Agilent FieldFox RF Vector Network Analyzer

N9923A 4/6 GHz

Technical Overview

World's most accurate handheld vector network analyzer

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Agilent Technologies

World's Most Accurate Handheld Vector Network Analyzer

FieldFox

The first step in ensuring that wireless communication systems are running at their optimum level is to verify that RF components in the system, such as cables, antennas, and filters are properly tested and kept in good condition. The majority of these tests are conducted in the field or in a warehouse, where bench top instruments are not readily available, testing space is limited, or where a power source is simply not available. Agilent's handheld FieldFox RF Vector Network Analyzer (VNA) is designed to make network analysis measurements in the field easier, convenient, and the most reliable.

QuickCal revolutionizes calibration in the field

The number one challenge in making accurate network analyzer measurements in the field is reliability, where large temperature fluctuations are common. Agilent's FieldFox RF VNA is the only handheld network analyzer with *QuickCal* technology that allows operators to easily correct for drift errors caused by temperature changes. *QuickCal* is a built-in calibration system that provides worry-free accuracy and reliability. FieldFox's built-in standards make calibration simpler, by eliminating the need to carry mechanical calibration kits into the field.

Unmatched reliability for day-to-day tests

Whether you are testing a flight line for the air force, an RF system on a war ship, a wireless communication cable and antenna system, tuning RF components, or making other general purpose network analyzer measurements — the FieldFox RF VNA provides unmatched measurement reliability, stability, and efficiency for your every day test needs. The FieldFox RF VNA also builds on Agilent's 40-year legacy of network analysis leadership in calibration, accuracy, and innovation.

Key measurements

- Full 2-port error corrected S-parameters, magnitude and phase
- Time domain analysis with gating
- Cable and antenna test (distance-to-fault, return loss, and VSWR)
- Cable loss measurement (1-port)
- Insertion loss and transmission measurement (2-port)
- Magnitude, phase, Smith chart, polar display, group delay and more
- Vector voltmeter (1- and 2- channel)
- Power meter with external USB power sensor

Key differentiators

- Built-in *QuickCal* enables calibration without a cal kit
- Best measurement stability over time and temperature
- Industry's only handheld network analyzer with MIL PRF 28800F Class 2 compliance with no exceptions
- Superior system dynamic range of 100 dB
- Easy-to-use, task-driven user interface
- Weather resistant, compact, and field-friendly design, no fan and vents

Pick up FieldFox for its ergonomics

FieldFox

Connector bay protects RF connectors

Test Port 1

External reference and external trigger

Spacious connector design makes connections fast and simple

Test Port 2

Quick-connect shoulder strap clips

Easily accessible battery compartment

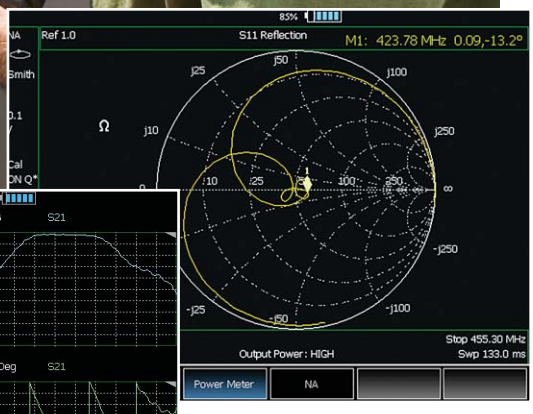
LAN port for remote control using SCPI and fast data transfer

Gasketed doors protect ports from moisture

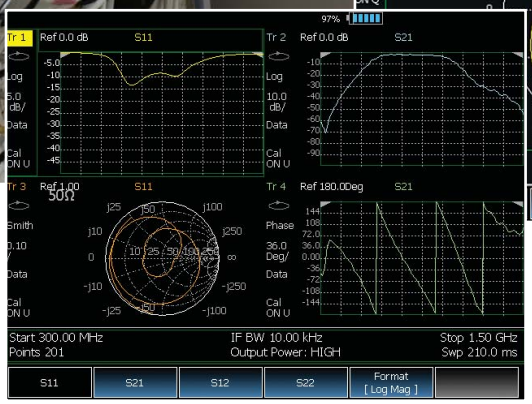
Micro SD flash card slot for additional data storage

