Keysight
FieldFox Handheld Analyzers
4/6.5/9/14/18/26.5 GHz

Data Sheet

N9913A
N9914A
N9915A
N9916A
N9917A
N9918A
N9925A
N9926A
N9927A
N9928A
N9935A
N9936A
N9937A
N9938A

KEYSIGHT TECHNOLOGIES

Table of Contents

This data sheet provides the specified and typical performance of the FieldFox family of portable analyzers. This data sheet should be used in conjunction with the technical overviews and configuration guide, for a complete description of the analyzers.

The specifications and measurement capabilities listed in this document require certain options on the FieldFox analyzer. Refer to the FieldFox Configuration Guide to obtain option information. The configuration guide (http://literature.cdn.keysight.com/litweb/pdf/5990-9836EN.pdf) is the main resource for option/measurement capability information.

Cable and Antenna Analyzer and Vector Network Analyzer

The performance listed in this section applies to the cable and antenna analyzer (referred to as CAT) and vector network analyzer (VNA) capabilities available in the following models:

- FieldFox microwave combination analyzers: **N9913A, N9914A, N9915A, N9916A, N9917A, N9918A**
- FieldFox microwave vector network analyzers: **N9925A, N9926A, N9927A, N9928A**

Specification (spec)

Specifications include guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions. Warranted performance. FieldFox must be within its calibration cycle. No warm-up required for the specifications listed on pages 3 through 7.

Typical

Expected performance of an average unit; does not include guardbands. It is not covered by the product warranty. FieldFox must be within its calibration cycle.

Nominal

A general, descriptive term or design parameter. It is not tested, and not covered by the product warranty. FieldFox must be within its calibration cycle.

Models	**Frequency range**
N9913A	30 kHz to 4 GHz
N9914A	30 kHz to 6.5 GHz
N9915A, N9925A	30 kHz to 9 GHz
N9916A, N9926A	30 kHz to 14 GHz
N9917A, N9927A	30 kHz to 18 GHz
N9918A, N9928A	30 kHz to 26.5 GHz
Frequency reference	**Spec**
	–10 to 55 °C
Accuracy	± 0.7 ppm (spec) + aging
	± 0.4 ppm (typical) + aging
Accuracy, when locked to GPS	± 0.010 ppm (spec)
Accuracy, when GPS antenna is disconnected	± 0.2 ppm (nominal) [1]
Aging rate	± 1 ppm/yr for 20 years (spec), will not exceed ± 3.5 ppm
Frequency resolution	**Spec**
Frequency ≤ 5 GHz	1 Hz
Frequency ≤ 10 GHz	1.34 Hz
Frequency ≤ 20 GHz	2.68 Hz
Frequency ≤ 26.5 GHz	5.36 Hz
Data points or resolution	
	101, 201, 401, 601, 801, 1001, 1601, 4001, 10,001 Arbitrary number of points settable through front panel and SCPI
IF bandwidth [2]	
	10 Hz, 30 Hz, 100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz
System impedance	
	50 Ω (nominal), 75 Ω with appropriate adapter and calibration kit

1. The maximum drift expected in the frequency reference applicable when the ambient temperature changes ± 5 °C from the temperature when the GPS signal was last connected.
2. VNA mode only. Recommend using averaging in CAT mode.

Cable and Antenna Analyzer and Vector Network Analyzer (continued)

Test port output power	**Port 1 or port 2, high power, 23 ± 5 °C**	
Frequency	**Typical**	**Nominal**
30 kHz to 300 kHz	–11 dBm	
> 300 kHz to 2 MHz	–3 dBm	–2 dBm
> 2 MHz to 625 MHz	–2 dBm	–1 dBm
> 625 MHz to 3 GHz	+1 dBm	+3 dBm
≥ 3 to 6.5 GHz	–1 dBm	+1 dBm
≥ 6.5 to 9 GHz	–2 dBm	0 dBm
≥ 9 to 14 GHz	–4 dBm	–2.5 dBm
≥ 14 to 18 GHz	–6 dBm	–4.5 dBm
≥ 18 to 23 GHz	–10 dBm	–8.5 dBm
≥ 23 to 26.5 GHz	–12 dBm	–11 dBm
Power level accuracy		
	± 1.5 dB at –15 dBm, for frequencies > 250 kHz, typical	
Power range		
	CAT: High, low and manual. Low power is –45 dBm, nominal. Default power is high.	
	VNA: High, low and manual. Low power is –45 dBm, nominal. Default power is manual power of –15 dBm.	
Power step size		
	Power settable in 1 dB steps across power range. Flat power, in 1 dB steps, is available across the whole frequency span, nominal.	
System dynamic range [1]	**Port 1 or port 2, high power, 100 Hz IF bandwidth, 100 point average, –10 to 55 °C**	
Frequency	**Spec**	**Typical**
> 300 kHz to 9 GHz [2]	95 dB	100 dB
≥ 9 to 14 GHz	91 dB	97 dB
≥ 14 to 18 GHz	90 dB	94 dB
≥ 18 to 20 GHz	87 dB	90 dB
≥ 20 to 25 GHz	74 dB	79 dB
> 25 to 26.5 GHz	65 dB	70 dB
Trace noise [3]	**Port 1 or port 2, high power, 300 Hz IF bandwidth, spec, –10 to 55 °C**	
Frequency	**Magnitude**	**Phase**
300 kHz	± 0.003 dB (rms)	± 0.020 degrees
> 300 kHz to 10 GHz	± 0.002 dB (rms)	± 0.014 degrees
> 10 to 20 GHz	± 0.004 dB (rms)	± 0.027 degrees
> 20 to 26.5 GHz	± 0.010 dB (rms)	± 0.066 degrees
Temperature stability	**Nominal**	
Magnitude	± 0.018 dB/°C ≤ 15 GHz, ± 0.08 dB/°C > 15 GHz	
Receiver compression	**Port 1 or port 2, typical, 23 ± 5 °C**	
500 MHz to 1 GHz	+10 dBm, 0.15 dB compression	
> 1 GHz to 26.5 GHz	+10 dBm, 0.10 dB compression	
Port 1 or port 2 maximum input level		
Average CW power	+27 dBm, 0.5 watts	
DC	± 50 VDC	
Immunity to interfering signals		
	+16 dBm (nominal)	

1. For CAT mode "Insertion loss (2-port)", decrease listed dynamic range specifications by 20 dB, as CAT mode IFBW is fixed at 10 kHz. Can obtain full dynamic range by using S21 measurement in VNA mode with 100 Hz IFBW.
2. <300 kHz: 63 dB nominal; 2 MHz to 9 MHz: 85 dB spec, 90 dB typical
3. For CAT mode, increase trace noise by a factor of 5.7, as CAT mode IFBW is fixed at 10 kHz. Can use averaging in CAT mode to reduce trace noise, or use VNA mode with 300 Hz IFBW.

Cable and Antenna Analyzer and Vector Network Analyzer (continued)

See FieldFox Configuration Guide for option information. Many capabilities listed in this Data Sheet require options.

Measurement speed	
	Includes hardware sweep time, re-trace and display update.
CAT	
	Return loss, 30 kHz to 26.5 GHz, 1-port cal, 1001 points 850 µs/pt
	Distance-to-fault, 100 meter cable, 1-port cal, 1001 points 850 µs/pt
VNA	
	S11 and S21, 30 kHz to 26.5 GHz, enhanced response cal, 100 kHz IF bandwidth, 1001 points 850 µs/pt
Measurements	
CAT	Distance-to-fault (dB), return loss, VSWR, distance-to-fault (VSWR), cable loss (1-port), insertion loss (2-port), distance-to-fault (linear or Rho)
VNA	T/R S11, S21
VNA S-parameters	S11, S21, S22, S12
VNA conversion	Impedance (Z), admittance (Y), 1/S
VNA mixed-mode S-parameters	Scc11, Sdd11, Scd11, Sdc11
Number of traces	
	Four traces available, Tr1, Tr2, Tr3, Tr4
Display formats	
	Single-trace
	Dual-trace overlay (both traces on one graticule)
	Dual-trace split (each trace on separate graticule)
	Three-trace overlay (all three traces on one graticule)
	Three-trace split (each trace on separate graticule)
	Quad-trace split (each trace on separate graticule)
Trace formats	
	Log magnitude, linear magnitude, VSWR, phase, Smith chart, polar, group delay, unwrapped phase, real impedance, imaginary impedance
Frequency sweep type	
	Linear
Sweep trigger	
	Continuous, single
Trigger type	Internal or external trigger input
	Edge trigger
	Sweep begins when external TTL signal occurs at the trigger input port
Polarity	Positive edge, negative edge
CAT mode distance-tofault	
	Start distance, stop distance. Units: meters or feet
Sweep time	
	Set sweep time in seconds
Averaging	
	Sweep and point averaging
	2 to 1000
Smoothing	
	0.25 to 25% of trace width
	Computes the moving average of adjacent data points. Smoothing aperture defines the trace width (number of points) to be averaged.

Cable and Antenna Analyzer and Vector Network Analyzer (continued)

Group delay	
Aperture (selectable)	Frequency span / (number of points -1)
Maximum aperture	25% of frequency span
Minimum delay	Limited to measuring no more than 180 degrees of phase change within the minimum aperture.
Electrical delay	
	0 to 10 seconds
Port extension	
	For both port 1 and port 2, delay settings. Port extensions apply to all measurements.
Title	
	Add custom titles to the display
Display data	
	Display data, memory, data and memory, or data math
	One memory trace per data trace. Total of 4 memory traces
Trace math	
	Vector division or subtraction of current linear measurement values and memory data
Scale	
	Autoscale, scale, reference level, reference position
	Autoscale: Automatically selects scale resolution and reference value to center the trace.
	Autoscale all: Scales all visible traces.
Display range	
	Start, stop, center, span
Return loss, log magnitude	–1000 to 1000 dB
Log magnitude resolution	0.01 dB
Phase	–180 to +180 degrees (unwrapped phase can show larger values)
Phase resolution	0.01 degrees
Phase offset	–360 to +360 degrees
VSWR	1.01 to 1000
VSWR	0.01
Data markers	
	Each trace has six independent markers that can be displayed simultaneously.
	Delta markers are available for each marker.
Marker formats	
	Default marker format is the trace format. In Smith chart or polar format, [Real + Imag] or [Mag and Phase] formats are also available.
	Default, R+jX, Z magnitude, phase, real, imaginary, mag and phase
Marker functions	
	Peak, Next Peak, Peak Left, Peak Right, Mkr → Center, Mkr → Delay, Min Search, Peak Excursion, Peak Threshold, Target, Bandwidth (BW, Q, Loss), Tracking CAT mode only: Tracking 3 peaks (CAT mode), Marker → Start distance, Marker → Stop distance
Marker table	
	On/Off
Marker types	
	Normal, delta, data trace and memory trace markers
Marker coupling	
	On/Off (coupling between traces)

Cable and Antenna Analyzer and Vector Network Analyzer (continued)

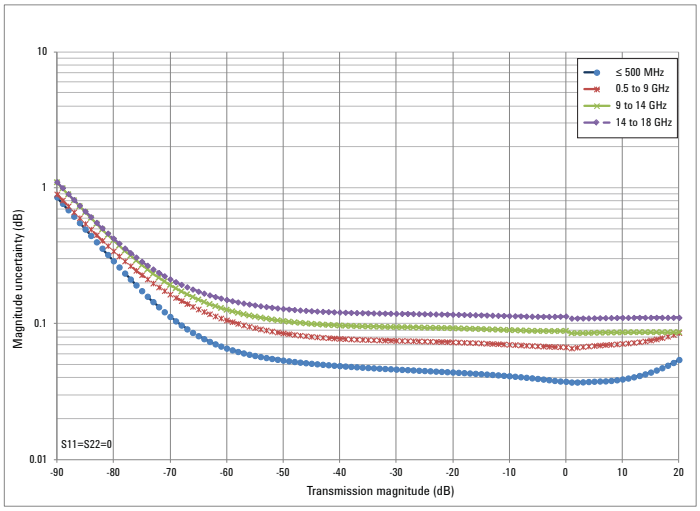
Calibration	Notes	
CalReady	FieldFox is calibrated at the test ports at the factory at room temperature, so users can make basic measurements upon power up.	
Response cal	Open or short response cal, with or without isolation	
	Normalization	
Short-open-load (SOL)	In addition to SOL, FieldFox supports SSL (short-offset short-load), which is a variation of SOL. SSL is often used in waveguide calibrations.	
Enhanced response cal	Also known as one-path, two-port	
Full 2-port	Full 2-port error correction based on short-open-load-response (SOLR) or unknown thru algorithm.	
	FieldFox's recommended calibration for non-insertable devices.	
QSOLT	Full 2-port error correction, though requires fewer connections compared to full 2-port (SOLR). Requires an insertable DUT.	
	FieldFox's recommended calibration for insertable devices.	
TRL	Standard and multi-line TRL supported.	
QuickCal	Uses internal and a subset of external standards. QuickCal is most accurate for DUTs with 7/16 and Type-N connectors and measurement uncertainties are provided for frequencies ≤ 18 GHz. Reduced accuracy for DUTs with 3.5 mm (m), SMA (m), or other male coaxial connectors; performance is unspecified. QuickCal is not recommended for DUTs with 3.5 mm (f), SMA (f), or other similar female connectors. QuickCal is not applicable to waveguide.	
Connectors	Coaxial:	Waveguide bands:
	Type-N 50 Ω	X-band WR-90
	Type-N 75 Ω	P-band WR-62
	Type-F	K-band WR-42
	7/16	
	TNC	
	2.4 mm	
	3.5 mm	
	7 mm	
	The connectors listed above are based on the default cal kits that are pre-loaded onto all microwave FieldFoxes. If a user saves a new cal kit with a different connector type on a FieldFox, then that new connector type will appear in the list. Custom coaxial or waveguide calibration kits can be added to any FieldFox analyzer	
ECal	FieldFox supports all of Keysight's USB ECal modules.	
Mechanical cal kits	List available at: www.keysight.com/find/fieldfoxsupport	
	Other cal kits can be added to FieldFox.	
Guided Cal Wizard	FieldFox's calibration wizard recommends a calibration type and calibration kit based on selected S-parameters and connector types. Alternatively, users can select their own calibration type and calibration kit.	
Interpolated error correction	With any type of accuracy enhancement applied, interpolated mode recalculates the error coefficients when the test frequencies are changed. The number of points can be increased or decreased and the start/stop frequencies can be changed, but the resulting frequency span must be a subset of the original calibration frequency span.	
Distance-to-fault		
Range	Range = velocity factor x speed of light x (number of points -1) / frequency span x 2	
	Number of points auto coupled according to start and stop distance entered.	
Range resolution	Resolution = range / (number of points -1)	
	Number of points settable by user	
Transform modes	Bandpass, low-pass	
Window types	Maximum, medium, and minimum	
Alias-free range indicator for bandpass mode	On/Off	
Dispersion compensation	Yes	

