Agilent
N8973A, N8974A, N8975A
NFA Series Noise Figure Analyzers

Data Sheet

Agilent Technologies

Specifications

Specifications are only valid for the stated operating frequency, and apply over 0° C to +55° C unless otherwise noted. The analyzer will meet its specifications after 2 hours of storage within the operating temperature range, 60 minutes after the analyzer is turned on, with Alignment running. A user calibration is required before corrected measurements can be made.

Frequency

Frequency range[1]

N8973A	10 MHz to 3.0 GHz
N8974A	10 MHz to 6.7 GHz
N8975A	10 MHz to 26.5 GHz

Measurement bandwidth (nominal)

N8973A, N8974A, N8975A 4 MHz, 2 MHz, 1 MHz, 400 kHz, 200 kHz, 100 kHz

Frequency reference

	Standard[2]	**Opt.1D5**[3]
Aging	± < 2 ppm[4]/year	± < 0.1 ppm/year
Temperature stability	± < 6 ppm	± < 0.01 ppm
Settability	± < 0.5 ppm	± < 0.01 ppm

Tuning accuracy[5] (start, stop, center, marker)

4 MHz measurement bandwidth (default on all models of noise figure analyzer)

Frequency	Error
10 MHz – 3.0 GHz	± < reference error + 100 kHz
3.0 GHz – 26.5 GHz	± < reference error + 400 kHz

< 4 MHz- measurement bandwidth (functionality not present in N8972A)

Frequency	Error
10 MHz – 3.0 GHz	< ± reference error + 20 kHz
3.0 GHz – 26.5 GHz	< ± reference error + 20% of measurement bandwidth

1. The N8974A and N8975A models have a mechanical switch fitted. This switch allows the analyzers to change between the 10 MHz to 3.0 GHz and the 3.0 GHz to 6.7 GHz frequency range on the N8974A. On the N8975A, the switch allows the change between the 10 MHz to 3.0 GHz and the 3.0 GHz to 26.5 GHz frequency range. If the current measurement frequency range crosses the 3.0 GHz point, the switch will operate. The mechanical switch has a limited number of cycles over which it is reliable. To maximize the reliable life of the switch, switching over the 3.0 GHz frequency point should be kept to a minimum.
2. Temperature stability on the standard frequency reference is achieved 60 minutes after the analyzer is turned on.
3. Option 1D5 recommended for applications requiring high frequency stability.
4. Parts per million (10^{-6}).
5. Tuning accuracy is dependent on measurement bandwidth.

Noise figure and gain

Performance is dependent on the ENR[1] of the noise source used:

N8973A, N8974A and N8975A		Noise source ENR		
(10 MHz to 3.0 GHz)		4-7 dB	12-17 dB	20-22 dB
Noise figure	Measurement range	0 to 20 dB	0 to 30 dB	0 to 35 dB
	Instrument uncertainty	± < 0.05 dB	± < 0.05 dB	± < 0.1 dB
Gain[2]	Measurement range	-20 to +40 dB		
	Instrument uncertainty	± < 0.17 dB		

N8974A and N8975A		Noise source ENR		
(>3.0 GHz)		4-7 dB	12-17 dB	20-22 dB
Noise figure	Measurement range	0 to 20 dB	0 to 30 dB	0 to 35 dB
	Instrument uncertainty	± < 0.15 dB	± < 0.15 dB	± < 0.2 dB
Gain[2]	Measurement range	-20 to +40 dB		
	Instrument uncertainty	± < 0.17 dB		

For NFA models that either have a serial prefix less than GB4446 or are fitted with the Noise Figure RF board, N8972-60001.

