55 dB (0.30 dB)	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)

Physical specifications

Table 3-3 Physical specifications

Specifications	R347B	Q347B
Net weight	0.21 kg (0.46 lb)	0.23 kg (0.51 lb)
Dimensions	52 x 108 x 60 mm (2.1 x 4.3 x 2.4 in)	53 x 108 x 62 mm (2.1 x 4.3 x 2.5 in)

4 Operating Guide

This chapter provides simple quick-check instructions to verify the noise sources' functionality prior to usage. It also provides information on service and maintenance of the noise sources.

Operating Instructions

This section provides a simple operator's check procedure.

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.

Operator's check

The operator's check in this section 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 cannot be used to check the unit against specifications.

Equipment required

- PNA-X Series network analyzer with noise figure measurement capability (N5245A 50 GHz model option H29 or equivalent)
- N1914A or equivalent power meter
- N8487A power sensor
- 50 GHz Ecal module
- 2.4 mm-to-2.4 mm RF cable
- 2.4 mm-to-waveguide adapter

1 Connect the PNA-X Series network analyzer and the power meter as shown in Figure 4-1.

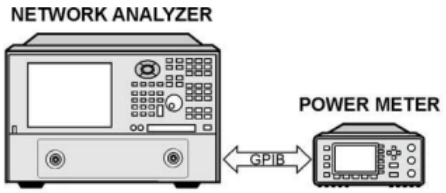


Figure 4-1 Operator's check setup

2 On the network analyzer, go to **More Meas Noise** and select **ENR**. Run the **Calibration Wizard**. Select **Power Meter** for **Receiver Characterization**.

3 Calibrate the system by following the instructions given by the network analyzer.

4 Connect the noise source (DUT) to Port 2 of the network analyzer for ENR measurement. The measurement setup is as shown in Figure 4-2.

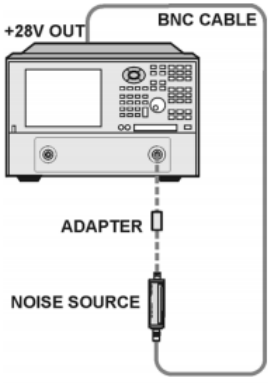


Figure 4-2 ENR measurement test setup

5 Monitor the measured ENR value. Below is a typical example of the ENR value of an R347B noise source on network analyzer screens.

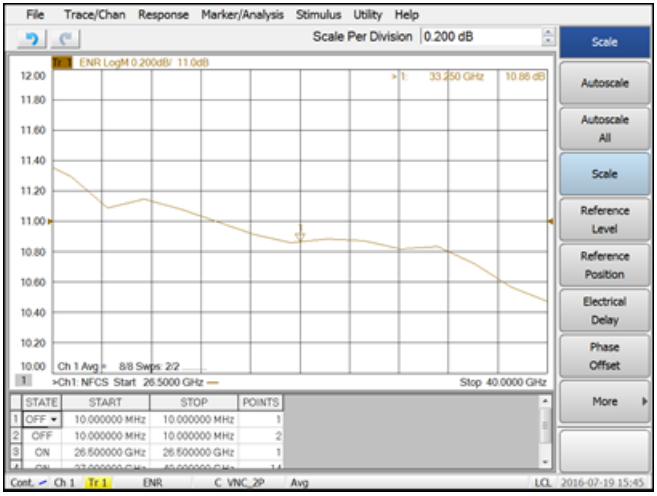


Figure 4-3 A typical example of the ENR value for R347B

Performance Tests

Due to the complex test equipment involved, there are no recommended performance tests to perform. Return the noise source to Keysight Technologies 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. The operator's check should never be considered a test of specifications.**

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 Keysight Technologies. 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.**

Replaceable Parts

If any parts need replacement, return the complete noise source to Keysight Technologies.

Returning a Noise Source for Calibration

When returning the 346/347 noise source to Keysight Technologies for repair or calibration, please specify whether an ENR Data Diskette or CD is needed.