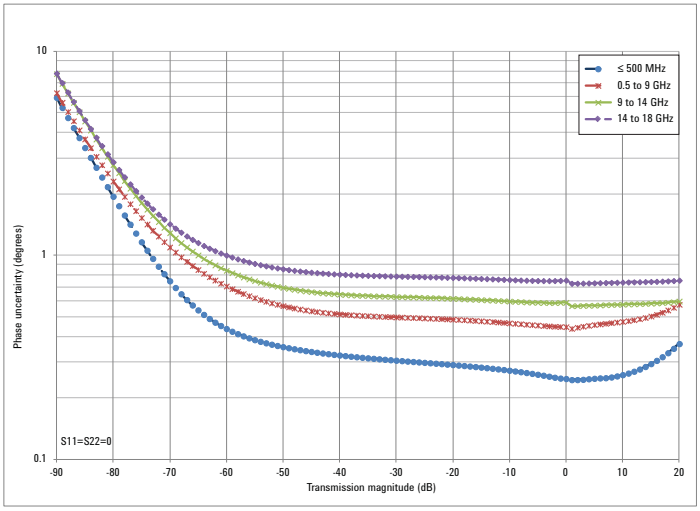
Corrected measurement uncertainty

Power level of -15 dBm, 10 Hz IF bandwidth, no averaging, battery saver off, and 30-minute warm-up time. Includes uncertainties due to drift, noise, compression, and dynamic accuracy. Coverage factor of x1 applied to uncertainties, for ease of comparison with other industry handheld analyzers.

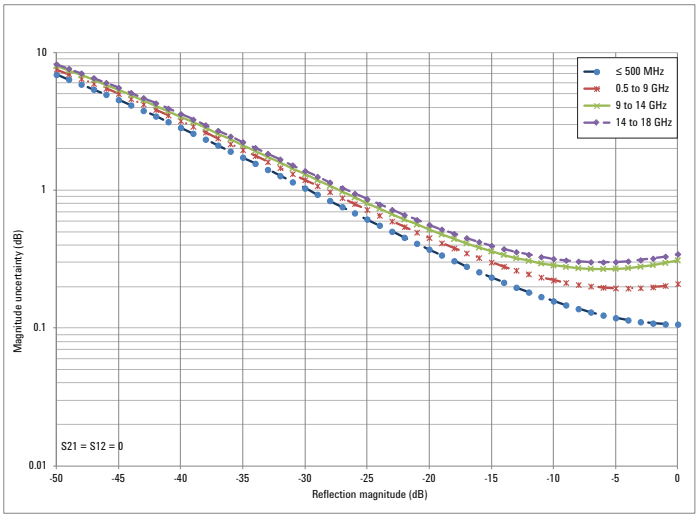
CalReady, Type-N test ports; applies to N9913/4/5/6/7A and N9925/6/7A [1]

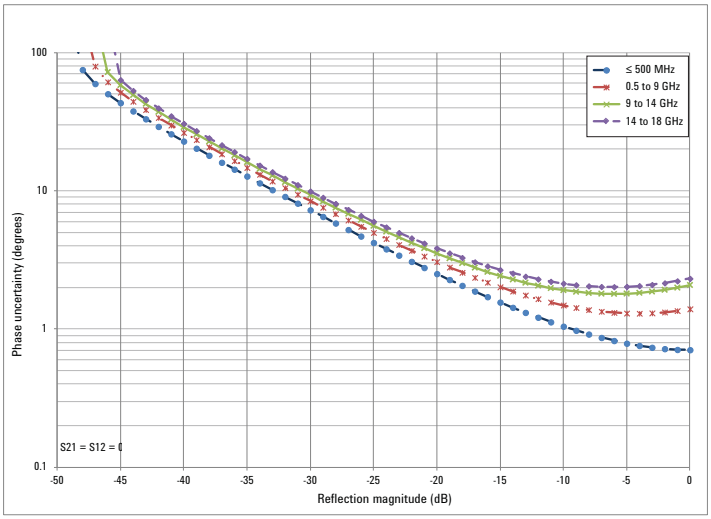
Transmission uncertainty (S21, S12)





Reflection uncertainty (S11, S22)





1. Uncertainties shown based on a factory calibration using data-based calibration kits.

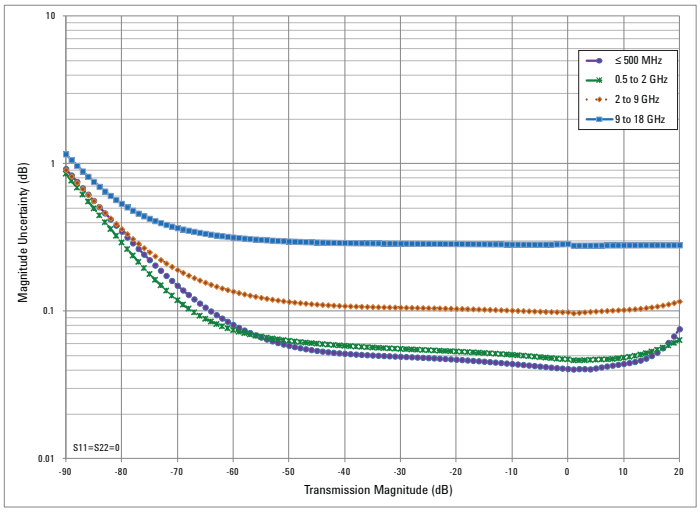
Corrected measurement uncertainty (continued)

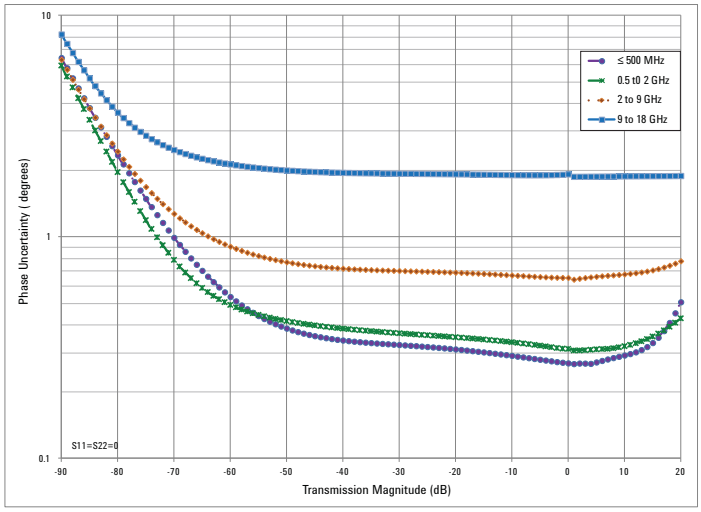
Power level of –15 dBm, 10 Hz IF bandwidth, no averaging, battery saver off, and 60-minute warm-up time. Includes uncertainties due to drift, noise, compression, and dynamic accuracy. Coverage factor of x1 applied to uncertainties, for ease of comparison with other industry handheld analyzers.

Full 2-port calibration, 85518A or 85519A Type-N (m) 4-in-1 calibration kit, spec

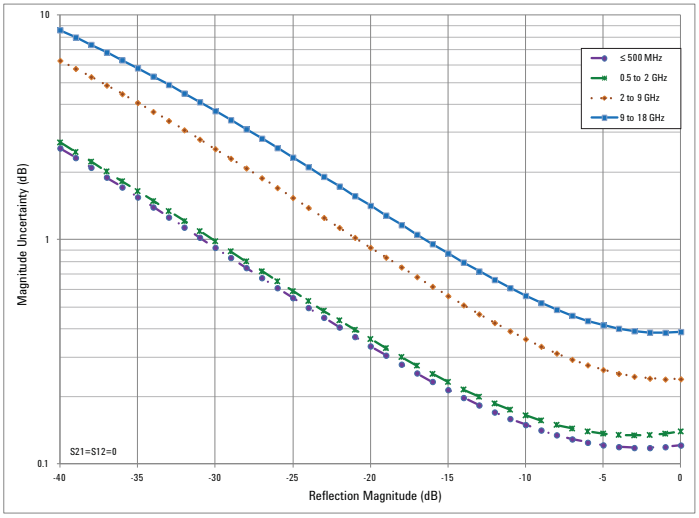
Corrected performance	≤ 0.5 GHz	0.5 to 2 GHz	2 to 9 GHz	9 to 18 GHz
Directivity	44 dB	42 dB	35 dB	32 dB
Source match	37 dB	36 dB	33 dB	30 dB
Load match	38 dB	37 dB	31 dB	27 dB
Reflection tracking	± 0.05 dB	± 0.06 dB	± 0.07 dB	± 0.1 dB
Transmission tracking	± 0.07 dB	± 0.1 dB	± 0.18 dB	± 0.5 dB

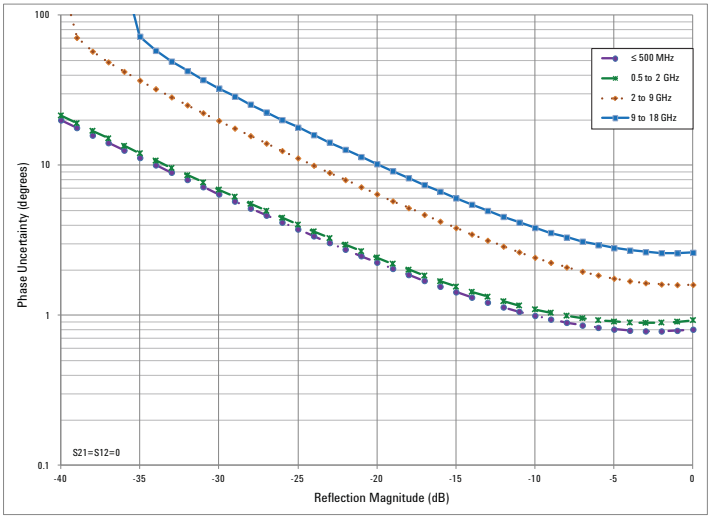
Transmission uncertainty (S21, S12)





Reflection uncertainty (S11, S22)





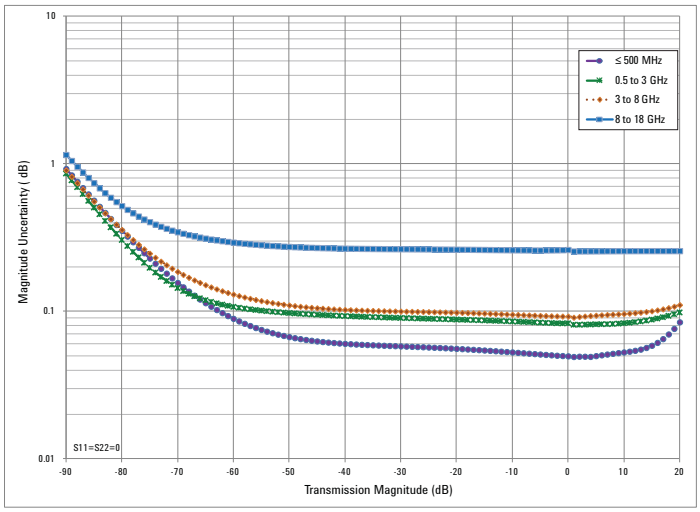
Corrected measurement uncertainty (continued)

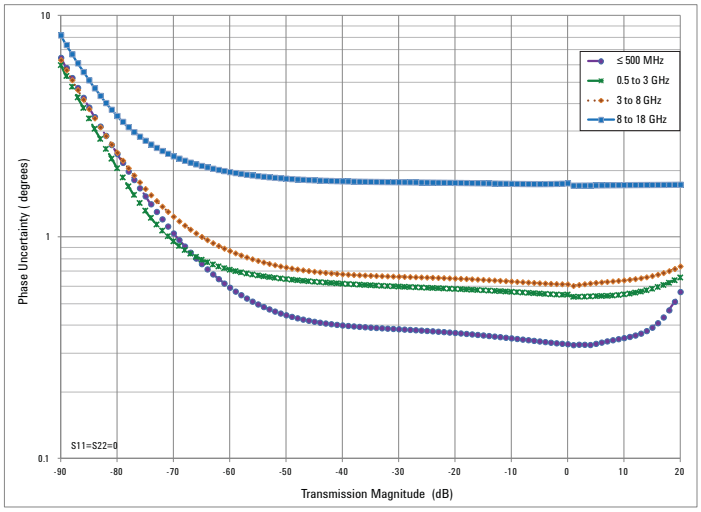
Power level of -15 dBm, 10 Hz IF bandwidth, no averaging, battery saver off, and 60-minute warm-up time. Includes uncertainties due to drift, noise, compression, and dynamic accuracy. Coverage factor of x1 applied to uncertainties, for ease of comparison with other industry handheld analyzers.