USB ports for convenient data transfer and GPS receiver

Headphone jack



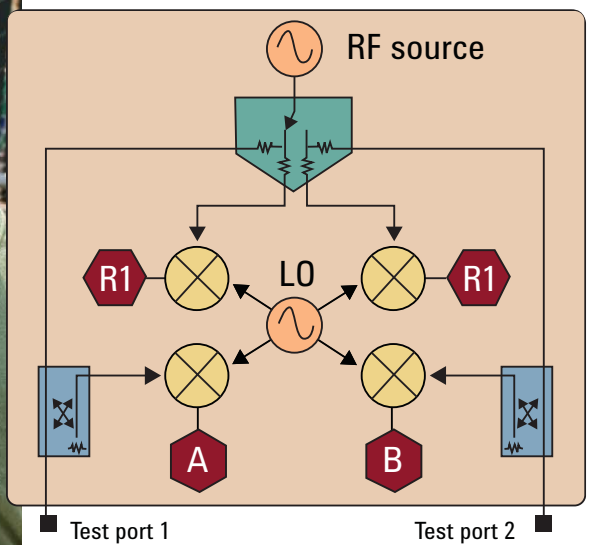
Smith chart display



Make multiple measurements simultaneously

Vector Network Analysis

The base FieldFox RF VNA provides transmission/reflection (T/R) measurements, or S11 and S21, with magnitude and phase.

