

# MAXWELLON 3986

10 MHz ~ 50 GHz  
Noise Figure Analyzers  
2023

3986 Series Noise Figure Analyzers include 3986A (10 MHz to 4 GHz), 3986D (10 MHz to 18 GHz), 3986E (10 MHz to 26.5 GHz), 3986F (10 MHz to 40 GHz) and 3986H (10 MHz to 50 GHz). Features of the product include wide-range frequency coverage, high-sensitivity reception, friendly user interface, big screen dual channel HD display, various external interfaces, and dual noise source drive etc. It can measure the noise figure and gain of amplifiers, up converters and down converters, as well as to support automatic measurement of noise figure of multi-stage converters. Guide interfaces are intuitive for setting measurement modes. The comprehensive loss compensation function can compensate loss induced in measurement channel before and/or after the device under test by means of fixed or table forms. The built-in noise figure measurement uncertainty calculator does quantitative analysis of the uncertainty of measurement noise figure. Limit line function that provides test passed/failed notification simplifies the determination of passed/failed test. User friendly features make it easy for engineering technicians to set measurements correctly, to observe and save measurement results in different forms. They can be widely used in R&D, manufacturing, testing and technical assurance tests of electronic equipment for radar, communication, navigation etc.

## ■ Key Feature

- Wide frequency coverage
- High-sensitivity reception and high-precision measurement performance
- Chinese and English operation interface, big screen dual channel HD display
- Amplifier, Up converter and down converter measurement mode
- Single sideband and double sideband measurement function
- Comprehensive loss compensation function
- Flexible file and table processing functions
- Passed/failed test notification limit line function
- Various external interfaces
- Dual noise source drive

### Wide Frequency Coverage

The coaxial integrated frequency of 3986 series Noise Figure Analyzers covers the range of 10 MHz to 50 GHz, where 5 frequency range configurations are selectable for different user's test demand of different band. With external MMW extended frequency modules, the noise figure measurement frequency range can be extended to 110GHz.

### High-Sensitivity Reception and High-Precision Measurement Performance

The optimum reception sensitivity precedes  $-170$  dBm/Hz, and the full-band reception sensitivity precedes  $-162$  dBm/Hz. It adopts automatic adjustment and precise calibration technologies, which improve the channel gain. And the linearity within the range of noise power measurement precedes  $\pm 0.1$  dB.

### Single Sideband And Double Sideband Measurement Function

It has the capacity of setting, controlling and data processing for the measurement of single sideband (including upper sideband and lower sideband) and double sideband. During noise figure measurement, the sideband setting must be the same as that is actually applied of the device under test.

### Comprehensive Loss Compensation Functions

Loss in the measurement channel can be compensated by means of fixed or table form before and/or after the measurement, which would greatly benefit precise measurement of noise figure of automatic test system or microwave chips.

## Chinese and English Operation Interface With Big Screen Dual-Channel HD Display

Chinese and English operation interface with 10.1 inch big screen LCD monitor that can display in three formats, i.e. graphs, tables and meter display. In the form of graph display, it can display in combination the measurement results of two arbitrary parameters which change along with frequency, such as noise figure, Y factor, gain, and equivalent input noise temperature.