Full 2-port calibration, 85054D Type-N (m) calibration kit, spec

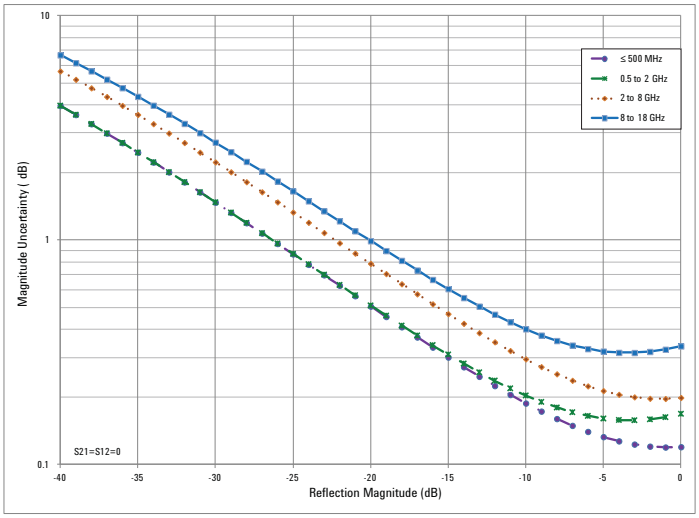
Corrected performance	≤ 0.5 GHz	0.5 to 2 GHz	2 to 8 GHz	8 to 18 GHz
Directivity	40 dB	40 dB	36 dB	34 dB
Source match	38 dB	33 dB	33 dB	27 dB
Load match	37 dB	35 dB	32 dB	27 dB
Reflection tracking	± 0.006 dB	± 0.006 dB	± 0.009 dB	± 0.027 dB
Transmission tracking	± 0.08 dB	± 0.1 dB	± 0.15 dB	± 0.43 dB

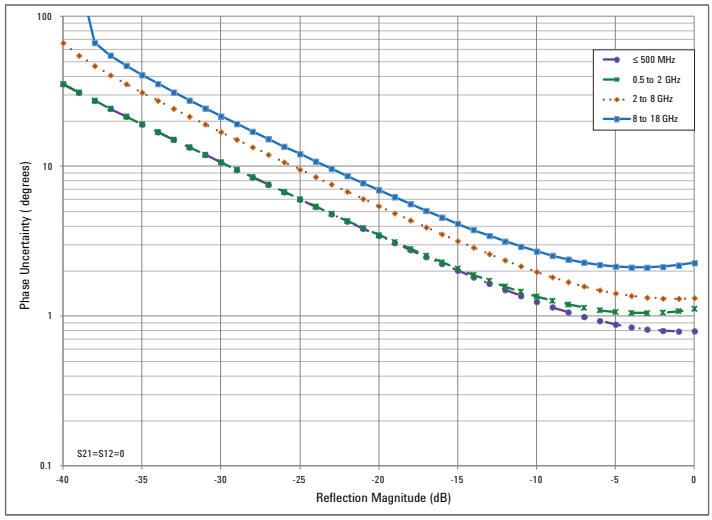
Transmission uncertainty (S21, S12)





Reflection uncertainty (S11, S22)



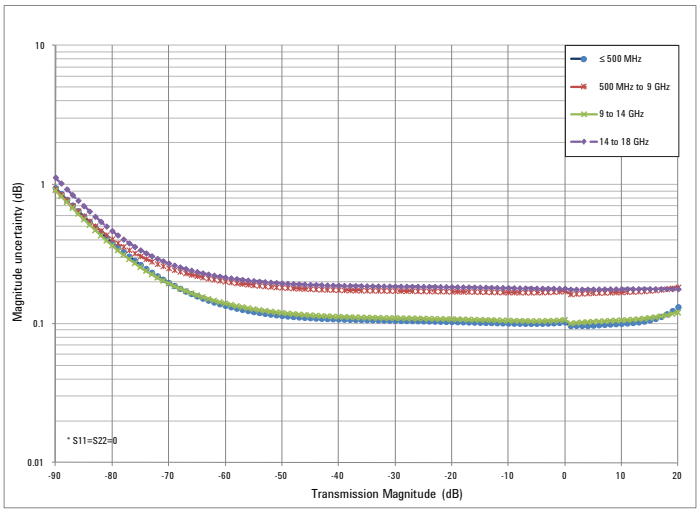


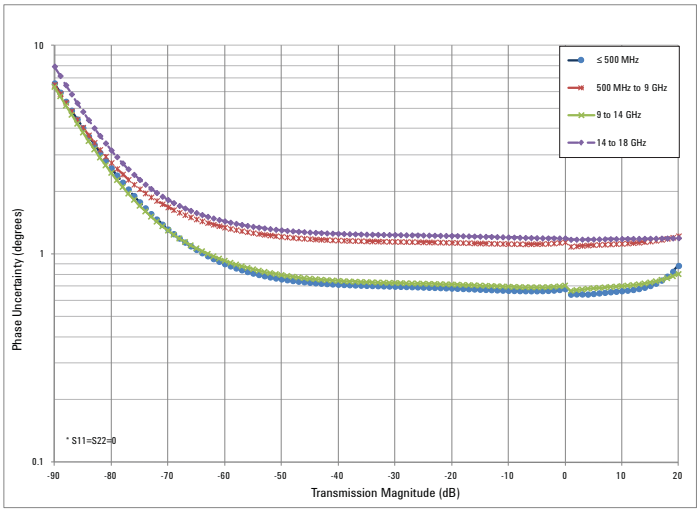
Corrected measurement uncertainty (continued)

Power level of -15 dBm, 10 Hz IF bandwidth, no averaging, battery saver off, and 30-minute warm-up time. Includes uncertainties due to drift, noise, compression, and dynamic accuracy. Coverage factor of x1 applied to uncertainties, for ease of comparison with other industry handheld analyzers.

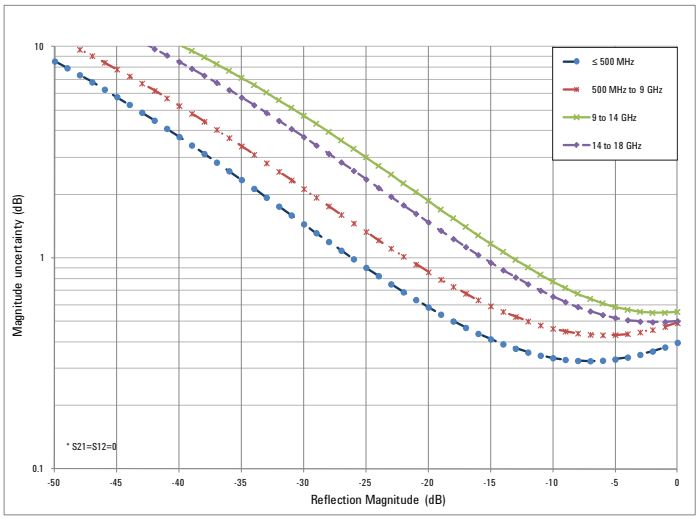
Full 2-port QuickCal calibration with load, Type-N (m) device [1]

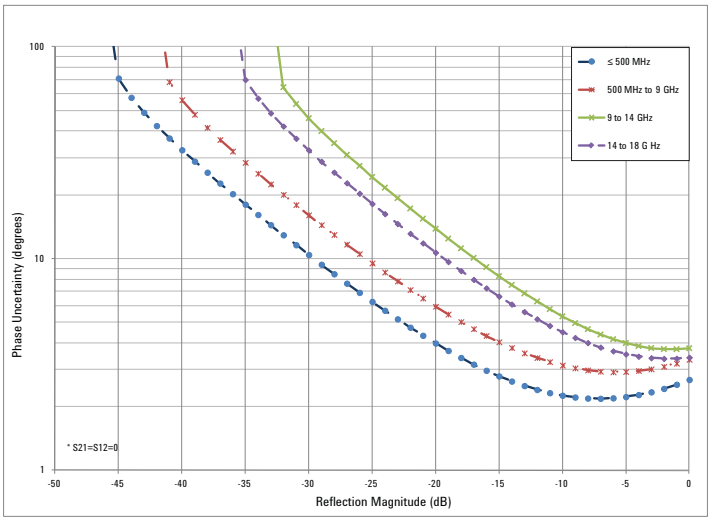
Transmission uncertainty (S21, S12)





Reflection uncertainty (S11, S22)





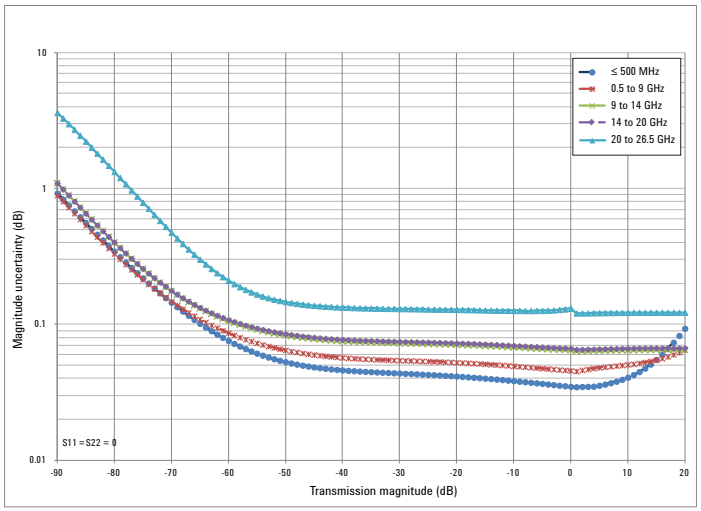
1. Uncertainties shown based on a factory calibration using data-based calibration kits.

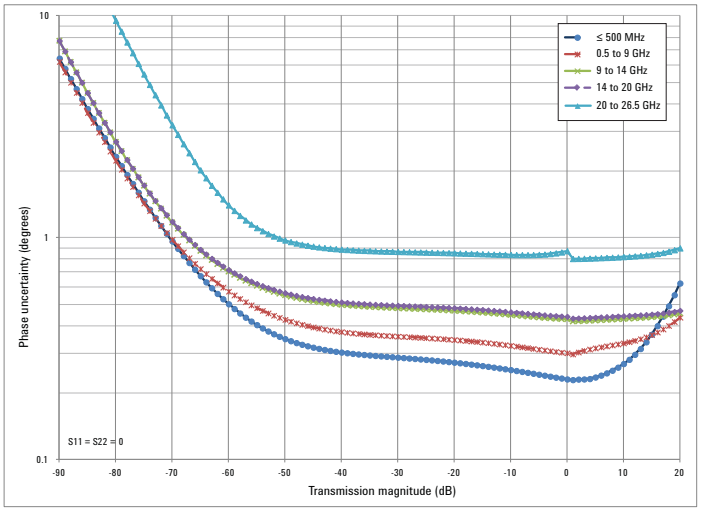
Corrected measurement uncertainty (continued)

Power level of -15 dBm, 10 Hz IF bandwidth, no averaging, battery saver off, and 30-minute warm-up time. Includes uncertainties due to drift, noise, compression, and dynamic accuracy. Coverage factor of x1 applied to uncertainties, for ease of comparison with other industry handheld analyzers.

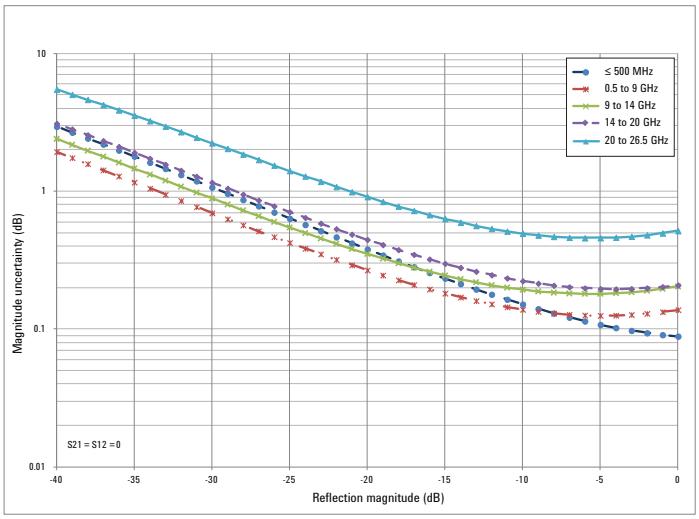
CalReady, 3.5 mm test ports; applies to N9918A, N9928A [1]

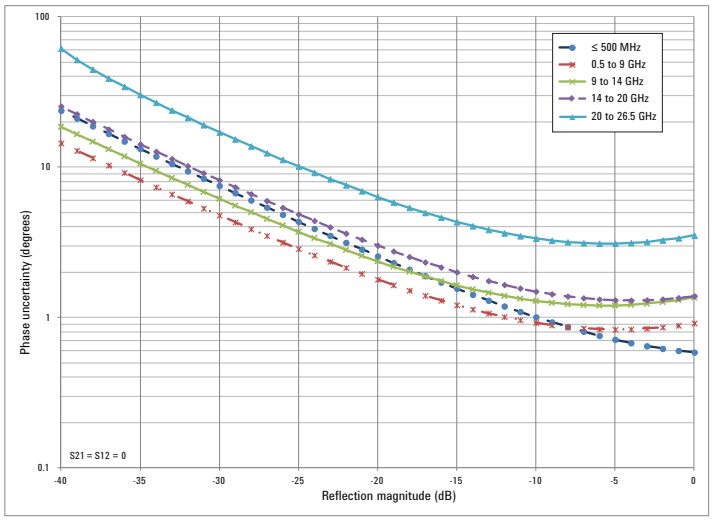
Transmission uncertainty (S21, S12)





Reflection uncertainty (S11, S22)





1. Uncertainties shown based on a factory calibration using data-based calibration kits.

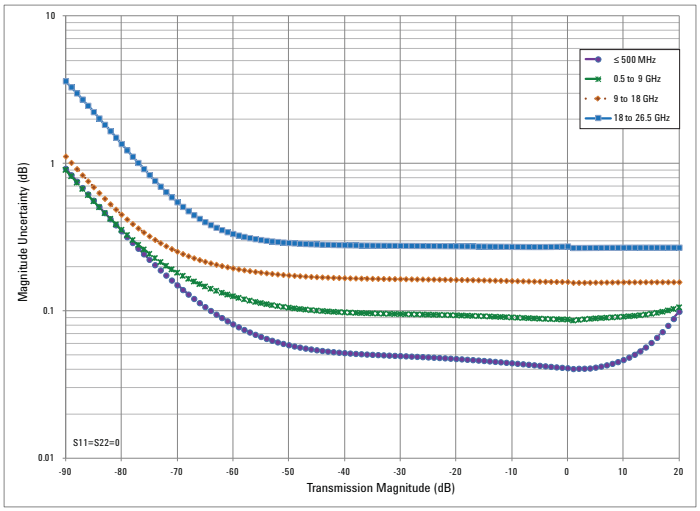
Corrected measurement uncertainty (continued)

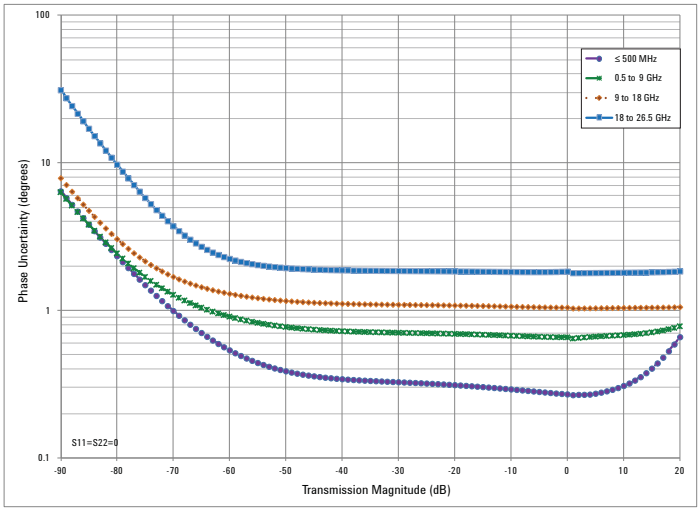
Power level of -15 dBm, 10 Hz IF bandwidth, no averaging, battery saver off, and 60-minute warm-up time. Includes uncertainties due to drift, noise, compression, and dynamic accuracy. Coverage factor of x1 applied to uncertainties, for ease of comparison with other industry handheld analyzers.