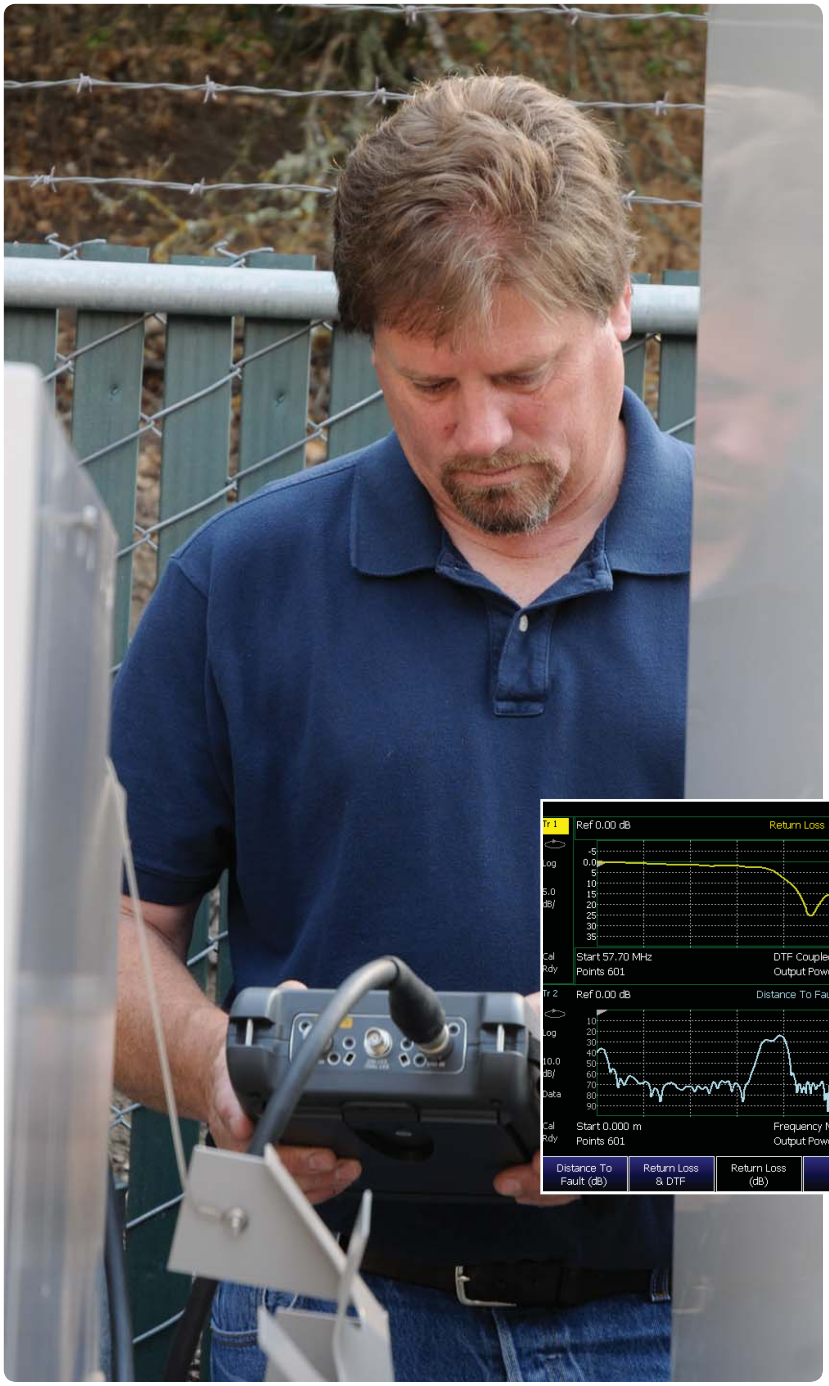


Adding Option 122 (full 2-port S-parameters) brings new levels of accuracy and convenience for testing RF components. A full 2-port network analyzer lets you measure the forward and reverse characteristics of your components without having to disconnect, turn around, and reconnect them to the analyzer.

It also provides full 2-port calibration to give you the best measurement accuracy possible. Depending upon your application, you can choose the optimum performance level of an S-parameter analyzer (Option 122) or transmission reflection analyzer (base model).

You also can simultaneously measure and view all four S-parameters, with a single connection.

FieldFox VNA contains four independent, sensitive receivers. The receivers provide more than 100 dB of dynamic range for vector measurements of high rejection, narrowband devices such RF filters. The receivers also make possible full 2-port error correction with the Unknown Thru method, allowing you to measure non-insertable devices.



View and control the return loss and DTF displays independently

Cable and antenna analyzer

Fifty to sixty percent of cell site problems are caused by faulty cables, connectors, and antennas. Degraded feed lines cause poor coverage, unnecessary handovers, paging failures and access failures on the uplink. To avoid service quality problems, it is critical to keep the cell sites' cable and antenna systems in good condition.

Use FieldFox to make return loss, VSWR, insertion loss/transmission, one-port cable loss, and distance-to-fault (DTF) measurements. You can test antennas, cables, filters, and amplifiers with a single handheld instrument.

Insertion loss display

Return loss and DTF measurements

FieldFox can make return loss and distance-to-fault measurements at the same time. It helps you correlate overall system degradation with specific faults in the cable and antenna system.

The built-in cable editor allows you to edit existing cable types on-site, and save them as new cable types with user defined names.

Calibration Wizard

CalReady when the instrument is turned on

Save time and get right to work with FieldFox's CalReady feature, which makes the unit calibration ready at either test port immediately following power on or preset. FieldFox is already calibrated and ready to make accurate measurements such as S11, S22, 1-port cable loss, VSWR, return loss, and DTF measurements at the test port without having to connect/disconnect additional cables or calibration devices.

Industry's first and only *QuickCal*

FieldFox is the industry's first and only handheld network analyzer with a built-in calibration capability that allows you to calibrate the network analyzer without carrying a calibration kit into the field. As with any test instrument, when you add an additional device to the test port, such as a jumper cable or adapter, you need to recalibrate using a calibration kit (cal kit). *QuickCal* eliminates the need to carry and use a cal kit, and also provides worry-free accuracy and excellent reliability. *QuickCal* allows the operator to easily correct drift errors caused by temperature changes during instrument operation.

The FieldFox RF VNA's full 2-port *QuickCal* supports measurements such as transmission/reflection, S21, S12, S11, S22, 1-port cable loss, VSWR, return loss, DTF, and gain/insertion loss. Full 2-port QuickCal is based on Agilent's Unknown Thru calibration methodology, providing an accurate way to measure a non-insertable device, such as a female-female filter.

Power meter display

Vector voltmeter used for cable trimming

The marker bandwidth/Q factor function simplifies filter testing and tuning.

Broadband calibration

FieldFox allows you to make broadband calibrations, which means the instrument is calibrated over the maximum frequency range. After a broadband calibration, you can change the frequency range or number of points without recalibrating the instrument. The calibration is interpolated, and accuracy is maintained.

User calibration kit support

FieldFox supports many Agilent standard calibration kits. In addition to *CalReady* and *QuickCal*, FieldFox also provides a comprehensive calibration utility. To obtain the most accurate measurement, users need to use cal kits that match their device connector types. FieldFox allows users to define their own mechanical calibration kits.

