TECHNICAL
OVERVIEW

FieldFox Handheld Analyzers

4/6.5/9/14/18/26.5 GHz

N9913B	N9933B
N9914B	N9934B
N9915B	N9935B
N9916B	N9936B
N9917B	N9937B
N9918B	N9938B

KEYSIGHT TECHNOLOGIES

Increased Precision is Here with Wider Bandwidth

The world of communications is embracing wireless in an unprecedent way regardless of industry segment. 5G will completely change human-to-human, machine-to-machine and human-to-machine communications and it will make industry 4.0 a reality, commonly referred to as the fourth industrial revolution.

5G is not only for commercial communication, it will completely change the military communication paradigm by providing higher capacity, instant sensing capability and hyper fast speeds.

The three main trends happening in RF and microwave communications are:

- Wider bandwidths
- Higher operating frequencies
- Active antenna systems like phased array antennas

The goal of these trends is to increase network speed and latency; nevertheless, these trends impose greater challenges to RF engineers and technicians who design and maintain these networks, including:

- Interference becomes much harder to detect due to short signal durations
- Microwave and millimeter wave signals can be easily blocked, and coverage is limited
- Signal beams from phased array antennas need to be optimized to achieve the intended coverage area vs. creating coverage holes

Given the new dynamics of wideband, microwave and millimeter wave communications, Keysight developed the next generation FieldFox Microwave Analyzer with 100 MHz of real-time bandwidth and frequency coverage up to 26.5 GHz. To address the millimeter wave frequency requirements for 5G, satellite and automotive radar industries, FieldFox can easily extend its frequency up to 110 GHz with an add-on downconverter. FieldFox is also the industries most integrated handheld analyzer supporting over 20 key RF and microwave instrument functions including signal analyzer, full 2-port vector network analyzer, real-time spectrum analyzer, over-the-air demodulation, CW signal source, power meter and many more, in an all-in-one field proof package.

Why choose FieldFox?

- Ideal tool for 5G deployment and testing in the field with 100 MHz real-time bandwidth and over-the-air (OTA) measurements
- Phased array antenna support enables 5G, satellite and radar operators make true RF coverage measurements and beamforming verifications
- Wideband capture and recording of fully corrected IQ data simplifies signal monitoring in the field
- Diagnose radar and EW systems more efficiently with spectrum analysis, full 2-port VNA, power meter, pulse and noise figure measurements with results that correlate with lab bench top instruments
- Count on the durability of handheld analyzers designed to withstand your toughest working conditions

RF and microwave spectrum analyzers

Base: Spectrum analyzer

Key options:

- 100 MHz bandwidth
- Full-band tracking generator
- Full-band preamplifier
- Built-in power meter
- Pulse measurements
- USB power sensor
- Channel scanner
- GPS receiver
- Real-time spectrum analyzer
- 89600 VSA software connection
- I/Q analyzer
- Noise figure
- Over-the-Air (OTA) LTE FDD and 5G
- Indoor and outdoor mapping
- EMF measurements (general and 5G)

RF and microwave (combination) analyzers

Base: Cable and antenna analyzer

Key options:

- 100 MHz bandwidth
- Spectrum analyzer
- Vector network analyzer
- TDR cable measurements
- Built-in power meter
- Pulse measurements
- Channel scanner
- GPS receiver
- Real-time spectrum analyzer
- 89600 VSA software connection
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Leverage Our Legacy of Measurement Leadership

With FieldFox, you're carrying the precision of our industry-standard benchtop analyzers. By delivering levels of consistency not available in any other handhelds, FieldFox ensures confidence in your results.

Inside, we leveraged well-tested algorithms from Keysight's high- performance VNAs. To lighten your load, we simplified calibration by adding built-in standards and eliminating the need to carry calibration kits.

To enhance spectrum analysis, FieldFox includes the same PowerSuite measurements used in Keysight signal analyzers, enabling fast, accurate, one- button characterization of channelized communication systems. The InstAlign capability lets you instantly make accurate power measurements in the field, even when temperature fluctuates.