Full 2-port calibration, 85520A or 85521A 3.5 mm (m) 4-in-1 OSLT calibration kit, spec

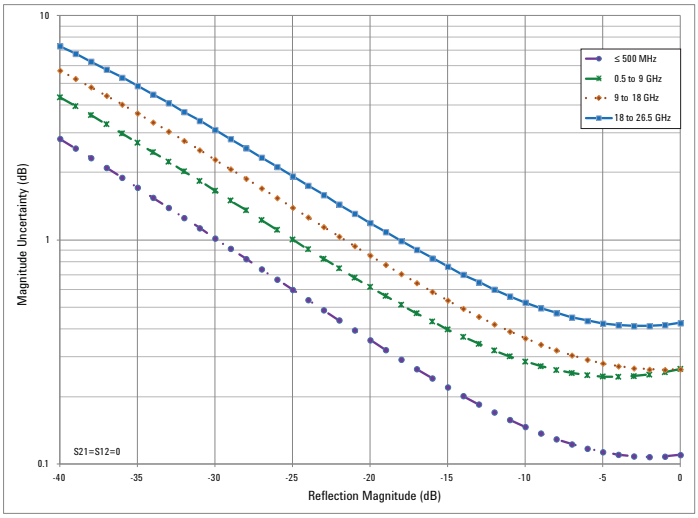
Corrected performance	≤ 0.5 GHz	0.5 to 9 GHz	9 to 8 GHz	18 to 26.5 GHz
Directivity	42 dB	36 dB	32 dB	32 dB
Source match	37 dB	30 dB	28 dB	27 dB
Load match	37 dB	30 dB	28 dB	24 dB
Reflection tracking	± 0.035 dB	± 0.13 dB	± 0.14 dB	± 0.21 dB
Transmission tracking	± 0.07 dB	± 0.29 dB	± 0.33 dB	± 0.52 dB

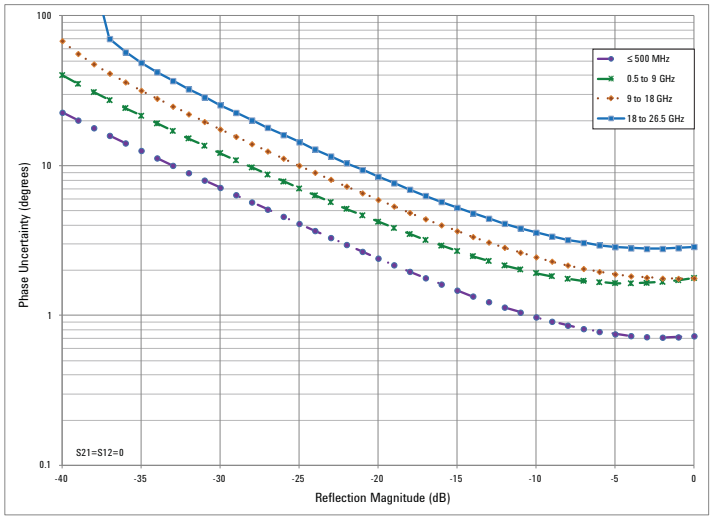
Transmission uncertainty (S21, S12)





Reflection uncertainty (S11, S22)





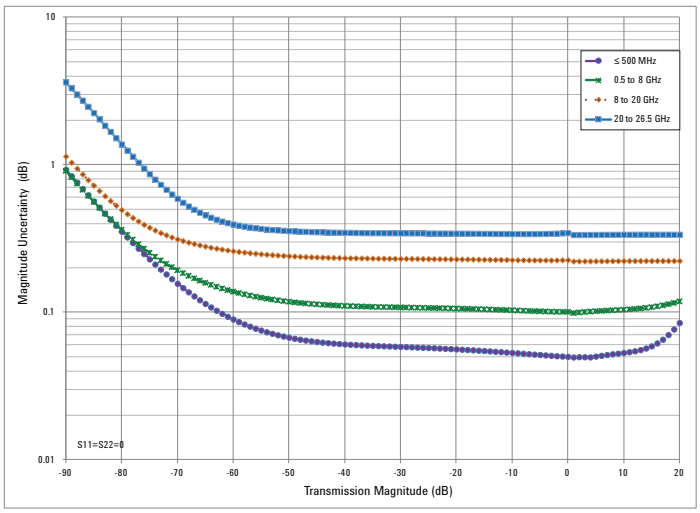
Corrected measurement uncertainty (continued)

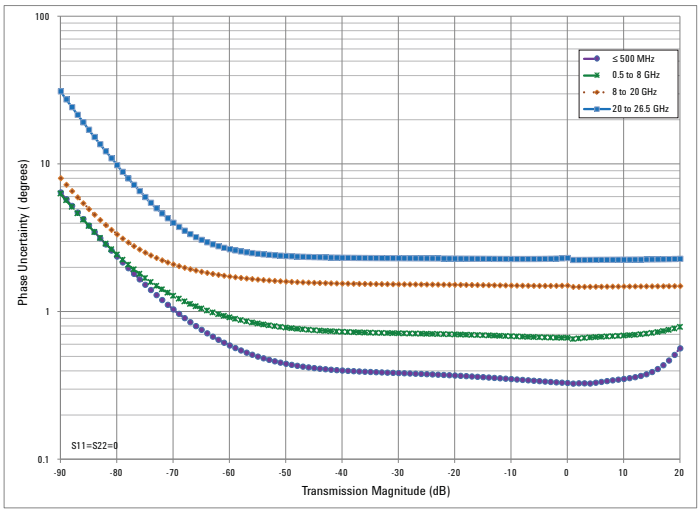
Power level of -15 dBm, 10 Hz IF bandwidth, no averaging, battery saver off, and 60-minute warm-up time. Includes uncertainties due to drift, noise, compression, and dynamic accuracy. Coverage factor of x1 applied to uncertainties, for ease of comparison with other industry handheld analyzers.

Full 2-port calibration, 85052D 3.5 mm calibration kit, spec

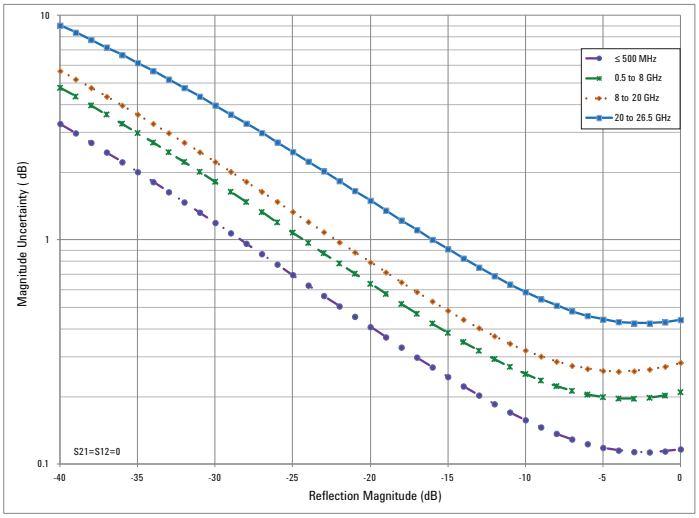
Corrected performance	≤ 0.5 GHz	0.5 to 8 GHz	8 to 20 GHz	20 to 26.5 GHz
Directivity	42 dB	38 dB	36 dB	30 dB
Source match	37 dB	31 dB	28 dB	25 dB
Load match	38 dB	33 dB	29 dB	24 dB
Reflection tracking	± 0.005 dB	± 0.006 dB	± 0.009 dB	± 0.012 dB
Transmission tracking	± 0.07 dB	± 0.135 dB	± 0.32 dB	± 0.50 dB

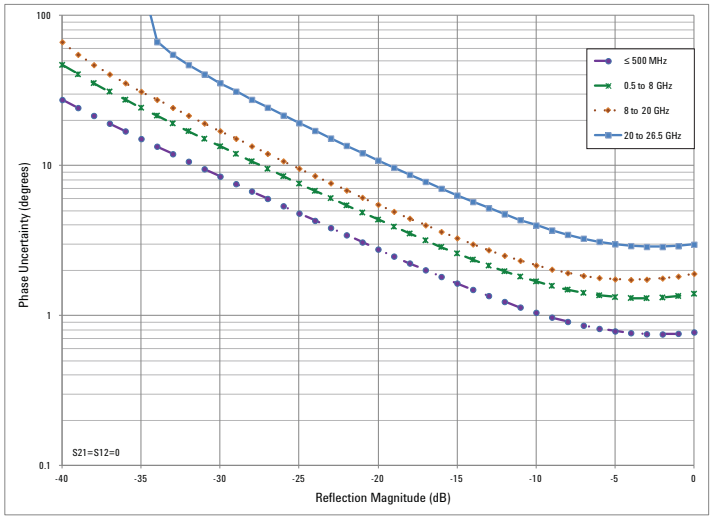
Transmission uncertainty (S21, S12)





Reflection uncertainty (S11, S22)





The performance listed in this section applies to the capabilities available in the following models:
- FieldFox microwave combination analyzers: **N9913A, N9914A, N9915A, N9916A, N9917A, N9918A**
- FieldFox microwave vector network analyzers: **N9925A, N9926A, N9927A, N9928A**

See **FieldFox Configuration Guide** for option information. Many capabilities listed in this Data Sheet require options.

TDR Cable Measurements

The TDR cable option adds time domain reflectometry (TDR) measurements to FieldFox's CAT mode. FieldFox's TDR measurements are based on an inverse Fourier transform of the frequency-domain data. TDR measurements are useful in not only identifying the location of faults along cables, but also the nature of the fault. Resistive, inductive and capacitive faults will each have a different response. These differences help engineers and technicians trouble-shoot line faults.

Measurements: TDR (linear rho) and TDR impedance (ohm)
Y-axis: linear (rho) or impedance (ohm)
X-axis: distance (meters or feet)

VNA Time Domain

In time-domain mode, FieldFox computes the inverse Fourier transform of the frequency-domain data to display reflection or transmission coefficients versus time.

Setup parameters
- Time: start, stop, center, span
- Gating: start, stop, center, span, and on/off
- Number of points, velocity factor, line loss, window shape, independent control for all four traces

Time stimulus modes	
Low-pass step	Low-pass step is similar to a traditional time domain reflectometer (TDR) stimulus waveform. It is used to measure low-pass devices. The frequency-domain data should extend from DC (extrapolated value) to a higher value.
Low-pass impulse	Low-pass impulse response is used to measure low-pass devices.
Bandpass impulse	The bandpass impulse simulates 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.	
Windows	Minimum, medium and maximum, manual entry of Kaiser Beta and impulse width.
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. The results can be viewed with gating on and off, using two traces.	
Gate types	Notch, bandpass
Gate shapes	Maximum, wide, normal, minimum

Mixed-Mode S-Parameters

Mixed-mode S-parameters are also known as balanced measurements.

Measurements	
Scc11	Common mode reflection
Sdd11	Differential mode reflection
Scd11	Differential mode stimulus, common mode response
Sdc11	Common mode stimulus, differential mode response

FieldFox's mixed-mode S-parameter measurements require the use of the default factory calibration or a user 2-port calibration. So the FieldFox analyzer must be equipped with 2-port measurement functionality to measure mixed-mode S-parameters. Mixed-mode S-parameters are an extension of the VNA capabilities.

Vector Voltmeter (VVM)

The performance listed in this section applies to the VVM capabilities available in the following models:
- FieldFox microwave combination analyzers: **N9913A, N9914A, N9915A, N9916A, N9917A, N9918A**
- FieldFox microwave vector network analyzers: **N9925A, N9926A, N9927A, N9928A**

See **FieldFox Configuration Guide** for option information. Many capabilities listed in this Data Sheet require options.

With vector voltmeter mode, you can characterize the difference between two measurements easily. The zeroing function allows you to create a reference signal, and characterize the difference between two device measurements. The results are shown on a large display in digital format.

Models	Frequency range
N9913A	30 kHz to 4 GHz
N9914A	30 kHz to 6.5 GHz
N9915A, N9925A	30 kHz to 9 GHz
N9916A, N9926A	30 kHz to 14 GHz
N9917A, N9927A	30 kHz to 18 GHz
N9918A, N9928A	30 kHz to 26.5 GHz

Setup parameters

- 1-port cable trimming - reflection or S11 measurement, magnitude and phase
- 2-port transmission - transmission or S21 measurement, magnitude and phase
- A/B and B/A - ratio of two receivers or channels, magnitude and phase – Need an external signal generator for the A/B or B/A measurement
- Frequency (one CW frequency point)
- IF bandwidth - 10 Hz to 100 kHz
- Output power - Low or high

Ratio accuracy (A/B and B/A)

Must zero before measuring DUT. Recommend using a high-quality power splitter or 6 dB attenuators to minimize uncertainty due to mismatch.