Instruments with serial prefixes MY5823 will only be provided with ENR DATA CD if requested.

When the 346/347 noise source is used with a Keysight Noise Figure Analyzer NFA, the ENR Data Diskette is used to automatically load the ENR values into memory.

When the 346/347 noise source is used with an 8970/X Noise Figure Meter, you must enter the ENR values manually, and the ENR Data Diskette is not necessary.

5 Using the ENR Data Diskette or CD

This chapter provides the information on using the ENR data for the Keysight NFA Series Noise Figure Analyzers.

Introduction

The Keysight 346 and 347 series of noise sources are supplied with the noise source ENR data preloaded on a diskette or CD to allow easy downloading into the Keysight NFA series noise figure analyzers. This eliminates time consuming and error prone manual keying of the ENR values.

Additionally you can easily open the ENR files using a standard text editor, and the files are easy to interpret and create.

This chapter covers the following:

- Loading ENR data from diskette
- Retrieving ENR data from CD
- Saving the ENR data to the noise figure analyzer's internal memory
- Copying the ENR data from the diskette to the noise figure analyzer's internal memory

NOTE

The following procedures do not apply to noise sources used with the Keysight 8970A/B Noise Figure Meter.

You must enter ENR values manually into the 8970A/B.

Loading ENR Data from Diskette

To load the ENR data from the diskette and use the data as the current ENR table, proceed as follows:

1. Power up the noise figure analyzer and wait for the power-up sequence to complete.
2. Insert the diskette into the floppy drive of the noise figure analyzer.

NOTE The following procedures do not apply to noise sources with serial prefixes MY5823.

Do not insert the diskette into the noise figure analyzer until the power-up sequence is complete.

3. On the noise figure analyzer, press the **File** key and press the **Load** menu key to access the file system.
4. Press the **ENR** menu key and select whether the ENR table is a **Meas Table** (used for measurements) or a **Cal Table** (used for calibration). If you intend to use the same ENR table for calibration and measurement, then set the ENR table as **Meas Table**.

   The noise figure analyzer allows you to use the same or separate ENR tables for calibration and measurement as required. For more details on specifying **Meas Table** and **Cal Table**, see the *Noise Figure Analyzer User's Guide*.
5. Press the **Select** menu key and use the arrow keys if necessary to highlight **[-A-]**. If `C:` is the currently selected drive use the **".."** directory to reach the `A:` drive as directed on the screen. Press the **Select** menu key again to read the diskette.
6. Use the down arrow key (↓) to highlight the ENR file and press the **Enter** key to load it.

   When the file is successfully loaded, a message for example, `A:A0100364.ENR file loaded` appears on the display.

NOTE ENR files with a large number of frequency points (for example, up to 50 GHz) may take a few seconds to load.

Retrieving ENR Data from CD

Noise Source with serial prefixes MY5823 and above are supplied with the noise source ENR data preloaded on a CD.

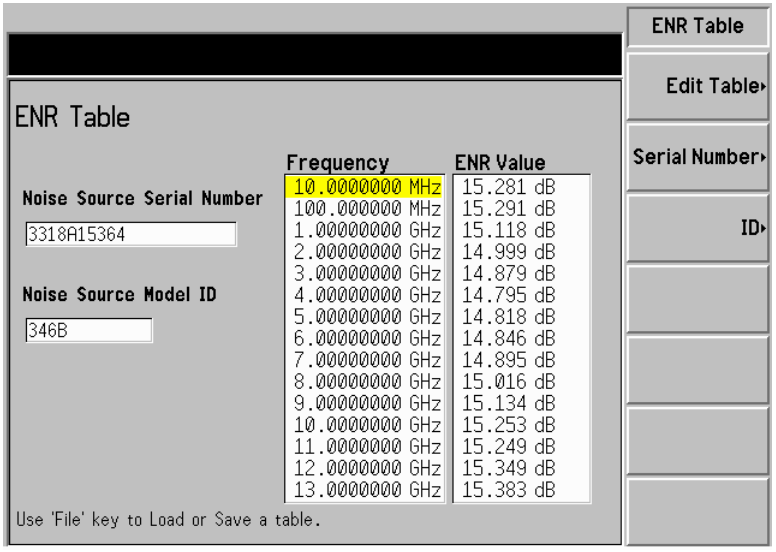
The ENR files can be retrieved using computer CD-ROM drive and edited using a standard text editor.