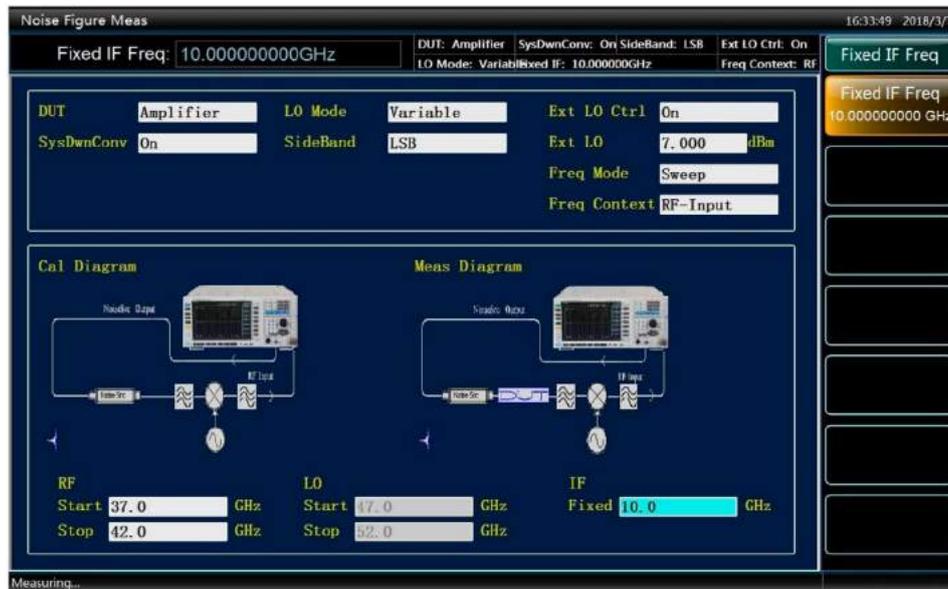


## Amplifier, Up Converter and Down Converter Measurement Mode

Basic amplifier measurement mode is used for noise figure and gain measurement of the device under test, which falls in the amplifier category within the frequency range of the Noise Figure Analyzers. The extended frequency range measurement in the down converter mode is used for noise figure and gain measurement of amplifier, of which the frequency exceeds the frequency range of the Noise Figure Analyzers.

They have noise figure and gain measurement functions of up converters and down converters, as well as to support automatic scanning measurement of noise figure of multi-stage converters.

Interface setting in measurement mode is intuitive. All measurement settings corresponding to measurement mode can be done in the same test interface.



## Flexible File And Table Processing Functions

The types of files and tables that can be processed by 3986 Series Noise Figure Analyzers include limit lines, excess noise ratio table, trace file, state file, frequency list, loss compensation table and screen images. For user data process purposes, files and tables can be edited, saved, loaded, and deleted.

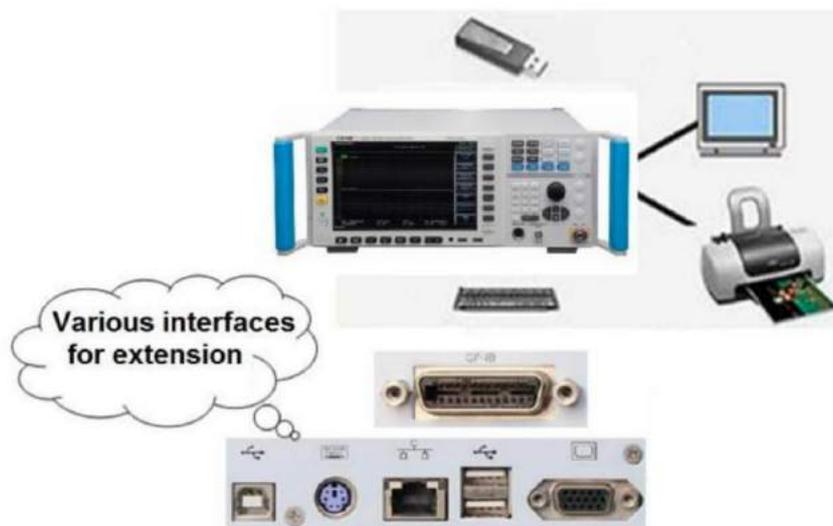
## Passed/Failed Test Notification Limit Line Function

Limit line function of test passed/failed notification simplifies passed/failed test for the use of production line. Types of limit lines include upper limits and lower limits. A pair of upper and lower limit lines could be set individually for each display channel. When measurement results exceed limit range, the instrument would prompt "Limit Line Failed" notification in red.



## Various External Interfaces

Various external interfaces enable high re-usability. Smart interfaces like GP-IB, LAN, USB and VGA can enable user function extension and reconstruction of the test system.