Power meter

FieldFox can connect with the Agilent U2000 Series USB power sensors to make RF/microwave power measurements up to 24 GHz.

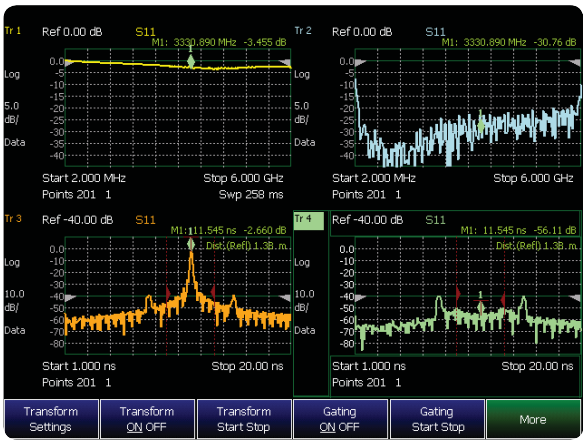
FieldFox provides true average power measurements with a high dynamic range from –60 dBm to +44 dBm (sensor dependent).

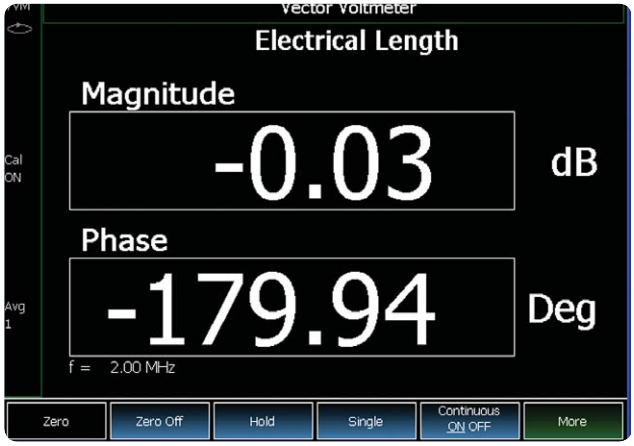
The sensor has an internal zeroing function and the sensor does not require external calibration.

Electrical delay and port extension

For in-fixture measurements, use FieldFox's port extension or electrical delay capability to easily extend the reference plane to the device interface for accurate measurements. You can use the electrical delay capability to measure *deviation from linear phase* by removing the linear portion of the phase delay.

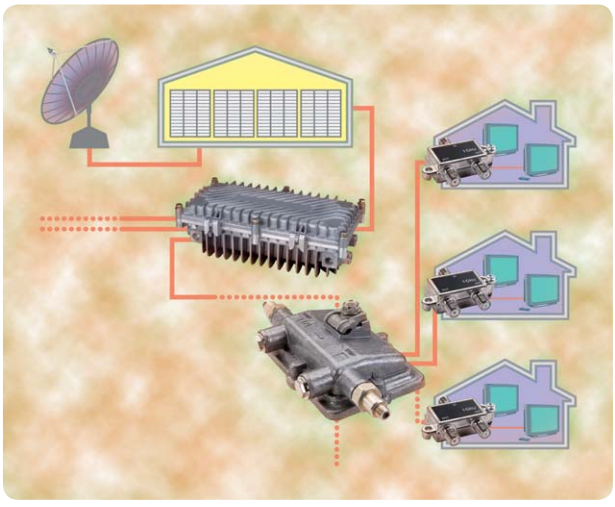
Use time domain gating to remove unwanted responses. Before gating: Traces 1 and 3, After gating: Traces 2 and 4.





VVM applications:

- **Cable trimming of phase matched cables**
- **Verifying the isolation of 2-port components**
- **Radio navigation – VHF omnidirectional radio range (VOR) and instrumentation landing system (ILS)**



Cable TV distribution system, cable TV is a 75 ohm system

Time domain

With the time domain option, FieldFox computes the inverse Fourier transform of the frequency-domain data to display reflection or transmission coefficients versus time. Time domain gating can be used to remove unwanted responses such as connector mismatch or cable discontinuities, and the results can be displayed in either time or frequency domain. FieldFox's time domain function supports both low pass mode and band pass mode, enabling users to measure both broadband and frequency-selective devices.

Vector voltmeter

Using FieldFox's vector voltmeter (VVM), the phase shift and electrical length of a device can be measured. By utilizing the "zero" function, the phase and electrical length of one device can be measured relative to a "golden device". You can view results on the large display.