Instrument's own noise figure

Frequency	Noise figure	Noise figure over a limited temperature range of 23° C ± 3° C
10 MHz to < 500 MHz	< 4.9 dB + (0.0025 * freq in MHz)	< 4.4 dB + (0.0025 * freq in MHz)
500 MHz to < 2.3 GHz	< 7.4 dB + (0.00135 * freq in MHz)	< 5.9 dB + (0.00135 * freq in MHz)
2.3 GHz to 3.0 GHz	4.9 dB + (0.0015 * freq in MHz)	< 2.9 dB + (0.0015 * freq in MHz)
> 3.0 GHz to 13.2 GHz	< 12.0 dB	< 10.5 dB
> 13.2 GHz to 26.5 GHz	< 16.0 dB	< 12.5 dB

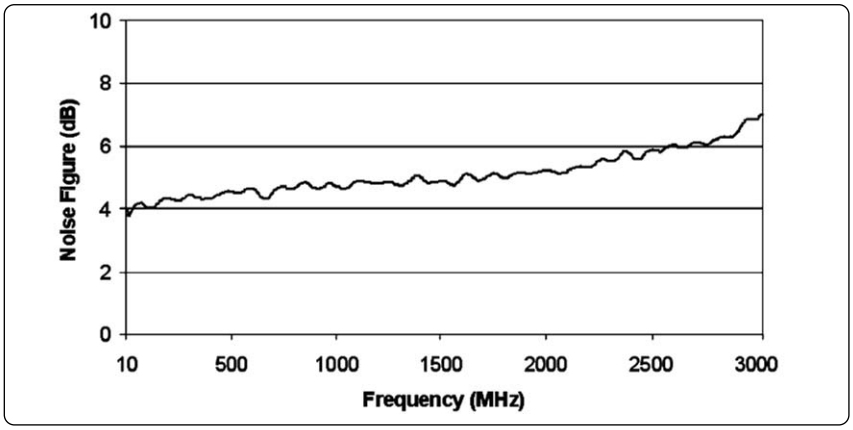
For NFA models that either have a serial prefix greater than GB4446 or are fitted with the Noise Figure RF board, N8972-60101.

Instrument's own noise figure

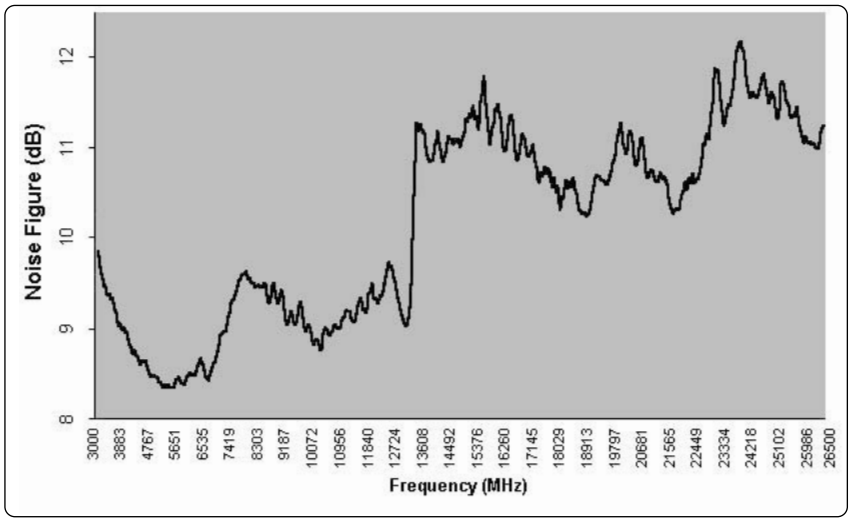
Frequency	Noise figure	Noise figure over a limited temperature range of 23° C ± 3° C
10 MHz to 3.0 GHz	< 4.8 dB + (0.00124 * freq in MHz)	< 4.4 dB + (0.00117 * freq in MHz)
> 3.0 GHz to 13.2 GHz	< 12.0 dB	< 10.5 dB
> 13.2 GHz to 26.5 GHz	< 16.0 dB	< 12.5 dB

1. Excess noise ratio
2. For measurement bandwidths below 4 MHz, and spacing between measurement points below 3 MHz, gain uncertainty may increase to a maximum of ± 0.7 dB.

Characteristic[1] noise figure at 23° C ±3° C (10 MHz to 3.0 GHz)
For NFA models that have either a serial prefix of GB4446 or greater or are fitted with Noise Figure RF board, N8972-60101.