ENR filename format

The ENR filename of the ENR file stored on the diskette or CD, for example `A0100123.enr`, has the following format:

- The first letter shows the noise source type and can be:
  - A = 346A
  - B = 346B
  - C = 346C
  - R = R347A
  - Q = Q347A
- The next four digits, for example `0100`, show the calibration date. For example, `0100` shows a calibration date of January 2000.
- The last three digits, for example `123`, are the last three digits of the serial number of the noise source.
- The file extension is `.enr` to indicate ENR file format.

Once the ENR file is loaded, to verify that the ENR data is correct, press the **ENR** key, then press the **ENR Table›** menu item to display the ENR table.



Confirm that the noise source Serial Number and the noise source Model ID are correct, and compare the Frequency and ENR values with the supplied Calibration Sheet or the data printed on the body of the noise source.

Saving the ENR Data to the Noise Figure Analyzer's Internal Memory

To save the current noise source ENR data from the diskette (`A:` drive) to the noise figure analyzer's internal memory (`C:` drive), proceed as follows:

1. Load the ENR table as described in "Loading ENR Data from Diskette" on page 35.
2. Press the **File** key and press the **Save** menu key.
3. The **ENR** menu key indicates whether the file is currently loaded as a measurement table (**Meas Table**) or a calibration table (**Cal Table**). Press the **ENR** menu key and select whether you want to store the ENR table as a **Meas Table** or a **Cal Table**. If you intend to use the same common ENR table for calibration and measurement, then set the ENR table as **Meas Table**.

The noise figure analyzer allows you to use the same or separate ENR tables for calibration and measurement as required. For more details on using ENR tables, see the *Noise Figure Analyzer User's Guide*.

When the ENR table is selected, the **Alpha Editor** is now presented to you, allowing you to specify a name for the file. If required you can use the numeric keypad to enter numbers in the filename. Note that you can also use the default filename which is in the format of `TSTxxxx` where `x` is a sequentially allocated number. For details of the filename format used for the ENR data supplied on the diskette, see "ENR filename format" on page 36.

4 Input the name of the ENR table using the **Alpha Editor** and numeric keypad. Use the **Tab** key to move to the **`"..":`** field.

5 If the `To: Path:` field is currently `A:`, press the **Select** menu key and use the arrow key to highlight **[-C-]**, then press the **Select** menu key again. With the `To: Path:` field set to `C:`, press **Enter** to save the file with the specified filename.

When the file is successfully saved, a message for example `C:A0100364.ENR file saved`, appears on the status line of the display.

Copying the ENR Data to the Noise Figure Analyzer's Internal Memory

To copy the noise source ENR data from the diskette (`A:` drive) to the noise figure analyzer's internal memory (`C:` drive), proceed as follows:

1. Power up the noise figure analyzer and wait for the power-up sequence to complete.
2. Insert the diskette into the floppy drive of the noise figure analyzer.

NOTE **Do not insert the diskette into the noise figure analyzer until the power-up sequence is complete.**

3. Press the **File** key and press the **File Manager** menu key.
4. Press the **Copy›** menu key.

   The file system is now presented to you.
5. Press the **ENR** menu key to set the file type and format to ENR.
6. Set the `From: Path:` field to `A:`, use the down arrow key (↓) to highlight the ENR file and the **Select** key to select it for copying.

   The filename you are going to copy now appears in the `From: Name:` field.
7. Press the **Tab** key to navigate to the `To: Path:` field and ensure it is set to `C:`.
8. Press the **Enter** key to copy the selected file from the diskette (`A:`) to the noise figure analyzer's internal memory (`C:`).