The VVM option also provides ratio measurements of two receivers or two channels, A/B or B/A. An external signal source is required for this measurement. You can use this capability to verify the magnitude and phase differences between multiple signal paths.

75 ohm device test

Most of the components used in cable TV systems are 75 ohm, like cables, filters, splitters and switches.

You can use the FieldFox RF VNA to measure 75-ohm devices easily. *QuickCal*, combined with a 50/75 ohm adapter (eg. Agilent part: N9910X-846) at each port and a 75 ohm load, turns the instrument into a 75 ohm tester. Alternatively you can use any of Agilent's 75 ohm calibration kits, along with a pair of 50/75 ohm adapters.

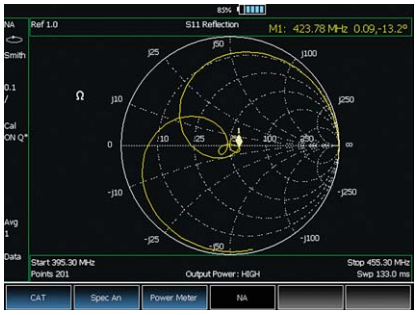
Perform and view return loss and distance-to-fault measurements at the same time

Tower mounted amplifier (TMA) measurement

Filter and amplifier measurement

Comprehensive measurement capabilities

Vector network analysis	Provides accurate network analysis of RF components and enables you to measure and display all four S-parameters simultaneously, with a single connection. This means you can quickly and accurately characterize the device under test, using a handheld instrument.
Cable and antenna test • Return loss, SWR • Distance-to-fault	Return loss/SWR measurements allow you to evaluate the impedance matching performance of a feed line across the frequency range of interest. Distance-to-fault measurements help you identify faults along a feed line. You can use these measurements to precisely pinpoint the location of damaged or degraded antennas, connectors, amplifiers, filters, duplexers, or other components. FieldFox provides up to a 1001 data-point resolution to help accurately locate faults and extend measurement distance.
Transmission test • Cable loss • Insertion loss • Amplifier gain	Transmission tests are used to accurately measure cable loss, insertion loss (filters) and amplifier gain (tower mounted amplifier). FieldFox offers 2-port transmission magnitude and phase measurements with a typical dynamic range of 100 dB.
One-port cable loss	For already-installed cables, FieldFox accurately measures one-port cable loss. The instrument measures the actual cable loss, without the need for additional computations.
***CalReady* at test port**	Each instrument is calibrated at the test ports. When you power up the instrument, it is ready to make accurate measurements such as S11, S22, one-port cable loss, VSWR, return loss and DTF at the test port.
QuickCal	The industry's first and only built-in calibration system allows you to calibrate the network analyzer without carrying a calibration kit into the field. ***QuickCal*** eliminates the hassle of carrying and using a cal kit, plus provides worry-free accuracy and excellent reliability. ***QuickCal*** allows operators to easily correct for drift errors caused by temperature changes during instrument operation. Full 2-port *QuickCal* is based on Agilent's Unknown Thru calibration methodology. It is an accurate way to measure non insertable devices, such as female-female diplexers.
Mechanical calibration	Open-short-load (OSL) calibration is standard in FieldFox. Common calibration kit constants are preloaded in the instrument. Additional kits can be added by users.
Time domain	Using the time domain feature, you can display reflection or transmission coefficients versus time. Time domain gating can be used to remove unwanted responses such as connector mismatch or cable discontinuities.



Smith chart display

Easy-to-use save/recall functions

Duplexer measurement

Comprehensive measurement capabilities *continued*

Interference rejection	The FieldFox RF VNA interference rejection mode is able to make reliable return loss and distance-to-fault measurements of cable and antenna systems under high interference signal environments. It can make valid measurements for interference signals coupled into the system up to +16 dBm.
Power meter	Makes accurate true average power measurements without the need for a power meter. The state-of-the-art Agilent USB power sensors provide measurements up to 24 GHz.
Smith chart	Smith charts can be used to display impedance matching characteristics in cable and antenna systems.
Vector voltmeter	The large vector voltmeter display makes it easy to match two or more device's electric length and ensure signals that travel on different devices have the same delay.
Electrical delay	Using the electrical delay function, you can remove the linear portion of the phase shift and view the deviation from linear phase.
Port extension	Allows you to extend the reference plan after calibration. This feature is useful for measurements such as in-fixture test, where calibrating at the DUT or reference plane is cumbersome.
GPS	Enables operators to find exact locations, and time/location stamp their measurement reports. The GPS information can be displayed on the screen, and saved as part of the image or data file, for reporting purposes.