Frequency	Typical
100 kHz to 300 kHz	± 1.0 dB
300 kHz to 1 MHz	± 0.4 dB
1 MHz to 100 MHz	± 0.2 dB
100 MHz to 300 MHz	± 0.4 dB
300 MHz to 1.5 GHz	± 0.6 dB
1.5 GHz to 2 GHz	± 1.0 dB

Spectrum Analyzer

The specifications in this section apply to the spectrum analyzer capabilities available in the following models:
- FieldFox microwave combination analyzers: **N9913A, N9914A, N9915A, N9916A, N9917A, N9918A**
- FieldFox microwave spectrum analyzers: **N9935A, N9936A, N9937A, N9938A**

See **FieldFox Configuration Guide** for option information. Many capabilities listed in this Data Sheet require options.

Specification (spec)

Specifications include guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions. Warranted performance. FieldFox must be within its calibration cycle. No warm-up required.

Typical

Expected performance of an average unit; does not include guardbands. It is not covered by the product warranty. FieldFox must be within its calibration cycle.

Nominal

A general, descriptive term or design parameter. It is not tested, and not covered by the product warranty. FieldFox must be within its calibration cycle.

Models	**Frequency range**	
N9913A	100 kHz to 4 GHz	Usable to 5 kHz
N9914A	100 kHz to 6.5 GHz	Usable to 5 kHz
N9915A, N9935A	100 kHz to 9 GHz	Usable to 5 kHz
N9916A, N9936A	100 kHz to 14 GHz	Usable to 5 kHz
N9917A, N9937A	100 kHz to 18 GHz	Usable to 5 kHz
N9918A, N9938A	100 kHz to 26.5 GHz	Usable to 5 kHz
The spectrum analyzer is tunable to 0 Hz or DC. The preamplifier covers the full band. Nominal gain of 20 dB.		
Frequency reference		
	–10 to 55 °C	
Accuracy	± 0.7 ppm (spec) + aging	
	± 0.4 ppm (typical) + aging	
Accuracy, when locked to GPS	± 0.010 ppm (spec)	
Aging rate	± 1 ppm/yr for 20 years (spec), will not exceed ± 3.5 ppm	
Frequency span	**Spec**	
Range	0 Hz (zero span), 10 Hz to maximum frequency range of instrument	
Resolution	1 Hz	
Accuracy	± (2 x RBW centering + horizontal resolution)	± (2 x RBW centering +2 x horizontal resolution) for detector = Normal
Frequency readout accuracy Start, stop, center, marker		
	± (readout frequency x frequency reference accuracy + RBW centering + 0.5 x horizontal resolution)	Horizontal resolution = frequency span/ (trace points – 1) RBW centering: – 5% x RBW, FFT mode (nominal) – 16% x RBW, step mode (nominal)
Marker frequency counter		
Accuracy	± (marker frequency x frequency reference accuracy + counter resolution)	
Resolution	1 Hz	

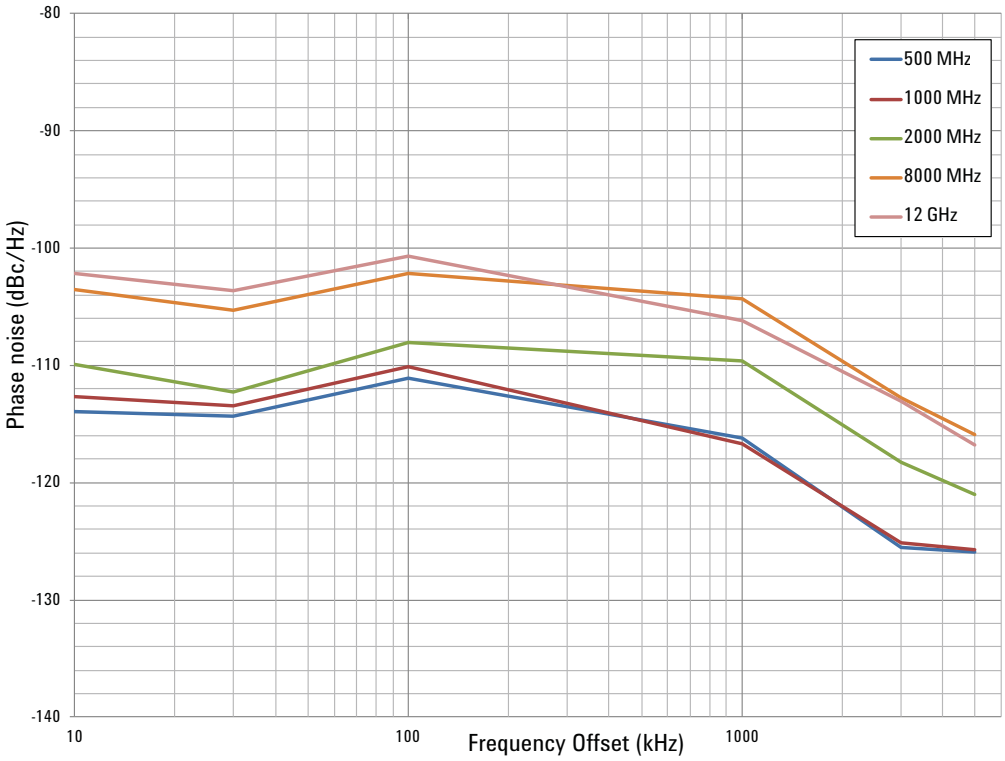
Spectrum Analyzer (continued)

Sweep acquisition, span > 0 Hz	**Spec**
Range	1 to 5000. Number of data acquisitions per measurement. Value is normalized to the minimum required to achieve amplitude accuracy with CW signals.
	Auto coupled. For pulsed RF signals, manually increase the sweep acquisition value to maximize the pulse spectrum envelope.
Resolution	1
Sweep time readout	Measured value representing time required to tune receiver, acquire data, and process trace.
Trace update	**Nominal**
Span = 20 MHz, RBW/VBW = 3 kHz	1.2 updates per second
Span = 100 MHz, RBW/VBW auto coupled	4.1 updates per second
Sweep time, zero-span	**Nominal**
Range	1 µs to 1000 s
Resolution	100 ns
Readout	Entered value representing trace horizontal scale range
Trigger (for zero-span and FFT sweeps)	
Trigger type	Free run, external, video, RF burst
Trigger slope	Positive edge, negative edge
Trigger delay	Range: -150 ms to 10 s
	Resolution: 100 ns
Auto trigger	Forces a periodic acquisition in the absence of a trigger event
	Range: 0 (off) to 10 s
Trigger position (zero-span)	Controls the horizontal position of the pulse edge; use sweep time to zoom into pulse edge
	Range: 0 to 10, integer steps; 0 is left edge of graticule, 10 is right edge of graticule
RF burst trigger	**Nominal**
Dynamic range	40 dB
Bandwidth	20 MHz
Operating frequency range	20 MHz to maximum instrument frequency
Resolution bandwidth (RBW)	**Spec**
Range (–3 dB bandwidth)	
Zero span	10 Hz to 5 MHz
	1,3,10 sequence
Non-zero span	1 Hz to 5 MHz
	1, 1.5, 2, 3, 5, 7.5, 10 sequence < 300 kHz, 300 kHz, 1 MHz, 3 MHz, 5 MHz
	Step keys change RBW in 1, 3, 10 sequence
Accuracy	**Nominal**
Zero span RBWs	
10 Hz to 1 MHz	± 5%
3 MHz	± 10%
5 MHz	± 15%
Non-zero span RBWs	
1 Hz to 100 kHz	± 1%
300 kHz to 1 MHz	± 5%
3 MHz	± 10%
5 MHz	± 15%
Selectivity (–60 dB/–3 dB)	
	4 : 1
Video bandwidth (VBW)	**Spec**
	1 Hz to 5 MHz in 1, 1.5, 2, 3, 5, 7, 10 sequence

Spectrum Analyzer (continued)

Phase noise	Stability, SSB phase noise at 1 GHz			
Offset	Spec (23 ± 5 °C)	Spec (–10 to 55 °C)	Typical (23 ± 5 °C)	Typical (–10 to 55 °C)
10 kHz	–106 dBc/Hz	–106 dBc/Hz	–111 dBc/Hz	–111 dBc/Hz
30 kHz	–106 dBc/Hz	–104 dBc/Hz	–108 dBc/Hz	–110 dBc/Hz
100 kHz	–100 dBc/Hz	–99 dBc/Hz	–104 dBc/Hz	–105 dBc/Hz
1 MHz	–110 dBc/Hz	–110 dBc/Hz	–113 dBc/Hz	–113 dBc/Hz
3 MHz	–119 dBc/Hz	–118 dBc/Hz	–122 dBc/Hz	–122 dBc/Hz
5 MHz	–120 dBc/Hz	–120 dBc/Hz	–123 dBc/Hz	–123 dBc/Hz

Phase noise at different center frequencies (nominal)



Measurement range	Spec
100 kHz to 26.5 GHz	DANL to +20 dBm
Input attenuator range	
	0 to 30 dB, in 5 dB steps
Maximum input safe level	
Average CW power	+27 dBm, 0.5 watts
DC	± 50 VDC

Spectrum Analyzer (continued)

Displayed average noise level (DANL)	RMS detection, log averaging, reference level of -20 dBm, normalized to 1 Hz RBW			
Preamp off	**Spec (23 ± 5 °C)**	**Spec (–10 to 55 °C)**	**Typical (23 ± 5 °C)**	**Typical (–10 to 55 °C)**
2 MHz to 4.5 GHz [1]	–137 dBm	–135 dBm	–139 dBm	–138 dBm
> 4.5 to 7 GHz	–133 dBm	–131 dBm	–136 dBm	–135 dBm
> 7 to 13 GHz	–129 dBm	–127 dBm	–132 dBm	–130 dBm
> 13 to 17 GHz	–124 dBm	–122 dBm	–126 dBm	–125 dBm
> 17 to 22 GHz	–119 dBm	–117 dBm	–122 dBm	–121 dBm
> 22 to 25 GHz	–114 dBm	–111 dBm	–117 dBm	–114 dBm
> 22 to 26.5 GHz	–110 dBm	–108 dBm	–112 dBm	–111 dBm
Preamp on	**Spec (23 ± 5 °C)**	**Spec (–10 to 55 °C)**	**Typical (23 ± 5 °C)**	**Typical (–10 to 55 °C)**
2 MHz to 4.5 GHz [1]	–153 dBm	–151 dBm	–155 dBm	–154 dBm
> 4.5 to 7 GHz	–149 dBm	–147 dBm	–151 dBm	–150 dBm
> 7 to 13 GHz	–147 dBm	–145 dBm	–149 dBm	–148 dBm
> 13 to 17 GHz	–143 dBm	–141 dBm	–145 dBm	–144 dBm
> 17 to 22 GHz	–140 dBm	–139 dBm	–143 dBm	–142 dBm
> 22 to 25 GHz	–134 dBm	–132 dBm	–137 dBm	–134 dBm
> 25 to 26.5 GHz	–128 dBm	–126 dBm	–131 dBm	–129 dBm

1. Increase the noise floor 4 dB for frequencies between 2.1 and 2.8 GHz.

	Spec
50 MHz absolute amplitude accuracy	50 MHz, verified with input level of 0 to –35 dBm, peak detector, 10 dB attenuation, preamplifier off, 30 kHz RBW, all settings auto-coupled, no warm-up required, –10 to 55 °C ± 0.3 dB, spec ± 0.10 dB, typical
Total absolute amplitude accuracy	Verified with input level of –10 to –5 dBm. Peak detector, 10 dB attenuation, preamplifier off, 30 kHz RBW, all settings auto-coupled, no warm-up required. Includes frequency response uncertainties.

	Spec (23 ± 5 °C)	**Spec (–10 to 55 °C)**	**Typical (23 ± 5 °C)**	**Typical (–10 to 55 °C)**
100 kHz to 18 GHz	± 0.8 dB	± 1.0 dB	± 0.35 dB	± 0.50 dB
> 18 GHz to 26.5 GHz	± 1.0 dB	± 1.2 dB	± 0.50 dB	± 0.60 dB

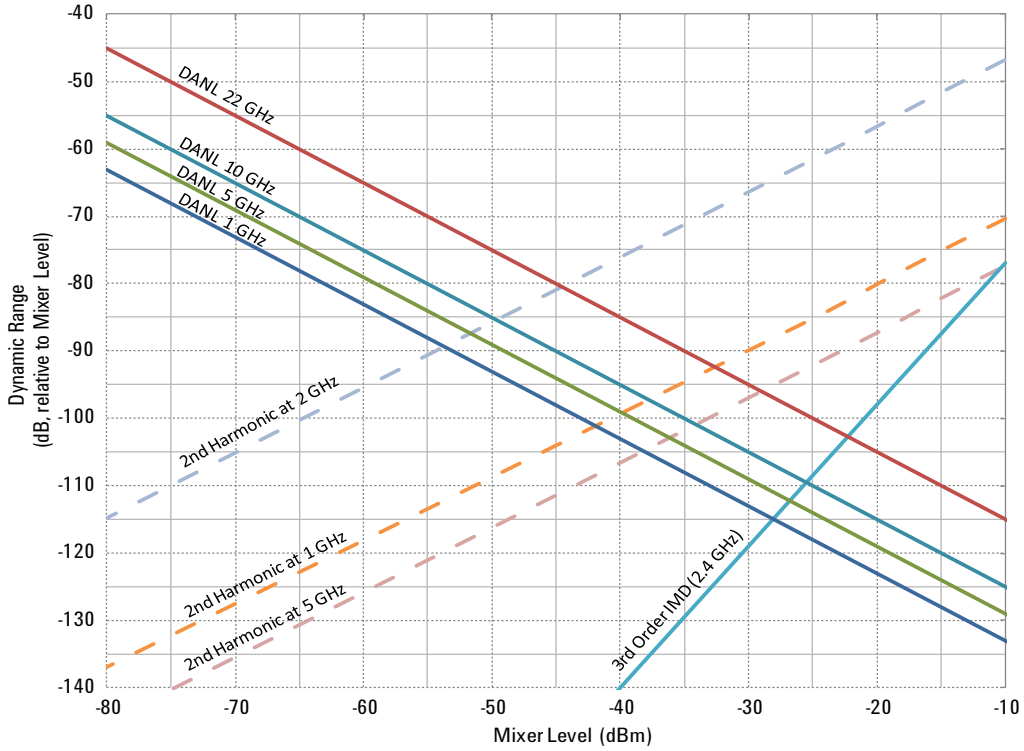
Spectrum Analyzer (continued)