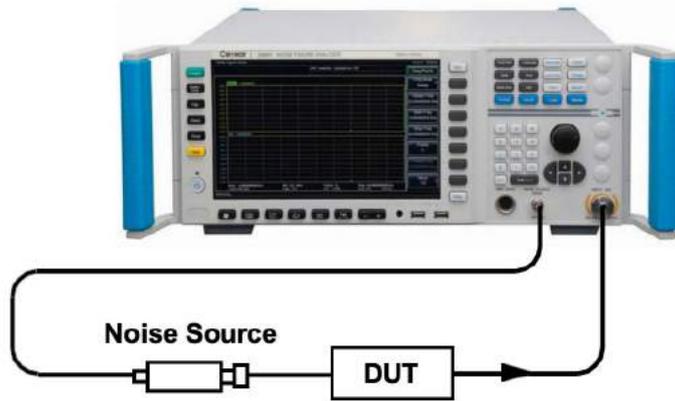
### Dual Noise Source Drive

Standard and smart noise source drive interfaces provided. Standard noise source drive interface that provides +28 V pulse drive voltage to support noise sources from multiple manufacturers. It's highly compatible. Noise Figure Analyzers can identify the connection of smart noise source and load excess noise ratio data automatically. It can also detect changes of environment temperature for temperature correction of noise figure to improve speed and accuracy of measurement.

## ■ Applications

### Basic Amplifier Measurement

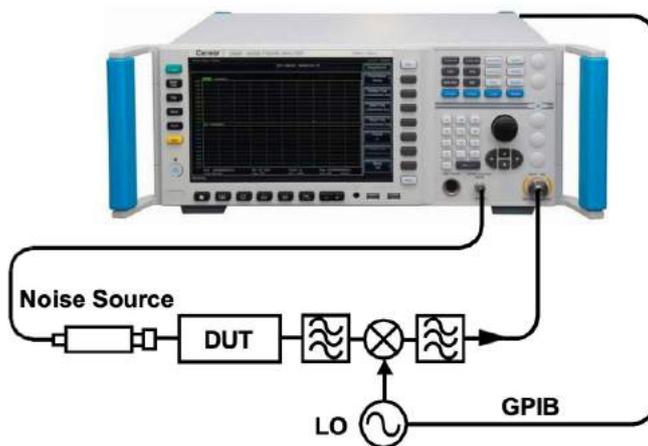
Basic amplifier measurement is the most common measurement mode. It's used for noise figure and gain measurement of the device under tests without frequency conversion (including active or passive linear units or systems like amplifiers, filters, and isolators).



Measurement Setup

### System Down Converter Measurement Mode

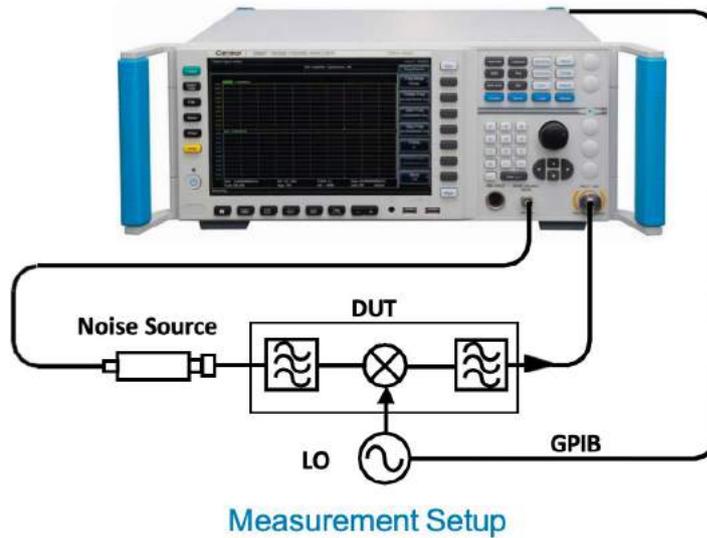
The down converter mode focuses on extended frequency range measurement of amplifier. When the frequency range of an amplifier exceeds that of the Noise Figure Analyzers, extended frequency range measurement of the noise figure is realized by an external mixer. External mixer is used during calibration and measurement as a part of the test system. To reduce the uncertainty of noise figure measurement, frequency conversion loss and noise figure of the chosen mixer should be as small as possible. Besides, the intermediate frequency output port of the mixer should be well isolated to local oscillation signals.