Data management

Limit lines	Automated pass/fail testing eliminates the guesswork from your test processes and helps ensure that your components are aligned and tested to the same specifications at all test stations. Pass/fail testing is easily accomplished with user-defined limit lines, which let you quickly and consistently compare measured data to test limits. The pass/fail results are displayed clearly on the instrument screen to minimize operator errors or misinterpretation.
Save/recall states	Save time and reduce operator errors with recall states. You can quickly switch between different manufacturing tests simply by recalling the appropriate instrument state. Saving and recalling states also eliminates operator errors that occur during repeated entry of instrument parameters. Each recall state contains all instrument parameters such as start and stop frequencies, power level, number of trace points, IF bandwidth, calibration data, markers, limit lines, and more.
Powerful marker functions	Speed up component test times by using the power of built-in data markers. Use the six markers per trace to display data in absolute or relative terms.

Make accurate true average power measurements without bringing along a power meter

Field-proof usability

Transflective display and backlit keys	The display is designed for easy viewing in indoor and outdoor settings and in direct sunlight and darkness. Access different display modes via softkeys.
Functional key access	Front-panel keys make it easy to perform tasks and make measurements.
One-button measurement	Provides task-driven user interface to simplify the measurements.

Transflective display makes it easy to read measurements in direct sunlight

Rugged design

Water-resistant chassis, keypad and case design	The case is made from polycarbonates that withstand wide temperature ranges and salty, humid environments.
RF connector protection	A specially designed connector bay protects the RF connectors from damage during drops or other external impacts.
Dust-free design	With no vents or fans in the case, FieldFox resists dust for better equipment reliability.
Meets tough environmental standard	Industry's only handheld network analyzer with MIL Class 2 compliance with no exceptions.
Gasketed ports	Protects instrument from moisture.

Water resistant chassis withstands wide temperature ranges and humid environments

Modern connectivity

USB 2.0 ports	Two USB 2.0 ports can be used to transfer files.
LAN port	Used for data transfer, remote control, and SCPI programming. Also used with GPS receiver.
SCPI support	SCPI over LAN allows users to automate tests or control a FieldFox from a remote location.
Micro SD flash card slot	Use as a data storage device.
FieldFox Data Link software	Transfer data from the instrument to a PC for back-office applications such as baseline analysis and report generation.

A condensed version of the specifications is provided here. See the User's Guide for the complete version; http://cp.literature.agilent.com/litweb/pdf/N9923-90001.pdf

Specification (spec.):
Warranted performance. Specifications include guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions. The following conditions must be met:

- FieldFox has been turned on at least 10 minutes unless otherwise specified
- FieldFox is within its calibration cycle
- Storage or operation at 25 °C ±5 °C range (unless otherwise stated)

Typical (typ.):
Expected performance of an average unit over a 20 °C to 30 °C temperature range, unless otherwise indicated; does not include guardbands. It is not covered by the product warranty. The FieldFox RF VNA must be within its calibration cycle.

Nominal (nom.):
A general, descriptive term or design parameter. It is not tested, and not covered by the product warranty.

Network analysis

Measurements

S11, S21	Magnitude and phase
S12, S22	Magnitude and phase (Option 122)
Display:	Log, linear, phase, group delay, VSWR, Smith chart, polar chart, split screen to show different S-parameters and phases
System impedance selection:	50 ohm and 75 ohm (with 50/75 ohm adapter)

Frequency

Frequency range

Option 104:	2 MHz to 4 GHz
Option 106:	2 MHz to 6 GHz

Frequency reference

Accuracy:	±2 ppm
Aging rate:	±1 ppm
Temperature stability:	±1 ppm over –10 to 55 °C

Frequency resolution

1 Hz

Sweep speed

S21, S11	2 MHz to 6 GHz, 30 kHz IFBW, 1001 points 0.695 ms/point

Data points

101, 201, 401, 601, 801, 1001, 1601, 4001, 10,001 (custom number of points can be set using SCPI)