Resolution bandwidth switching uncertainty	**Nominal**	
RBW < 5 MHz	0.0 dB	
For signals not at center frequency	0.7 dB peak-to-peak	
RF input VSWR, 10 dB attenuation	**Nominal**	
10 MHz to 2.7 GHz 1.7 : 1	1.7 : 1	
> 2.7 to 7.5 GHz 1.5 : 1	1.5 : 1	
> 7.5 GHz	2.2 : 1	
Second harmonic distortion	**Nominal**	
–30 dBm signal at mixer input		
≤ 4 GHz	<–60 dBc or +30 dBm	
> 4 GHz	<–80 dBc or +50 dBm	
Third order intermodulation distortion (TOI)	**Spec**	**Typical**
	At 2.4 GHz, +15 dBm	< 1 GHz, +10 dBm
		1 to 7.5 GHz, +15 dBm
		> 7.5 GHz, +21 dBm
Spur free dynamic range		
	At 2.4 GHz > 105 dB nominal	
	2/3 (TOI-DANL) in 1 Hz RBW	
Residual responses	**Nominal**	
Preamp off, 0 dB attenuation	Preamp off, 0 dB attenuation	
100 kHz to 13 GHz [1]	–110 dBm	
> 13 to 20 GHzm	–90 dBm	
> 20 to 26.5 GHz	–80 dBm	
Input related spurs		
–30 dBm signal at mixer input (excludes frequencies listed below)	–80 dBc	
f = center frequency		
< 2.6 GHz, f + 2 x 33.75 MHz	–80 dBc	
< 2.6 GHz, f – 2 x 866.25 MHz	–80 dBc	
< 2.6 GHz, f + 2 x 3.63375 GHz	–85 dBc	
≥ 2.6 to 7.5 GHz, f + 2 x 33.75 MHz	–80 dBc	
≥ 2.6 to 7.5 GHz, f + 2 x 866.25 MHz	–80 dBc	
≥ 2.6 to 7.5 GHz, f + 2 x 9.86625 GHz	–80 dBc	
≥ 7.5 to 16.3 GHz, f + 2 x 3.63375 GHz	–65 dBc	
≥ 16.3 to 26.5 GHz, f – 2 x 3.63375 GHz	–60 dBc	
≥ 7.5 to 26.5 GHz, f + 2 x 33.75 MHz	–80 dBc	
≥ 7.5 to 26.5 GHz, f – 2 x 866.25 MHz	–80 dBc	
LO related spurs		
	–60 dBc	
Sideband		
	–80 dBc	

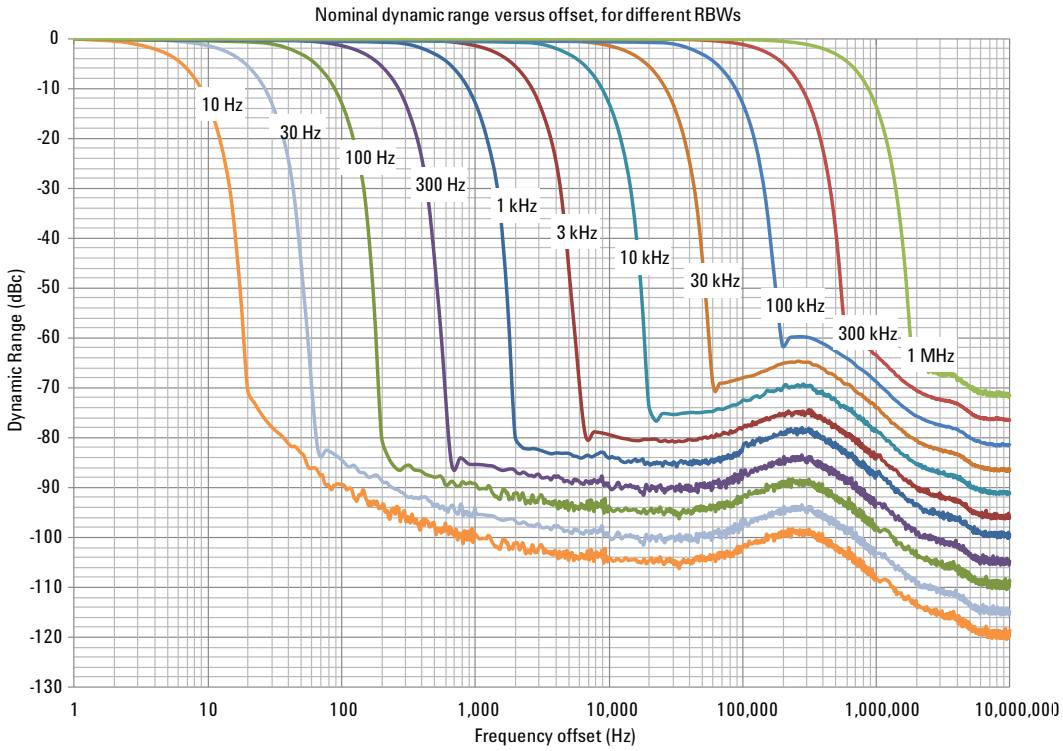
1. Excludes 4.5 MHz, –95 dBm at 4.5 MHz.

Spectrum Analyzer (continued)

Nominal distortion and noise limited (10 Hz RBW) dynamic range



Dynamic range versus offset frequency versus RBW (nominal)



Spectrum Analyzer (continued)

	Spec
Display range	Log scale
	10 divisions
	1 to 100 dB/division in 0.01 dB steps
Amplitude scale units	dBm, dBmV, dBµV, W, V, A, dBmA, dBµA
Trace detectors	Normal, positive peak, negative peak, sample, average (RMS)
Trace states	Clear/write, max hold, min hold, average, view, blank
Number of traces	4 traces; all four can be active simultaneously
Trace points	
	101, 201, 401, 801, 1001 (defaults to 401)
	10,001 points settable through SCPI
Markers	
Number of markers	6
Marker type	Normal, delta, noise, band power, frequency count
Marker to	Peak, next peak, peak left, peak right, center, reference level, minimum
	Peak criteria: peak excursion, peak threshold
	Tune frequency, for AM/FM tune and listen
Number of averages	
	1 to 10,000
Reference level	
	–150 to + 30 dBm

Tracking Generator or Independent Source

The specifications in this section apply to the tracking generator or independent source capabilities available in the following models:

- FieldFox microwave combination analyzers: **N9913A, N9914A, N9915A, N9916A, N9917A, N9918A**
- FieldFox microwave spectrum analyzers: **N9935A, N9936A, N9937A, N9938A**

See **FieldFox Configuration Guide** for option information. Many capabilities listed in this Data Sheet require options.

Note: Traditional tracking generators track the receiver frequency. In FieldFox analyzers, the tracking generator frequency can be set to either track the receiver frequency, or act as an independent CW source.

Models	**Tracking generator or independent source frequency range**	
N9913A	30 kHz to 4 GHz	
N9914A	30 kHz to 6.5 GHz	
N9915A, N9935A	30 kHz to 9 GHz	
N9916A, N9936A	30 kHz to 14 GHz	
N9917A, N9937A	30 kHz to 18 GHz	
N9918A, N9938A	30 kHz to 26.5 GHz	
Output power, maximum	**23 ± 5 °C**	
Frequency	**Typical**	**Nominal**
30 kHz to 300 kHz	–11 dBm	
300 kHz to 2 MHz	–3 dBm	–2 dBm
> 2 MHz to 625 MHz	–2 dBm	–1 dBm
> 625 MHz to 3 GHz	+1 dBm	+3 dBm
≥ 3 to 6.5 GHz	–1 dBm	+1 dBm
≥ 6.5 to 9 GHz	–2 dBm	0 dBm
≥ 9 to 14 GHz	–4 dBm	–2.5 dBm
≥ 14 to 18 GHz	–6 dBm	–4.5 dBm
≥ 18 to 23 GHz	–10 dBm	–8.5 dBm
≥ 23 to 26.5 GHz	–12 dBm	–11 dBm
Power level accuracy		
	± 1.5 dB at –15 dBm, for frequencies > 250 kHz, typical	
	Power flattened across frequency range	
Power step size		
	Power settable in 1 dB steps across power range	
Functions		
	Continuous wave (CW), CW coupled, tracking	
RF output VSWR, 10 dB attenuation	**Nominal**	
10 MHz to 2.7 GHz	1.7 : 1	
> 2.7 to 7.5 GHz	1.5 : 1	
> 7.5 GHz	2.2 : 1	
Dynamic range	**Typical, –10 to 55 °C**	
Frequency	**Preamp off**	**Preamp on**
2 MHz to 2 GHz	97 dB	112 dB
> 2 to 7 GHz	93 dB	108 dB
> 7 to 11 GHz	88 dB	103 dB
> 11 to 16 GHz	79 dB	94 dB
> 16 to 21 GHz	71 dB	86 dB
> 21 to 23 GHz	55 dB	70 dB
> 23 to 25 GHz	50 dB	65 dB
> 25 to 26.5 GHz	45 dB	60 dB

See **FieldFox Configuration Guide** for option information. Many capabilities listed in this Data Sheet require options.

Spectrum Analyzer IF Output

	Description
Center frequency	33.75 MHz
IF bandwidth	5 MHz (default), 25 MHz
Connector	SMB male
Conversion loss	0 to 27 dB nominal
	The loss increases approximately linearly as frequency increases, with ~27 dB loss at 26.5 GHz. Conversion loss is defined from RF input to SA output with –10 dBm input power, 0 dB attenuation, and preamp off.

AM/FM Tune and Listen

	Description
Audio demodulation types	AM, FM narrow, FM wide
Audio bandwidth	16 kHz
Receiver IF bandwidth	
AM	35 kHz
FM narrow	12 kHz
FM wide	150 kHz
Listen time range	0 to 100 seconds

Preamplifier

	Description
Preamplifier	Full band; nominal gain 20 dB

Interference Analyzer and Spectrogram

The capabilities listed in this section apply to the interference analyzer capabilities available in the following models:

- FieldFox microwave combination analyzers: **N9913A, N9914A, N9915A, N9916A, N9917A, N9918A**
- FieldFox microwave spectrum analyzers: **N9935A, N9936A, N9937A, N9938A**

Interference analyzer	
Spectrogram	Overlay, full screen, top, or bottom with active trace
Waterfall	
Markers	Time, delta time
Trace playback and recording	Record all spectrum analyzer measurements
	Store data internally or on USB or SD card
	Playback recorded data using FieldFox
	Frequency mask trigger allows recording to occur upon trigger

Spectrum Analyzer Time Gating

The capabilities listed in this section apply to the time gating features available in the following models:
- FieldFox microwave combination analyzers: **N9913A, N9914A, N9915A, N9916A, N9917A, N9918A**
- FieldFox microwave spectrum analyzers: **N9935A, N9936A, N9937A, N9938A**

See **FieldFox Configuration Guide** for option information. Many capabilities listed in this Data Sheet require options.

With time gating, you can measure the spectrum of a periodic signal during a specified time interval. Pulsed-RF signals are an example of a periodic signal that can be measured with time gating. For example, you can measure the pulse during the on period, not the transition or the off period. Or you can exclude interfering signals such as a periodic transient. Time gating allows you to view spectral components that would otherwise be hidden. FieldFox's time gating method is a Gated FFT.

	Description
Gate method	Gated FFT
Span range	Any span
RBW range	1 Hz to 300 kHz (derived from gate width)
Gate delay range	–150 ms to 10 s
Gate width (length) range	6 µs to 1.8 s
Gate sources	External, RF burst, Video

Reflection Measurements (RL, VSWR)

The capabilities listed in this section apply to the reflection measurements in the following models:
FieldFox microwave spectrum analyzers: **N9935A, N9936A, N9937A, N9938A**

Models	**Reflection measurements**
N9935A	30 kHz to 9 GHz
N9936A	30 kHz to 14 GHz
N9937A	30 kHz to 18 GHz
N9938A	30 kHz to 26.5 GHz

Measurements	Return loss, VSWR Normalization using data/memory

Radio standards

With a radio standard applied, pre-defined frequency bands, channel numbers or uplink / downlink selections can be used instead of manual frequency entry. The pre-defined FieldFox radio standards include bands such as W-CDMA, LTE, and GSM. Alternately, users can create custom standards and import them into FieldFox analyzers.

Extended Range Transmission Analysis (ERTA)

ERTA specifications apply to the following FieldFox models. The combination analyzers must be equipped with the spectrum analyzer option.

- FieldFox microwave combination analyzers: N9913A, N9914A, N9915A, N9916A, N9917A, N9918A
- FieldFox microwave spectrum analyzers: N9935A, N9936A, N9937A, N9938A

ERTA operation requires *two* FieldFoxes, each one configured with specific options, and certain accessories. Refer to the FieldFox Configuration Guide for detailed ordering information http://literature.cdn.keysight.com/litweb/pdf/5990-9836EN.pdf.

Definitions

Specification (spec)

Specifications include guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions. Specifications are warranted performance. FieldFox must be within its calibration cycle. No warm-up required for the specifications listed on pages 28 through 30.

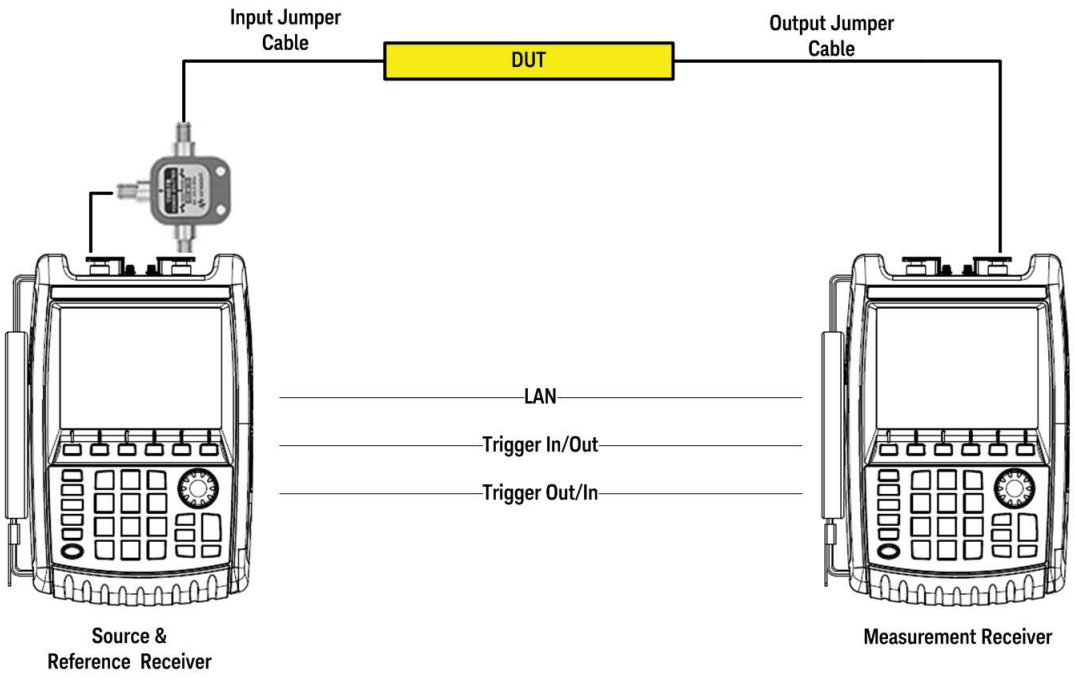
Typical

Expected performance of an average unit; does not include guardbands. It is not covered by the product warranty. FieldFox must be within its calibration cycle.