Characteristic[1] noise figure at 23° C ±3° C (3.0 GHz to 26.5 GHz)



Maximum external gain between noise source output and RF input[2]
> 65 dB

Averaging
Up to 999 measurement results

Jitter[3]

Jitter with no averaging[4]	5 dB Y-factor standard deviation < 0.1 dB

1. Characteristic values are met or bettered by 90% of instruments with 90% confidence.
2. Subject to maximum operating input power.
3. Specified for a 4 MHz measurement bandwidth. Jitter in noise figure is equivalent to jitter in Y-factor to within 10% for ENR > 14 dB and F < 4 dB. At minimum smoothing, jitter can limit accuracy; the small jitter at high smoothing does not.
4. For true Gaussian noise, jitter reduces with increased averaging typically by a factor of 1/√(number of averages).

RF input

Connector

N8973A N female, 50 Ω nominal

N8974A, N8975A APC 3.5 (m), 50 Ω nominal (ESD sensitive)

SWR (50 Ω reference)

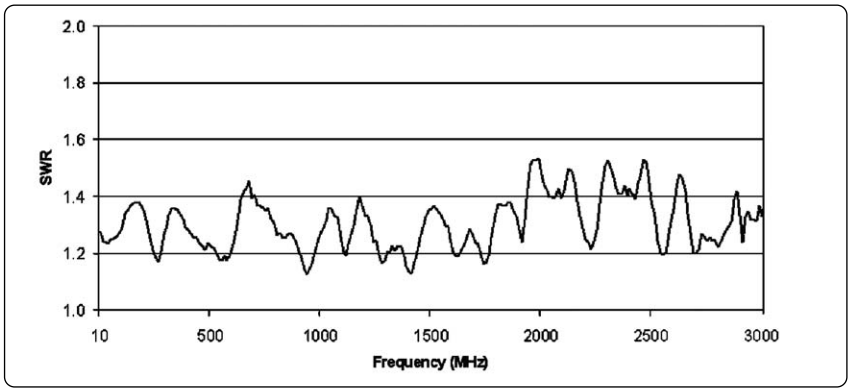
For NFA models that have either a serial prefix less than GB4446 or are fitted with Noise Figure RF board, N8972-60001.

	10 MHz to 500 MHz	500 MHz to 1000 MHz	1000 MHz to 1500 MHz	1500 MHz to 3000 MHz	3000 MHz to 6700 MHz	6700 MHz to 20000 MHz	20000 MHz to 26500 MHz
Input VSWR Test Record	≤ 1.6:1	≤ 1.8:1	≤ 1.9:1	≤ 1.8:1	≤ 1.3:1	≤ 2.1:1	≤ 2.4:1

For NFA models that have either a serial prefix of GB4446 or greater or are fitted with Noise Figure RF board, N8972-60101.

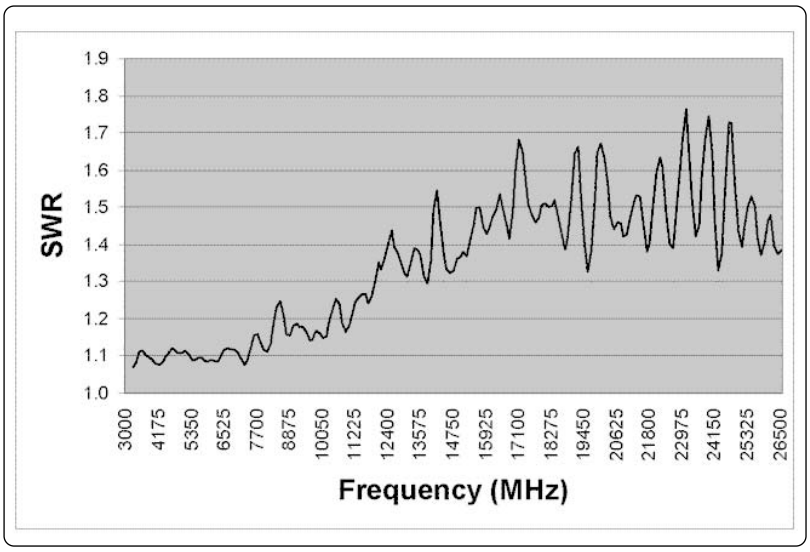
	10 MHz to 500 MHz	500 MHz to 1.5 GHz	1.5 GHz to 3 GHz	3 GHz to 6.7 GHz	6.7 GHz to 20 GHz	20 GHz to 26.5 GHz
SWR	< 1.5:1	< 1.7:1	< 1.8:1	< 1.3:1	< 2.1:1	< 2.4:1