Directivity

Corrected:	42 dB

System dynamic range (S21)

2 MHz to 6 GHz: 100 dB (typical)

IF bandwidth

300 Hz, 1 kHz, 3 kHz, 10 kHz, and 30 kHz

Output power range

High power: +6 dBm (nominal)
Low power: –40 dBm (nominal)

Trace noise (high output power, IF bandwidth = 300 Hz)

Magnitude: < 0.01 dB rms

Immunity to interference

+16 dBm (nominal)

Maximum input level port 1 or port 2

+23 dBm /±50 VDC

Cable and antenna analyzer (Option 305)

Capabilities

Return loss

VSWR

Distance-to-fault (DTF):

- Range = (n - 1)/(span*2) x Vf (velocity factor in cable) x C (light speed)
- Resolution = range/number of points
- Number of points: 101, 201, 401, 601, 801, 1001
- Distance-to-fault display: Return loss, VSWR , reflection coefficient

Cable loss (1-port): Terminated cable under test with short

Transmission measurement (insertion loss and gain)

Calibration types
CalReady
One port mechanical calibration
Full 2-port mechanical calibration
Enhanced response calibration
QuickCal (1-port and 2-port)
Automatic cal update with frequency change

Vector network analyzer time domain (Option 010)

Using time domain, data from transmission or reflection measurements in the frequency domain are converted to the time domain. The time-domain response shows the measured parameter value versus time.

Time stimulus modes
Low-pass step This stimulus, similar to a traditional time domain reflectometer (TDR) stimulus waveform, is used to measure low-pass devices. The frequency-domain data should extend from DC (extrapolated value) to a higher value.
Low-pass impulse This stimulus is also used to measure low-pass devices.
Bandpass impulse The bandpass impulse stimulates a pulsed RF signal and is used to measure the time-domain response of band-limited devices.
Windows
The windowing function can be used to filter the frequency-domain data and thereby reduce overshoot and ringing in the time-domain response.
Gating
The gating function can be used to selectively remove reflection or transmission time-domain responses. In converting back to the frequency domain the effects of the responses outside the gate are removed.

Power meter measurement (Option 302)

Frequency range	
	9 kHz to 24 GHz (sensor dependent)
USB power sensor	
	9 kHz to 24 GHz: see Agilent U2000 Series USB power sensor specifications for details

General specifications

Connector type (port 1 and port 2)	
	Type N female
Test port impedance	
	50 ohm
External reference	
Input type:	BNC female
Reference frequency:	10 MHz
Required level:	–5 dBm to 10 dBm
External trigger input	
Impedance:	10 kΩ
Level range:	Rise edge: 17V; falling edge: 1V
Display	
	6.5" transflective, color VGA LED backlit 640 x 480 with anti-glare coating
Speaker	
	Built-in speaker
Headphone jack	
	Built-in headphone jack
Connectivity	
	2 x USB 2.0; 1 x micro USB; 1 x LAN
GPS	
	Latitude, longitude, elevation, and accurate time are provided. The GPS information can be displayed on the screen and saved as part of the image or data file. The GPS capability is standard with all N9912A FieldFox RF analyzers. An external USB GPS receiver is required. Agilent recommends the Microsoft Streets & Trips, or Microsoft AutoRoute with GPS locator.
Internal storage	
	Minimum 16 MB, up to 1000 traces
External storage	
	1 x micro SD slot and 2 x USB 2.0

EMC

Complies with European EMC Directive 2004/108/EC

- IEC/EN 61326-1
- CISPR Pub 11 Group 1, Class A
- AS/NZS CISPR 11
- ICES/NMB-001

ESD

- IEC/EN 61000-4-2, functional up to 20 kV test

Safety

Complies with European Low Voltage Directive 2006/95/EC

- IEC/EN 61010-1 2nd Edition
- Canada: CSA C22.2 No. 61010-1-04
- USA: UL 61010-1 2nd Edition

Environmental

Compliant with MIL-PRE-28800F Class 2 general requirements - no exceptions

Temperature

Operating:	–10 °C to 55 °C
Non operating:	–51 °C to 71 °C

Weight

6 lbs / 2.7 kg including battery

Dimensions (H x W x D)

292 x 188 x 72 mm (11.5″ x 7.4″ x 2.8″)