System Description

ERTA can be used to measure the scalar transmission gain or loss of an RF system. It is useful when measuring long lossy cables where the two ends cannot easily be brought together, such as those bolted in on ships or aircrafts. It is also useful in measuring the insertion loss of waveguide systems, or using the frequency-offset feature, devices such as mixers and converters.

ERTA measurements are based on two FieldFoxes; one at each end of the measured DUT. One FieldFox is the source and reference receiver (R), while the other is the measurement receiver (B). The two FieldFoxes are synchronized using hardware triggering. By taking advantage of FieldFox's InstAlign technique, ERTA can be used to make accurate gain or loss measurements.



ERTA system diagram

Extended Range Transmission Analysis (ERTA) (continued)

Frequency Range

The ERTA frequency range is limited by each individual analyzer's frequency range.

Models	Source frequency range	Receiver frequency range[1]
N9913A	30 kHz to 4 GHz	100 kHz to 4 GHz
N9914A	30 kHz to 6.5 GHz	100 kHz to 6.5 GHz
N9915A, N9935A	30 kHz to 9 GHz	100 kHz to 9 GHz
N9916A, N9936A	30 kHz to 14 GHz	100 kHz to 14 GHz
N9917A, N9937A	30 kHz to 18 GHz	100 kHz to 18 GHz
N9918A, N9938A	30 kHz to 26.5 GHz	100 kHz to 26.5 GHz

Frequency Reference Accuracy

Refer to the frequency accuracy specifications on page 3.

Frequency Setup Parameters

Receiver frequency	Center/span or start/stop (standard spectrum analyzer settings) Reverse receiver sweep direction (default direction is forward, but can be set to reverse)
Source frequency [Remote]	[Tracking] – FieldFox source tracks the receiver by default. The frequencies are identical. [CW] – FieldFox's source can be set to a CW frequency independent of FieldFox's receiver frequency. FieldFox's source is at a single CW frequency; FieldFox's receiver is swept. [Coupled CW] – FieldFox's source CW frequency is auto-coupled to FieldFox's receiver [Center Frequency] setting.

Frequency-offset Capability

This feature allows FieldFox's source frequency to be offset from FieldFox's receiver frequency. The offset frequency can be negative, zero, or positive. The frequency-offset capability is useful when characterizing the scalar transmission response of devices such as mixers and converters.

Frequency-offset Setup Parameters

Receiver frequency	Center/span or start/stop (standard spectrum analyzer settings) Receiver frequency span is always equal to source frequency span.
Frequency tracking offset	On/Off Offset values: 0, >0, <0
Receiver sweep direction	Reversal: Off Default setting Both source and receiver sweep in the forward direction. Receiver stop frequency > Receiver start frequency Source frequency = Offset + Receiver frequency Reversal: On Source and receiver sweep in opposite directions. Source frequency = Offset – Receiver frequency Offset > receiver frequency

FieldFox's Source Output Power

Refer to the test port output power typical data on page 4.

1 The receiver (spectrum analyzer) is usable to 5 kHz, though only specified to 100 kHz.

Extended Range Transmission Analysis (ERTA) (continued)

Dynamic Range and Maximum Attenuation

Dynamic range is the difference between the maximum output power available from FieldFox's source and the noise floor of the second FieldFox, while ensuring that neither FieldFox's ADC goes into over-range. Dynamic range also accounts for the loss of the power splitter. Dynamic range is applicable when testing devices such as filters, where there is low loss in the passband, and significant loss in the stopband, and both passband and stopband need to be on the display at the same time (same sweep).

Maximum attenuation is the difference between maximum output power available from FieldFox's source and the noise floor of FieldFox. It also accounts for the loss of power splitter. Maximum attenuation is applicable when testing devices such as cables, which have relatively uniform loss over the swept frequency range.

The values shown below are based on the recommended minimum RBW of 3 kHz when the frequency references are locked via GPS, and 300 kHz when the frequency references are unlocked. Locking the frequency references to GPS allows for greater frequency accuracy of the FieldFoxes and use of a narrower RBW, which in turn results in a lower DANL, and hence a wider measurement range. When the GPS signals cannot be present at all times, the GPS hold-over mode can be used.

	Typical (23 ± 5 °C)			
Dynamic range	**Pre-amp Off** Frequency references locked to GPS, RBW 3 kHz	**Pre-amp On** Frequency references locked to GPS, RBW 3 kHz	**Pre-amp Off** Frequency references unlocked, RBW 300 kHz	**Pre-amp On** Frequency references unlocked, RBW 300 kHz
> 2 MHz[1] to 6 GHz	88 dB	83 dB	68 dB	63 dB
> 6 GHz to 13 GHz	86 dB	83 dB	66 dB	63 dB
> 13 GHz to 22 GHz	70 dB	86 dB	50 dB	66 dB
> 22 GHz to 25 GHz	63 dB	83 dB	43 dB	63 dB
> 25 GHz to 26.5 GHz	58 dB	77 dB	38 dB	57 dB

	Typical (23 ± 5 °C)			
Maximum attenuation	**Pre-amp Off** Frequency references locked to GPS, RBW 3 kHz	**Pre-amp On** Frequency references locked to GPS, RBW 3 kHz	**Pre-amp Off** Frequency references unlocked, RBW 300 kHz	**Pre-amp On** Frequency references unlocked, RBW 300 kHz
> 2 MHz to 6 GHz	93 dB	108 dB	73 dB	88 dB
> 6 GHz to 13 GHz	86 dB	103 dB	66 dB	83 dB
> 13 GHz to 22 GHz	70 dB	91 dB	50 dB	71 dB
> 22 GHz to 25 GHz	63 dB	83 dB	43 dB	63 dB
> 25 GHz to 26.5 GHz	58 dB	77 dB	38 dB	57 dB

1 Dynamic range is decreased from 3 to 9 dB at 2 MHz.

Cable Correction

Input and output jumper cable losses can be accounted for using ERTA's cable correction wizard.

Absolute Power and Gain Measurement Uncertainties

Verified with input level of -10 dBm, peak detector, 10 dB attenuation, pre-amplifier off, all settings auto-coupled, no warm-up required. Includes frequency response uncertainties. Assumes an ERTA system using a Keysight 11667A or 11667B power splitter.

Input power (R) measurement uncertainty, 30 kHz RBW

	Spec (23 ± 5 °C)	Spec (-10 to 55 °C)	Typical (23 ± 5 °C)	Typical (-10 to 55 °C)
100 kHz to 18 GHz	± 1.1 dB	± 1.3 dB	± 0.40 dB	± 0.50 dB
> 18 GHz to 26.5 GHz	± 1.4 dB	± 1.5 dB	± 0.50 dB	± 0.60 dB

Output power (B) measurement uncertainty, frequency references locked to GPS, RBW ≥ 3 kHz

	Spec (23 ± 5 °C)	Spec (-10 to 55 °C)	Typical (23 ± 5 °C)	Typical (-10 to 55 °C)
100 kHz to 18 GHz	± 1.0 dB	± 1.2 dB	± 0.40 dB	± 0.50 dB
> 18 GHz to 26.5 GHz	± 1.2 dB	± 1.4 dB	± 0.50 dB	± 0.60 dB

Output power (B) measurement uncertainty, frequency references unlocked, RBW ≥ 300 kHz

	Spec (23 ± 5 °C)	Spec (-10 to 55 °C)	Typical (23 ± 5 °C)	Typical (-10 to 55 °C)
100 kHz to 18 GHz	± 1.0 dB	± 1.3 dB	± 0.40 dB	± 0.50 dB
> 18 GHz to 26.5 GHz	± 1.4 dB	± 1.6 dB	± 0.50 dB	± 0.60 dB

Gain/Loss (B/R) measurement uncertainty, frequency references locked to GPS, RBW ≥ 3 kHz

	Spec (23 ± 5 °C)	Spec (-10 to 55 °C)	Typical (23 ± 5 °C)	Typical (-10 to 55 °C)
100 kHz to 18 GHz	± 1.3 dB	± 1.7 dB	± 0.60 dB	± 0.70 dB
> 18 GHz to 26.5 GHz	± 1.7 dB	± 2.1 dB	± 0.70 dB	± 0.90 dB

Gain/Loss (B/R) measurement uncertainty, frequency references unlocked, RBW ≥ 300 kHz

	Spec (23 ± 5 °C)	Spec (-10 to 55 °C)	Typical (23 ± 5 °C)	Typical (-10 to 55 °C)
100 kHz to 18 GHz	± 1.4 dB	± 1.7 dB	± 0.70 dB	± 0.70 dB
> 18 GHz to 26.5 GHz	± 2.0 dB	± 2.1 dB	± 0.90 dB	± 1.00 dB

The specifications in the sections that follow apply to these FieldFox analyzers:
- FieldFox microwave combination analyzers: **N9913A, N9914A, N9915A, N9916A, N9917A, N9918A**
- FieldFox microwave vector network analyzers: **N9925A, N9926A, N9927A, N9928A**
- FieldFox microwave spectrum analyzers: **N9935A, N9936A, N9937A, N9938A**

Built-in Power Meter

Using the built-in power meter, FieldFox is able to make very accurate channel power measurements. The channel bandwidth can be set wide to simulate average power meter measurements. This measurement function provides the flexibility to make user definable channel power measurements.
- Setup parameters:
  - Center frequency, including selection of radio standards and channel selection, span or channel width
- Functions:
  - Relative/absolute measurements, offsets, units of dBm or watts, or dB or %, minimum and maximum limits

Models	Frequency range	
N9913A	100 kHz to 4 GHz	Usable to 5 kHz
N9914A	100 kHz to 6.5 GHz	Usable to 5 kHz
N9915A, N9925A, N9935A	100 kHz to 9 GHz	Usable to 5 kHz
N9916A, N9926A, N9936A	100 kHz to 14 GHz	Usable to 5 kHz
N9917A, N9927A, N9937A	100 kHz to 18 GHz	Usable to 5 kHz
N9918A, N9928A, N9938A	100 kHz to 26.5 GHz	Usable to 5 kHz

Amplitude accuracy				
	Spec (23 ± 5 °C)	Typical (23 ± 5 °C)	Spec (–10 to 55 °C)	Typical (–10 to 55 °C)
100 kHz to 18 GHz	± 0.8 dB	± 0.35 dB	± 1.0 dB	± 0.50 dB
> 18 GHz to 26.5 GHz	± 1.0 dB	± 0.50 dB	± 1.2 dB	± 0.60 dB

External USB Power Sensor Support

The external USB power sensor option supports various Keysight USB power sensors. For an up-to-date listing of the supported power sensors, visit http://www.keysight.com/find/fieldfoxsupport
- Setup parameters:
  - Frequency
- Functions:
  - Relative/absolute measurements, offsets, units of dBm or watts, or dB or %, minimum and maximum limits
- Internal source:
  - FieldFox's internal source can be turned on in the USB power sensor mode. CW frequency and nominal power level control are available.

Pulse Measurements

FieldFox's pulse measurement option can be used to characterize RF pulses such as those used in radar and electronic warfare systems. Measurements are made using FieldFox and Keysight's USB peak power sensors.

Performance specifications such as frequency, dynamic range and minimum pulse width depend on the peak power sensor. Supported peak power sensors: www.keysight.com/find/usbsensorsforfieldfox.
- Setup parameters:
  - Frequency, time (center), time/division, gating, triggering, video bandwidth, averaging
- Functions:
  - Average power, peak power, and peak to average ratio
  - Analog gauge display and digital display, dBm and watts
  - Relative/absolute measurements, dB or %, minimum and maximum limits
  - Trace graph for pulse profiling with gating
  - Rise time, fall time, pulse width, pulse period, pulse repetition frequency

USB Power Sensor Measurements Versus Frequency

This feature allows FieldFox's source frequency to be set independently from the power sensor (receiver) frequency. With frequency-offset using power sensor (FOPS), the frequency of both the source and receiver are swept, and the two track each other. The offset frequency can be negative, zero, or positive.

FOPS can be used to characterize the scalar transmission response of devices such as mixers and converters. This frequency-offset capability is necessary for conversion loss/gain measurements on frequency-translating devices, since by definition, the input and output frequencies of the DUT are different. The FieldFox source stimulates the DUT and the power sensor is used as the measurement receiver.

Since power sensors are inherently broadband devices (not frequency-selective), the user should ensure that only the signal of interest is present at the power sensor input and that all others signals are filtered appropriately.

Setup parameters	
Source frequency	Center/span or start/stop
Receiver frequency	Range determined by power sensor range
Frequency offset	0, > 0, < 0
Frequency step size	30 kHz minimum
Number of points	2 to 1601
Combination of number of points and frequency step size limited by span.	
Dwell time/point	0 to 1.0 sec

Source frequency span must be equal to receiver frequency span.

Receiver sweep direction: forward (default setting) or reverse

For some DUTs, the output frequency may sweep in a reverse direction, as compared to the source frequency. The basic relationships between the source, receiver and offset frequencies are shown in the table below. The FieldFox analyzer includes an offset calculator that ensures a fast measurement setup.