Characteristic[1] SWR at 23° C ±3° C (10 MHz to 3.0 GHz)
For NFA models that have either a serial prefix of GB4446 or greater or are fitted with Noise Figure RF board, N8972-60101.



1. Characteristic values are met or bettered by 90% of instruments with 90% confidence.

Characteristic[1] SWR at 23° C ±3° C (3.0 Ghz to 26.5 Ghz)



Maximum operating input power[2]

-10 dBm

Maximum protected input level

±20 Vdc; +15 dBm peak (or average) at RF

1. Characteristic values are met or bettered by 90% of instruments with 90% confidence.
2. This is the total wide-band noise power. Contributing factors are: Noise source ENR, external gain, noise figure and bandwidth (including DUT).

Measurement

Sweep

Number of points	2 to 401, or fixed frequency
Setting	Start/stop, center/span, Frequency list of up to 401 points
Sweep trigger	Continuous or single

Measurement speed[1] (nominal)

	8 averages	**64 averages**
N8973A (10 MHz to 3.0 GHz)	< 50 ms/measurement	< 42 ms/measurement
	8 averages	**64 averages**
N8974A (10 MHz to 3.0 GHz)	< 50 ms/measurement	< 42 ms/measurement
N8974A (3.0 GHz to 6.7 GHz)	< 70 ms/measurement	< 50 ms/measurement
N8975A (10 MHz to 3.0 GHz)	< 50 ms/measurement	< 42 ms/measurement
N8975A (3.0 GHz to 26.5 GHz)	< 70 ms/measurement	< 50 ms/measurement

Modes

Amplifier	
Downconverter in DUT	With fixed or variable IF. Instrument capable of controlling an external LO via dedicated 'LO GPIB' connector
Upconverter in DUT	With fixed or variable IF. Instrument capable of controlling an external LO via dedicated 'LO GPIB' connector
System downconverter	Allows the use of an external downconverting mixer as part of the measurement system. Instrument capable of controlling an external LO via dedicated 'LO GPIB' connector
Loss compensation	Table of values vs. frequency for losses between noise source and DUT, and between DUT and analyzer
SNS Series noise source	ENR tables automatic upload. Continuous upload of T_{cold}

1. Corrected Noise Figure and Gain measured on a 3 dB pad with a repetitive sweep of 101 points from 600 MHz to 1.0 GHz with a 4 MHz measurement bandwidth.
2. Corrected Noise Figure and Gain measured on a 3 dB pad with a repetitive sweep of 101 points from 4.0 GHz to 6 GHz with a 4 MHz measurement bandwidth.

Display

Type	17 cm color LCD panel
Output format	Graphical, table of values, or meter mode
Display channels	2
Number of markers	4 per display channel
Limit lines	Upper and lower for each of 2 channels
Display units	
Noise figure	Noise figure (F dB), or as a ratio (F)
Gain	Gain (G dB), or as a ratio (G)
Y-factor	Y-factor (Y dB) or as a ratio (Y)
Effective noise temperature	Effective input noise temperature in Kelvin, ° C, ° F
P_{hot}	Relative power density in dB or as a ratio
P_{cold}	Relative power density in dB or as a ratio