FieldFox industry innovations

Industry's most precise handheld RTSA

100 MHz real-time bandwidth with 5.52 us POI

Cable and antenna analyzer

DTF and TDR in a single sweep

Vector network analyzer

Dynamic range up to 115 dB

Spectrum analyzer

Absolute amplitude accuracy ± 0.3 dB

2019 FieldFox microwave analyzer with 100 MHz real-time bandwidth

"FieldFox's result is almost identical to my PNA. I want one of these for all of my engineers."

-- Senior calibration engineer from spacecraft research and development center.

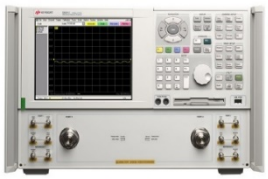
2016 FieldFox handheld microwave analyzer with 10 MHz RTSA

2015 UXA X-Series signal analyzer with 510 MHz RTSA

2006 PXA X-Series signal analyzer

2007 PNA-X vector network analyzer

2001 PSA spectrum analyzer



2000 PNA vector network analyzer

1984 8510A vector network analyzer

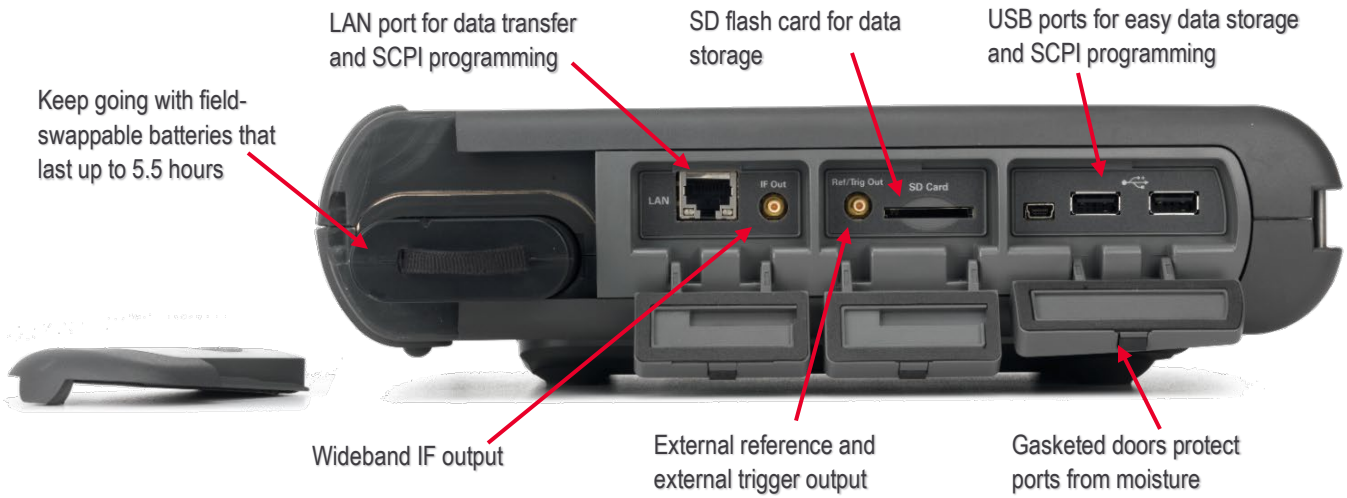
1978 HP 8566B spectrum analyzer

Pick Up FieldFox for its Ergonomics

… and Depend on Its Durability and Convenience

TOP

RIGHT SIDE

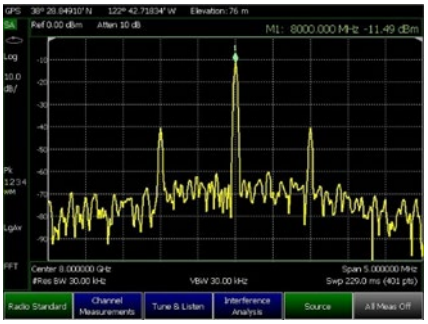


LEFT SIDE

Utilize the Industry's Most Comprehensive Handheld Analyzers

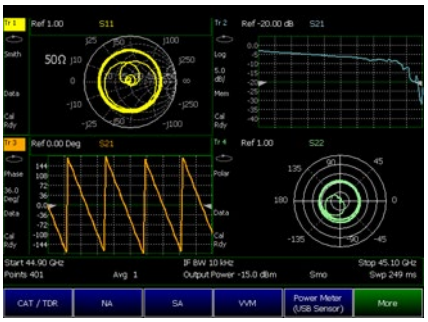
Cable and antenna analyzer

- Distance-to-fault (DTF) and return loss/VSWR
- 1-port cable loss, 2-port insertion loss, and time-domain reflectometry (TDR)
- Single sweep DTF and TDR can determine the location of faults and the nature of the discontinuities, for example, short, open, or water ingress



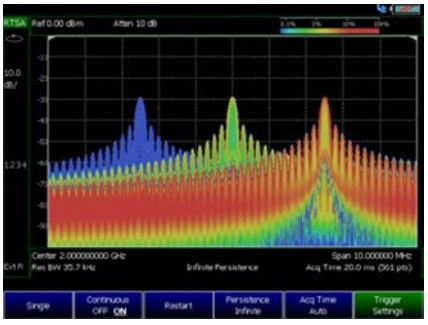
Spectrum analyzer