Src sweep direction	**Rx sweep direction**	**Frequency calculations**
Forward $f2_{src} > f1_{src}$	Forward $f2_{rx} > f1_{rx}$	Receiver frequency = Source frequency ± Offset
Forward $f2_{src} > f1_{src}$	Reverse $f2_{rx} < f1_{rx}$	Receiver frequency = Offset – Source Frequency Offset > Source frequency

See FieldFox Configuration Guide for option information. Many capabilities listed in this Data Sheet require options.

USB Power Sensor Measurements Versus Frequency (continued)

Measurements

Source power, gain/loss and receiver (Rx) power
Gain = Rx power / source power (memory). Source power (memory) is measured during setup.

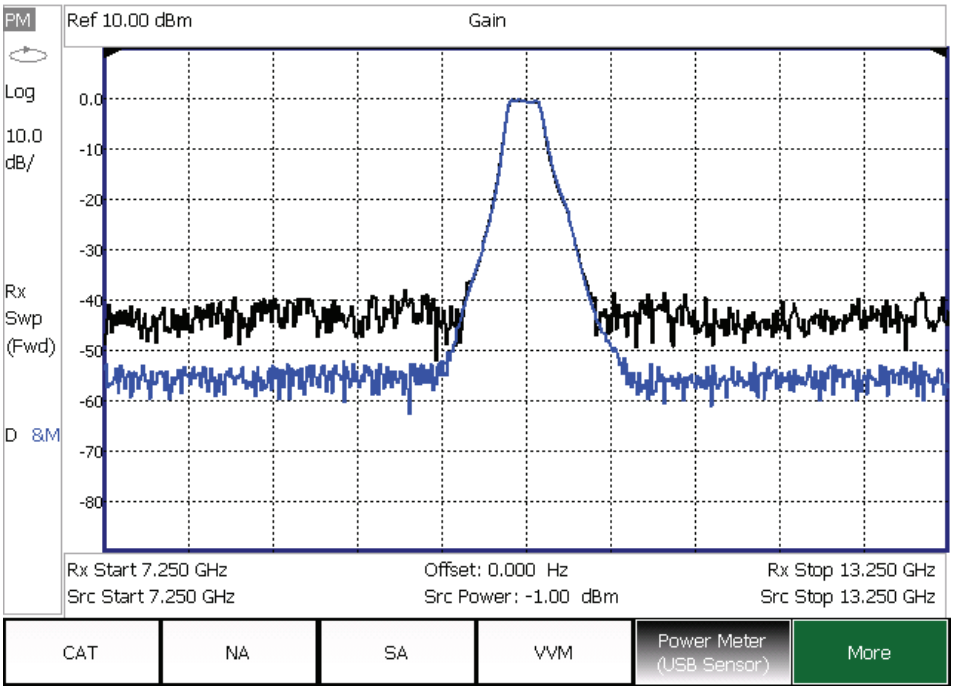
Dynamic range

Output power: See FieldFox source specs on page 4.
Dynamic range: The dynamic range with FOPS is dependent on FieldFox's output power and the power sensor's dynamic range. Supported USB power sensors: www.keysight.com/find/fieldfoxsupport

Dynamic range example

The graph below shows a filter measurement using two different power sensors, the U2002A (–60 to +20 dBm) and the U2021XA (–45 to +20 dBm). While a filter is not commonly measured using FOPS, it is a useful device for demonstrating dynamic range.

For both measurements, the FieldFox source power was set to –1 dBm, the maximum available in the selected frequency range of 7.25 to 13.25 GHz. An external amplifier was not used in this case, but one can be added to increase the source power and hence dynamic range.



Measured using U2021XA power sensor

Measured using U2002A power sensor

Example showing typical dynamic range of FOPS

Built-In GPS Receiver

	Description
GPS receiver	The internal GPS receiver can be used as a frequency reference. [1]
Modes	Off, internal, external
Sync clock	On, off
Functionality	Geo-location: latitude, longitude, altitude, time, sync time/date
Connector for antenna	SMA (f), 3.3 V

1. External GPS USB receivers can be used to provide geo-location data. However, they cannot be used for frequency reference locking.

DC Bias Variable-Voltage Source

	Description
	Nominal
Connector SMB (m)	SMB (m)
Voltage	+1 to +32 V
Resolution	0.1 V
Maximum current [1]	0.65 A
0.01 A	0.01 A
Maximum power [1]	7 watts
Display read out	Voltage, current

1. Battery life will be reduced when DC source is used. A trip function turns off the power supply when the rated current or power is exceeded.

Remote Control Capability

Option 030 adds remote control capability to FieldFox analyzers, so that FieldFox can be controlled via an iOS device. The FieldFox app, running on the iOS device, combined with Option 030 on the FieldFox analyzer provides full control of the instrument from a remote location. The app emulates the front panel of FieldFox, so users can press the FieldFox hardkeys or softkeys using their iPhone or iPad, and make measurements remotely.

For example, a tower climber can be on the tower with a FieldFox analyzer, while the technician controls and makes the measurements down below, using an iPad. The iPad and FieldFox communicate via a network connection.

iOS device requirements
- iPad, iPhone, or iPod Touch
- iOS of 6.1 or higher
- A WiFi or 3G/4G connection

The FieldFox app communicates with FieldFox via a network connection, so both the iOS device and FieldFox need to be on a network where both devices can reach the other. For example, a company intranet or a site installation using a wireless router. FieldFox can directly be connected to a LAN cable, or if wired LAN is not available, a user supplied wireless router can be configured to work with FieldFox. FieldFox does not include a wireless router.

FieldFox app without Option 030

The FieldFox app can be installed on an iOS device independent of the presence of Option 030 on the analyzer. Without Option 030, users can view the live display screen of their FieldFox remotely, but cannot control the instrument. With 030 purchased and installed on their FieldFox, users can both view and control their FieldFox. Control refers to the ability to press hardkeys, softkeys, make or change measurements, etc.

Option 030 does not include the iOS device itself. Users must supply their own iOS device. Option 030 is a license on the FieldFox analyzer.

Option 030 and the FieldFox app are not applicable to Android, BlackBerry, or Windows phone/tablet devices.

General Information

Calibration cycle	
	1 year
Weight	
	3.0 kg or 6.6 lbs. including battery
Dimensions: H x W x D	
	292 x 188 x 72 mm
	11.5" x 7.4" x 2.8"
Environmental	
MIL-PRF-28800F Class 2	Operating temperature
	Storage temperature
	Operating humidity
	Random vibration
	Functional shock
	Bench drop
Maximum humidity	95%
Altitude – operating	9144 m or 30,000 ft (using battery)
Altitude – Non-operating	15,240 m or 50,000 ft
Altitude – AC to DC adapter	3000 m or 9840 ft
Ingress protection	
	Ingress protection IP53 IEC/EN 60529 (IP rating for instrument by itself, with no cover)
Temperature range	
Operating, AC power, spec	–10 to 55 °C
	14 to 131 °F
Operating, battery, spec	–10 to 50 °C
	14 to 122 °F
Operating, battery, typical	–10 to 55 °C
	14 to 131 °F
Storage, spec [1]	–51 to 71 °C
	–60 to 160 °F
Complies with European EMC directive 2004/108/EC	
	IEC/EN 61326-1
	CISPR Pub 11 Group 1, class B, Group 1 limit of CISPR 11:203/EN 55011:2007
	AS/NZS CISPR 11
	ICES/NMB-001
Complies with European low voltage directive 2006/95/EC	
	IEC: 61010-1:2010 / EN 61010-1:2010 (3rd Edition)
	Canada: CAN/CSA-C22.2 No. 61010-1-12
	USA: ANSI/UL 61010-1 (3rd Edition)
Explosive environment	
	This product has been type tested to meet the requirements for operation in explosive environments in accordance with MIL-STD-810G, Method 511.5, Procedure I."

1. The battery packs should be stored in an environment with low humidity. Extended exposure to temperature above 45 °C could degrade battery performance and life.

General Information (continued)

Power supply	
External DC input	5 to 19 VDC, 40 watts maximum when battery charging
External AC power adapter	Efficiency level IV, 115 VAC
Input	100 to 250 VAC, 50 to 60 Hz, 1.25 to 0.56 A
Output	15 VDC, 4 A
Power consumption 14 watts typical	14 watts typical
Battery	
Lithium ion	10.8 V, 4.6 A-h
Operating time	3.5 hours (typical)
Charge time: A fully discharged battery takes about 1.5 hours to recharge to 80%. Four hours to 100%.	
Discharge temperature limits	–10 to 60 °C, ≤ 85% RH
Charge temperature limits	0 to 45 °C, ≤ 85% RH
Storage temperature limits	–20 to 50 °C, ≤ 85 % RH
	The battery packs should be stored in an environment with low humidity. Extended exposure to temperature above 45 °C could degrade battery performance and life.
Test port connectors	
Models ≤ 18 GHz	Type-N (f)
Models > 18 GHz	3.5 mm (m) for FieldFox Combo Analyzer N9918A and FieldFox VNA N9928A. On FieldFox SA N9938A, you may choose 3.5 mm (m) or Type-N (f). You cannot get a Type-N connector for the Combo or VNA 26.5 GHz analyzers; only the SA analyzer.
Display	
	6.5" transflective color VGA-LED backlit
Headphone jack connector	
	3.5 mm (8 inch) miniature audio jack
USB-A, 2-ports	
	Hi-speed USB 2.0
Mini USB, 1-port	
	Hi-speed USB 2.0; provided for future use
Keyboard	
	USB keyboards are supported (user must supply their own keyboard)
LAN	
	100 base-T, RJ-45 connector
	Used for programming, data saving, and connection to Data Link software
Programming	
	SCPI, using the built-in LAN interface
Languages	
	English, Spanish, German, Italian, French, Russian, Japanese, Chinese, Turkish, and Portugese
Preset	
	User preset for both mode preset and complete system preset

General Information (continued)

Limit lines	
The limit line capabilities listed in this section apply to the cable and antenna analyzer, network analyzer and spectrum analyzer modes in all FieldFox analyzers.	
Limit lines can be a combination of horizontal lines, sloping lines, or discrete data points	
Limit types: Fixed or relative	
Each trace can have its own limit line	
Limit lines can be built from a current trace	
Limit segments > 100, limited by memory size	
Max limit line number of points: 10,001	
Beep: Beep off, Beep on fail, Beep on pass	
Pass/fail warning: on/off	
Offset and margin: An increase or decrease in the limit line	
Save/recall limit lines	
Data storage	
Internal	Internal Minimum: 4 GB
	Minimum states and traces: 1000
External	Supports USB 2.0 compatible memory devices and SD/SDHC memory cards
Data types	Trace, trace+state, picture (png), data (csv), S2P
Secure operation	
Frequency blanking	For protection of sensitive data all frequency information can be turned off.
Erase user data	All user data can be erased on a FieldFox analyzer. For more information visit: http://www.keysight.com/find/securefieldfox
Reference out/trigger out	
Connector	SMB (m), 50 Ω
Output amplitude	≥ 0 dBm
Frequency	10 MHz (1 + frequency reference accuracy)
Trigger out	Reserved for future use
Reference in/trigger in	
Connector	SMA(f), 50 Ω
Reference input	10 MHz, –5 to +10 dBm
Trigger input	3.3 or 5 V TTL logic levels

Carry Precision With You

Every piece of gear in your field kit had to prove its worth. Measuring up and earning a spot is the driving idea behind Keysight's FieldFox analyzers. They're equipped to handle routine maintenance, in-depth troubleshooting and anything in between. Better yet, FieldFox delivers Keysight-quality measurements - wherever you need to go. Add FieldFox to your kit and carry precision with you.

Related literature	Publication number
FieldFox Handheld Analyzers, Configuration Guide	5990-9836EN
FieldFox Handheld Analyzers, Data Sheet	5990-9783EN
FieldFox Spectrum Analyzers, Technical Overview	5990-9782EN
FieldFox Vector Network Analyzers, Technical Overview	5990-9781EN
FieldFox Combination Analyzers, Technical Overview	5990-9780EN
FieldFox Handheld Analyzers, Brochure	5990-9779EN
FieldFox N9923A RF Vector Network Analyzer, Technical Overview	5990-5087EN
FieldFox N9923A RF Vector Network Analyzer, Data Sheet	5990-5363EN
FieldFox N9912A RF Analyzer, Technical Overview	5989-8618EN
FieldFox N9912A RF Analyzer, Data Sheet	N9912-90006

Download application notes, watch videos, and learn more:
www.keysight.com/find/fieldfox

myKeysight

myKeysight

www.keysight.com/find/mykeysight
A personalized view into the information most relevant to you.

Three-Year Warranty
www.keysight.com/find/ThreeYearWarranty
Keysight's commitment to superior product quality and lower total cost of ownership. The only test and measurement company with three-year warranty standard on all instruments, worldwide.

Keysight Assurance Plans
www.keysight.com/find/AssurancePlans
Up to five years of protection and no budgetary surprises to ensure your instruments are operating to specification so you can rely on accurate measurements.

www.keysight.com/find/go/quality
Keysight Technologies, Inc.
DEKRA Certified ISO 9001:2008
Quality Management System

Keysight Channel Partners
www.keysight.com/find/channelpartners
Get the best of both worlds: Keysight's measurement expertise and product breadth, combined with channel partner convenience.

www.keysight.com/find/fieldfox

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:
www.keysight.com/find/contactus

Americas

Canada	(877) 894 4414
Brazil	55 11 3351 7010
Mexico	001 800 254 2440
United States	(800) 829 4444

Asia Pacific

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 112 929
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 6375 8100

Europe & Middle East

Austria	0800 001122
Belgium	0800 58580
Finland	0800 523252
France	0805 980333
Germany	0800 6270999
Ireland	1800 832700
Israel	1 809 343051
Italy	800 599100
Luxembourg	+32 800 58580
Netherlands	0800 0233200
Russia	8800 5009286
Spain	800 000154
Sweden	0200 882255
Switzerland	0800 805353 Opt. 1 (DE) Opt. 2 (FR) Opt. 3 (IT)
United Kingdom	0800 0260637

For other unlisted countries:
www.keysight.com/find/contactus
(BP-09-23-14)

KEYSIGHT TECHNOLOGIES

Published in USA, January 28, 2015
5990-9783EN
www.keysight.com