   When the file is successfully copied, a message for example `A:A0100364.ENR file copied`, appears on the status line of the display.

   For details on the ENR filename format, see "ENR filename format" on page 36.

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6 ENR File Format

This chapter explains the format of an ENR file.

Format Details

An ENR file:

- includes all data currently supplied on the printed noise source Calibration Certificate
- can be viewed and edited using a standard text editor (for example Notepad)
- is simple to create and interpret
- is easily printable
- is easily imported into Excel

The ENR file is read line by line. Each line is terminated by either a linefeed character, or a carriage-return, linefeed pair. Each line must be less than 100 characters long, excluding the terminator.

Lines containing only whitespace (tab or space character) are ignored. Each line is interpreted as one of three types of record:

- Comment
- Header Field
- ENR Data

Comment records

A comment record must have either a '#' or '!' as the first character in the line. The entire line is ignored. Comment records can appear at any point within the file.

Header fields

General form

Header fields must have a '`[`' as the first character in the line. Each header field has the general form:

- `[FieldName OptionalValue]`
- The '`[`' must be the first character on the line.
- The fieldname and optionalvalue, if present, must be separated by whitespace.
- Whitespace following the '`]`' is ignored.

– The file must start with one or more header fields (ignoring comments and blank lines).

All header fields must appear at the beginning of the file before the ENR data records. Mixing header fields and ENR data is not permitted.

Mandatory header fields

Certain header fields must be present. These are:

Table 6-1 Mandatory header fields

FieldName	Description	OptionalValue	Description	Example
Filetype	Indicates the type of file	ENR	Only 'ENR' is allowed for ENR data files	`[Filetype ENR]`
Version	Indicates the version of the file format which applies to this file	versionnumber (formatted as major.minor)	Allows for future changes in the file format.	`[Version 1.0]`

NOTE All mandatory fields must appear in the file before any optional header fields.

Optional header fields

The following header fields are also allowed. Note that only the first two, `Serialnumber` and `Model` are currently used by the noise figure analyzer.

Table 6-2 Optional header fields

FieldName	Description	OptionalValue	Description	Example
Serialnumber	The serial number of the noise source	serialtext	A string containing the serial number	`[Serialnumber 3318A14223]`
Model	Identifies the noise source model number	modelcode	Model code string	`[Model 346B]`
Option	Identifies any model code option	optioncode	Option code string	`[Option 001]`

Table 6-2 Optional header fields

FieldName	Description	OptionalValue	Description	Example
Caldate	Date of calibration of noise source	date&time	Formatted date and optional time	`[Caldate 19991202.09:15:30]`
Calduedate	Indicates date when next calibration of noise source is due	date&time	Formatted date and optional time	`[Calduedate 20001225]`
Temperature	Calibration temperature	value	Number followed by unit. Valid units are C, F, K	`[Temperature 24C]`
Humidity	Calibration relative humidity	value	Number followed by optional '%'	`[Humidity 40%]`

The format of **`date&time`** parameters is **`YYYYMMDD[.hh:mm:ss]`**, i.e. a 4-digit year, 2-digit month, and 2-digit date, optionally followed by a '**`.`**' then 2-digit hour '**`:`**' 2-digit minutes '**`:`**' 2-digit seconds.

Unknown header fields are ignored by the noise figure analyzer. This allows for future expansion.

ENR data

ENR data records must be ordered from the lowest to the highest frequency.

General form

The noise figure analyzer attempts to interpret lines which are not comments or header fields as ENR data. ENR data has the general form:

```
Freq [Funit] ENR [Eunit] [Euncert [on_mag on_phase off_mag
off_phase [Runcert]]]
```

NOTE The square brackets denote optional fields.

Field separator

Each field is separated by whitespace. A single '**,**' is allowed within or instead of the whitespace.