Measurement Setup

## Up/Down Converter Measurement

The device under test is an up/down converter installation, up converter and transmitter or down converter and receiver for instance, then the output intermediate frequency would be in the frequency range of the Noise Figure Analyzers. During up/down converter measurement, 3986 series Noise Figure Analyzers provide two modes of settings, fixed intermediate frequency, variable local oscillation and fixed local oscillation, variable intermediate frequency, which are used for measuring the RF response characters and intermediate frequency response characters of the device under test, respectively.



## ■ Specification

**Technical Specifications (spec.):** Unless clarified otherwise, calibrated instruments shall be placed within working temperature ranged from 0°C to 40°C for at least two hours before warming up for 30 minutes to ensure performance. The measurement of uncertainty is included. Unless clarified otherwise, data included herein are technical indicators.

**Typical Value (typ.):** indicates that 80% instruments can reach typical performance. The data is not assurance data and doesn't include uncertain factors during measurement. It's only valid at 25°C (room temperature).

**Nominal Value (nom.):** indicates anticipated average performance, and performances can't be tested through designed performance features or limited test means (e.g. 50 Ω connectors). Product performance labeled as nominal value is not included in product warranty. It is measured under room temperature (around 25°C).

**Measured Value (meas.):** indicates, to compare with anticipated performance, performance features measured during design stage. Such as amplitude drift variable through time. The data is not assurance data and is measured under room temperature (around 25°C).

**Table 1 Technical Specifications**

Major Technical Specifications	
Frequency Range	10 MHz to 4 GHz/18 GHz/26.5 GHz/40 GHz/50 GHz
Accuracy of Frequency Reference	$\pm < 0.2 \text{ ppm}$ (23°C $\pm$ 3°C)
Accuracy of Frequency Tuning	$\pm <$ (Reference frequency error +100 kHz) 10 MHz to 4 GHz
	$\pm <$ (Reference frequency error +400 kHz) 4 GHz to 18/26.5/40/50 GHz
Noise Figure Measurement Range	0 to 30 dB (ENR: 12 dB to 17 dB)
Noise Figure Uncertainty Measurement	$\pm < 0.1 \text{ dB}$
Gain Measurement Range	-20 dB to +40 dB
Gain Measurement Uncertainty	$\pm < 0.17 \text{ dB}$
Input VSWR	<1.90: 1 10 MHz $\leq$ f $\leq$ 4 GHz
	<2.10: 1 4 GHz $<$ f $\leq$ 18 GHz
	<2.40: 1 18 GHz $<$ f $\leq$ 26.5 GHz
	<2.40: 1 26.5 GHz $<$ f $\leq$ 40 GHz
	<2.40: 1 40 GHz $<$ f $\leq$ 50 GHz

Major Technical Specifications	
Instrument's own Noise Figure	<8.0 dB 10 MHz≤f≤4 GHz
	<7.5 dB 4 GHz<f≤18 GHz
	<8.0 dB 18 GHz<f≤26.5 GHz
	<10.0 dB 26.5 GHz<f≤40 GHz
	<12.0 dB 40 GHz<f≤50 GHz
Jitter (uneven)	<0.17 dB (Y Factor Typical Value 5 dB)
Noise source drive voltage	<1.0 V (Noise source off); +28.0±0.10 V (Noise source on)