Connectivity

GPIB	IEEE-488 bus connector
LO GPIB	IEEE-488 bus connector dedicated to local oscillator control (SCPI or custom command set)
Serial	RS-232, 9-pin D-Sub male
Printer	25-pin parallel D-Sub female, for connection with IEEE 1284 cable to a PCL3 or PCL5 compatible printer
VGA output	15-pin mini D-Sub female[1]
Probe power (nominal)	+15 Vdc, -12.6 Vdc at 150 mA max.
10 MHz Ref out	50 Ω nominal BNC (f), > 0 dBm
10 MHz Ref in	50 Ω nominal BNC (f), -15 to +10 dBm
BNC noise source drive output	
Connector type	50 Ω-type BNC (f)
Output voltage	On: 28.0 V ±0.1 V at up to 60mA peak Off: < 1 V
SNS noise source connector	For use with Agilent Technologies' SNS Series noise sources

1. 31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced, analog RGB 640 x 480.

General specifications

Data storage (nominal)	
Internal drive	30 traces, states or ENR tables
Floppy disk	30 traces, states or ENR tables
Power requirements	
On (line 1)	90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz Power consumption< 300 W
Standby (line 0)	< 5 W
Dimensions	
Without handle	222mm(H) x 410mm(D) x 375mm(W)
With handle (max)	222mm(H) x 515mm(D) x 409mm(W)
Weight (typical, without options)	
N8973A	15.5 kg (34.2 lbs.)
N8974A	17.5 kg (38.61 lbs.)
N8975A	17.5 kg (38.61 lbs.)

Audible noise

< 42 dBa pressure and < 5.0 bels power (ISODP7779)

Temperature range	
Operating	0° C to +55° C
Storage	-40° C to +70° C
Humidity range	
Operating	Up to 95% relative humidity to 40° C (non-condensing)
Altitude range	
Operating	to 4,600 meters

Calibration interval

1-year minimum recommended

Electromagnetic Compatibility

This product conforms with the protection requirements of European Council Directive 89/336/EEC for Electromagnetic Compatibility (EMC).

The conformity assessment requirements have been met using the technical construction file route to compliance, using EMC test specifications EN 55011:1991 (Group 1, Class A) and EN 50082-1:1992.

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.

Radio-Frequency Electromagnetic Field Immunity

When a 3 Vm-1 radio-frequency electromagnetic field is applied to the noise figure analyzer according to IEC 61000-4-3:1995, degradation of performance may be observed. When the frequency of the incident filed matches the frequency of a measured noise figure or gain, the values displayed will deviate from those expected. This phenomenon will only affect that specific frequency, and the analyzer will continue to perform to specification at all other frequency sample points.

The noise figure analyzer may be unable to calibrate a chosen frequency sample point, if the frequency matches that of an incident electromagnetic field.[1]

1. Radiated immunity testing. When tested at 3 V/m, according to IEC 801-3/1984, the displayed average noise level will be within specifications over the full immunity test frequency range of 27 MHz to 500 MHz except at the immunity test frequencies of 223.5714 MHz +/- selected resolution bandwidth, and 437.1429 MHz +/- selected resolution bandwidth, where the displayed average noise level can be up to -45 dBm. When the noise figure analyzer tuned frequency is identical to these immunity test frequencies, the measurements could be corrupted and there may be signals of up to -70 dBm displayed on the screen.

For further information

Key literature:
Please visit the Agilent noise figure analysis web site for on-line access to literature or contact your local Agilent sales office or representative.

Noise Figure Analyzers - NFA Series - Brochure,
literature number 5980-0166E

Noise Figure Analyzers - NFA Series - Configuration Guide,
literature number 5980-0163E

Fundamentals of RF and Microwave Noise Figure Measurements, Application Note 57-1, literature number 5952-8255E

Noise Figure Measurement Accuracy, Application Note 57-2,
literature number 5952-3706E

10 Hints for Making Successful Noise Figure Measurements; Application Note 57-3, literature number 5980-0288E

Key web resources:
For the latest information on our noise figure solutions, see our web page at:

www.agilent.com/find/nf

For the latest news on the component test industry, see our web page at:

www.agilent.com/find/component_test

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	*0.14 /minute
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