- Unprecedented amplitude accuracy of ± 0.3 dB with InstAlign[1] - no warm-up required
- Tracking generator, independent source, and preamplifier covering the full frequency range
- Channel power (CHP), occupied bandwidth (OBW), spectrum emission mask (SEM), adjacent channel power (ACP)
- Interference analysis and analog demodulation



Vector network analyzer

- All four S-parameters, magnitude and phase
- Up to 117 dB system dynamic range
- Time-domain analysis, mixed-mode reflection S-parameters
- CalReady, QuickCal, full 2-port cal, TRL, waveguide cal, ECal support, and a Guided Calibration Wizard



Real-time spectrum analyzer (RTSA)

- Capture signals as short as 5.52 µs with 100% POI with a maximum 100 MHz real-time bandwidth and full amplitude accuracy
- Visualize small signals as short as 47 ns independent of amplitude accuracy
- Detect a low-level signal in the presence of a high-power transmitter using the spectrum density view

[1] With FieldFox InstAlign, internal amplitude alignments occur automatically as environmental conditions change, without any user intervention.

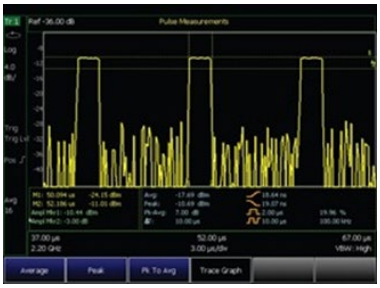
Utilize the Industry's Most Comprehensive Handheld Analyzers (continued)

Built-in power meter

- Power measurements over a defined bandwidth, without an external sensor
- Easy to view analog and digital displays
- ± 0.3 dB accuracy with InstAlign[1]

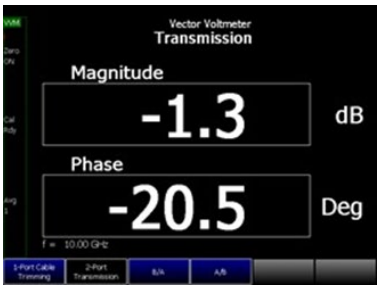
Power measurements using a USB power sensor

- Accurate absolute power measurements at a CW frequency
- Swept-frequency power measurements
- Frequency-offset capability for converter test