**Table2 Product Features**

General Technical Specifications	
Temperature Range	Operation: 0 to +40°C; Storage: -40 to +70°C
Altitude Range	4, 600 meters
Electromagnetic compatibility	Comply with the following requirements of GJB 3947A-2009 provision 3.9.2: a)Conducted emission through CE102 power cable; b)Conducted susceptibility of CS101 power cable; c)Conducted susceptibility injected by CS114 harness; d)Radiated emission through RE102 electric field; Radiated susceptibility through RS103 electric field.
Safety	Comply with safety certificate requirements of GJB 3947A-2009 provision 3.10. a)The resistance between power input end and the chassis (power switch on engaged position) shall be no less than100 MΩ under standard atmosphere pressure and no less than 2 MΩ in damp environment. b)Apply 1500 VAC between the power input end and the chassis. And no symptom like breakdown, flash-over and flicker shall happen. In operation, leakage current between chassis and ground shall be no more than 3.5 mA.
Power requirements	Voltage and frequency (nominal value) 220 V, 50 Hz; (99 to 121) Vrms, (50 to 60/440) Hz (198 to 242) Vrms, (50 to 60) Hz
	Power consumption Max. power consumption: 250 W Max. standby: 20 W
Monitor	1280×800, XGA 10.1"
Data storage	160 G solid state disk Support USB 2.0 standard storage units
Weight	Net weight: less than23 kg; Packaged shipping weight: 34 kg nominal value
Size (Width×Height×Depth (mm))	426×177×460 (handle, bottom, pad and side strap excluded), allowed tolerance ±10 mm. 510×190×534 (handle, bottom, pad and side strap included), allowed tolerance ±10 mm.
Warranty	3986 Series Noise Figure Analyzers are under a standard warranty of 18 months.
Reliability	MTBF (θ ) ≥5000 h
Calibration interval	A calibration interval of one year is recommended. Calibration service shall be provided by professional calibration institutions.

**Table3 Front Panel Interfaces**

Front Panel Interfaces		
RF input connector	3986A	3.5 mm (m)
	3986D	3.5 mm (m)
	3986E	3.5 mm (m)
	3986F	2.4 mm (m)
	3986H	2.4 mm (m)
Standard noise source drive output	BNC female adapter	
Smart noise source drive output	Multi-core connector	
USB2.0 interface	For connecting mouse, keyboard, and updating software and backing up data.	

**Table 4 Back Panel Interfaces**

Back Panel Interfaces	
Keyboard interface	Standard PS/2 interface for connecting standard computer keyboard.
Video interface	VGA interface (15-core D-SUB adapter) for connecting monitors
LAN interface	StandardRJ-45 type, 1000Base-T for software update and remote control
GP-IB Interface	IEEE-488 Bus connector, 24-pin plug (GP-IB code: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, C0) for remote control
USB2.0 interface	For connecting mouse, keyboard, and updating software and backing up data.
10 MHz reference input	50 $\Omega$ impedance, BNC female adapter, amplitude range -5 dBm to +10 dBm
10 MHz reference output	50 $\Omega$ impedance, BNC female adapter, output amplitude $\geq 0$ dBm
Trigger input	BNC female adapter
Trigger output1	BNC female adapter
Trigger output2	BNC female adapter
Detection output	BNC female adapter

## ■ Ordering Information

### Model

Part No.	Name	Description
3986A	Noise Figure Analyzer	10 MHz to 4 GHz
3986D	Noise Figure Analyzer	10 MHz to 18 GHz
3986E	Noise Figure Analyzer	10 MHz to 26.5 GHz
3986F	Noise Figure Analyzer	10 MHz to 40 GHz
3986H	Noise Figure Analyzer	10 MHz to 50 GHz

### Standard

Part No.	Name
1	Standard 3-phase power cord
2	USB mouse
3	User Manual
4	Programing Manual

## Options

Part No.	Name	Function
3986-H01	16603/4 series noise sources	Noise power standard for noise figure measurement
3986-H02	711XX series high-performance coaxial adapter	Used for interface adaptation connection between noise sources and noise figure analyzers
3986-H03	Multicore cable	Used for intelligent noise source driver interface and intelligent noise source connection of noise coefficient analyzer
3986-H04	BNC (m) - BNC (m) cable	Connection between standard noise source driver interface and standard noise source for noise figure analyzer
3986-H05	Aluminum alloy transport box	High strength and lightweight aluminum alloy transport box with handles and rollers for easy transportation
3986-H98	English kit	English panel, English manual, English operation interface, and English operating system; Power supply AC 100/115V: 50/60Hz; AC 220/240V: 50/60Hz.



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