Power

Power supply	**External DC input:** 15 to 19 VDC
External AC power adapter	
Input:	100 to 250 VAC, 50 to 60 Hz; 1.25 to 0.56 A
Output:	15 VDC, 4 A
Power consumption:	14 W (typical)
Battery:	6 cell Lithium Ion, 10.8 V, 4.6 A-h
Battery operating time:	3.5 hours

Language

English, Chinese, French, Spanish, Japanese, Russian, German, Italian, and Turkish

N9923A FieldFox RF vector network analyzer options

Option 104	4 GHz RF vector network analyzer, transmission/reflection
Option 106	6 GHz RF vector network analyzer, transmission/reflection
Option 112	*QuickCal*
Option 122	Full 2-port S-parameters
Option 010	Time domain
Option 305	Cable and antenna analyzer
Option 302	External USB power sensor support
Option 308	Vector voltmeter
Standard accessories	AC/DC adapter; battery; soft carrying case; LAN cable, Quick Reference Guide, and full manual

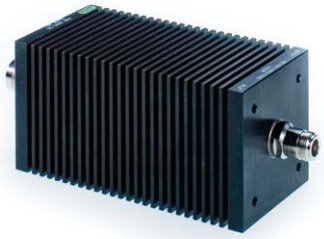
N9910X RF/MW handheld analyzer accessories

N9910X-800	T-calibration kit, DC-6 GHz, Type-N (m)
N9910X-801	T-calibration kit, DC-6 GHz, Type-N (f)
N9910X-802	T-calibration kit, DC-6 GHz, 7/16 DIN (m)
N9910X-803	T-calibration kit, DC-6 GHz, 7/16 DIN (f)
85514A	4-in-1 OSLT mechanical calibration kit, DC to 9 GHz, Type-N (m), 50 ohm
85515A	4-in-1 OSLT mechanical calibration kit, DC to 9 GHz, Type-N (f), 50 ohm
N9910X-810	Rugged phase-stable cable, Type-N (m) to Type-N (m), 5 ft
N9910X-811	Rugged phase-stable cable, Type-N (m) to Type-N (f), 5 ft
N9910X-812	Rugged phase-stable cable, Type-N (m) to Type-N (m), 12 ft
N9910X-813	Rugged phase-stable cable, Type-N (m) to Type-N (f), 12 ft
N9910X-814	Rugged phase-stable cable, Type-N (m) to 7/16 (m), 60 inch or 1.5 m
N9910X-815	Rugged phase-stable cable, Type - N (m) to 7/16 (m), 12 ft or 3.6 m
N9910X-816	Rugged phase-stable cable, Type-N (m) to Type-N (f), 3.28 ft or 1 m
N9910X-817	Rugged phase-stable cable, Type-N (m) to Type-N (m), 3.28 ft or 1 m
N9910X-843	Coaxial adapter, Type-N (m) to 7/16 DIN (f)
N9910X-845	Adapter kit: Type-N (f) to 7/16 DIN (f), Type-N (f) to 7/16 DIN (m), Type-N (f) to Type-N (f)
N9910X-846	Coaxial adapter, Type-N (m) 50 ohm to Type-N (f) 75 ohm (recommend quantity 2 for 75 ohm measurements)
N9910X-860	Fixed attenuator, 40 dB, 100 W, DC-3 GHz, Type-N (m) to Type-N (f)
N9910X-861	Fixed attenuator, 40 dB, 50 W, DC-8.5 GHz, Type-N (m) to Type-N (f)
N9910X-870	Extra battery
N9910X-872	External battery charger
N9910X-873	AD/DC adapter
N9910X-874	External bias-tee, 2.5 MHz to 6 GHz, 1 W, 0.5 A
N9910X-880	Extra soft carrying case with backpack and shoulder strap
N9910X-875	DC car charger and adapter
N9910X-881	Hard transit case

For more information go to: www.agilent.com/find/fieldfox

Bias-tee, N9910X-874

Phase stable cable, N9910X-810



100 Watt attenuator, N9910X-860

Adapter kit, N9910X-845

85514A

85515A

N9910X-800

N9910X-801

N9910X-802

N9910X-803

T-Cal kits

Soft carrying case with backpack and shoulder straps included with a standard FieldFox.
For an extra soft carrying case order N9910X-880.

Hard transit case, N9910X-881

AC/DC adapter, N9910X-873

FieldFox fits inside hard transit case

External battery charger,
N9910X-872

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