Numeric fields

With the exception of the two optional unit fields, the other fields are numeric. Numbers are formatted as an optional sign, followed by a sequence of one or more digits (which can include a single decimal point within the sequence), followed by an optional exponent. The exponent consists of the '**e**' or '**E**' followed by an optional sign followed by between one and three digits.

Frequency fields

The frequency field (**Freq**) is the frequency at which the ENR amplitude was measured.

The frequency unit field (**Funit**) is optional. The default unit is Hz.

Valid units are Hz, kHz, MHz, GHz, THz. Units are not case sensitive.

ENR fields

The ENR amplitude (**ENR**) is the measured ENR at the specified frequency.

The ENR unit field (`Eunit`) is optional. The default unit is dB. Currently, the only allowed unit is dB. Note that units K, C, F (temperature) are reserved for possible future use, but are not supported by the noise figure analyzer at this time.

The uncertainty field for the ENR amplitude (`Euncert`) is optional. However, this field must be present if reflection coefficient data is supplied.

Reflection coefficient data

The reflection coefficient data is optional and is formatted as four fields (`on_mag`, `on_phase`, `off_mag`, `off_phase`):

- reflection magnitude with noise source on
- reflection angle (in degrees) with noise source on
- reflection angle with noise source off
- reflection angle (degrees) with noise source off

If any reflection coefficient data is supplied, then all four fields must be present. Note that the file format requires that the ENR uncertainty field must be present before any reflection data.

The reflection coefficient uncertainty (`Runcert`) is an optional parameter. Reflection coefficient data must be present if this field is supplied.

Examples

Example 1

This first example shows a simple ENR file where the Frequency and ENR values have been entered manually into the noise figure analyzer:

```
# ENR Data File
# Created by N8973A Keysight NFA Series Noise Figure Analyzer
# Serial Number US00000012 Firmware Revision X.09.02
# 13:37:07 Mar 28, 2000
# Format is: Frequency (Hz), ENR (dB)

[Filetype ENR]
[Version 1.0]
```

26500000000,	12.568
27000000000,	12.477
28000000000,	12.378
29000000000,	12.392
30000000000,	12.277
31000000000,	12.319
32000000000,	12.294
33000000000,	12.321
34000000000,	12.365
35000000000,	12.391
36000000000,	12.374
37000000000,	12.296
38000000000,	12.175
39000000000,	12.058
40000000000,	11.941

Example 2

The second example is a typical ENR file supplied on diskette or CD with a noise source:

```
[Filetype ENR]
[Version 1.0]
[Serialnumber MY44420312]
[Model R347B]
[Caldate 20180228.10:38:49]
[Temperature 24C]
[Humidity 40%]
```

!	Frequency	ENR	Unc	Refl. Coef. On		Refl. Coef. Off	
!	MHz	dB	dB	Mag	Phase Deg	Mag	Phase Deg
	26500	12.568	0.160	0.096	131.084	0.098	-174.150
	27000	12.477	0.161	0.080	40.715	0.107	97.318
	28000	12.378	0.178	0.023	-139.741	0.100	-69.180
	29000	12.392	0.157	0.017	-79.130	0.077	114.789
	30000	12.277	0.151	0.048	87.386	0.053	-60.811
	31000	12.319	0.148	0.061	-65.628	0.039	84.049
	32000	12.294	0.151	0.054	144.879	0.067	-109.198
	33000	12.321	0.144	0.042	13.026	0.102	82.770
	34000	12.365	0.143	0.030	-74.715	0.126	-69.814
	35000	12.391	0.148	0.047	-174.112	0.124	139.887
	36000	12.374	0.152	0.070	51.842	0.104	-11.098
	37000	12.296	0.153	0.073	-84.961	0.063	-171.010
	38000	12.175	0.190	0.059	132.462	0.038	-7.290
	39000	12.058	0.149	0.040	-8.182	0.050	147.287
	40000	11.941	0.155	0.027	-98.343	0.092	-30.495

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