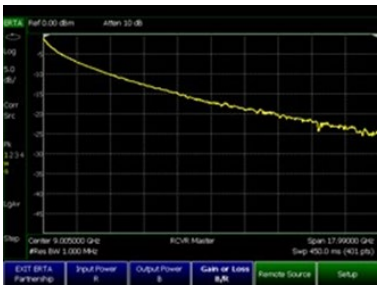
Pulse measurements using a USB peak power sensor

- Peak power, average power and peak-to-average ratio measurements
- Pulse profile characterization
- Portable solution for radar pulse analysis



Vector voltmeter

- Cable trimming, phase shift, and electrical length measurements
- A/B and B/A ratio measurements
- Similar functionality to the HP 8508A VVM



Extended range transmission analysis (ERTA)

- Scalar insertion loss measurement of in-situ cables with long distances between test ports
- InstAlign enables accurate microwave measurements with no warm-up
- Converter test using ERTA's frequency-offset capability

[1] With FieldFox InstAlign, internal amplitude alignments occur automatically as environmental conditions change, without any user intervention.

Utilize the Industry's Most Comprehensive Handheld Analyzers (continued)

Channel scanner

- Channel power measurements up to 20 channels
- Customizable frequency and bandwidth settings for each channel
- Data logging capability with geo tagging

Noise figure (NF)

- Portable Y-factor noise figure measurements for amplifiers, downconverters, upconverters, and converters
- Auto integration mode optimizes gain to avoid compression and measurement time to achieve jitter goal
- User definable loss compensation for loss (dB) before and after DUT
- Built-in uncertainty calculator displays vertical bars representing the calculated measurement uncertainty overlaid on the trace data
- Supports Keysight's noise source models 346A/B/C/K40/K01 and external preamplifiers models U7227A/C/F or U7228A/C/F

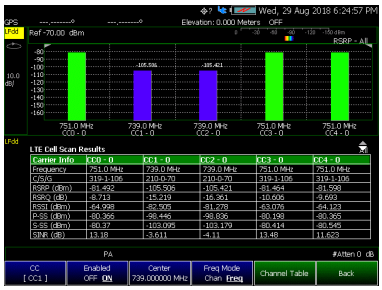
I/Q analyzer (IQA)

- Frequency and time domain measurements up to 100 MHz of analysis bandwidth
- I/Q capture parameters include capture time, sample rate, sample period and capture samples
- Customize display with up to 4 simultaneous and multi-domain measurement views
- Enhance performance with features such as amplitude and IF alignment before capture
- I/Q capture data file types include CSV, text (TXT), SDF (compatible with 89600 VSA software), MATLAB (MAT)
- Requires spectrum analyzer mode (Option 233 on combination analyzers)

89600 VSA software connection

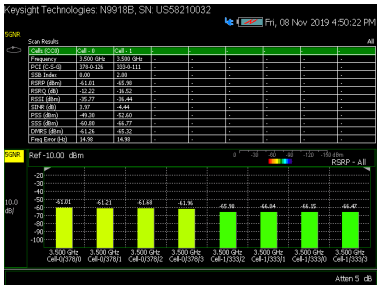
- Windows based software for signal demodulation and vector signal analysis
- Connected VSA software runs on external PC or tablet
- Transmitting signal quality verification
- Analysis bandwidth: 100 MHz
- Spectrum, IQ constellation, error vector magnitude (EVM), time domain waveform and frequency error display views
- Record a signal's IQ data for offline process or playback
- Keysight model number 89601B, requires spectrum analyzer mode on FieldFox

Over-the-air (OTA) LTE FDD



- Portable OTA LTE FDD measurements for base station downlink multi-path and multi-cell environments
- Modulation analysis of downlink primary and secondary synchronization signals (PSS and SSS)
- Scan results of key performance indicators including Cell ID, RSRP, RSRQ, RSSI, PSS, SSS, SINR and Frequency Error
- Configurable display with up to four windows including table, bar chart, magnitude spectrum, and strip chart data formats
- Supports record, recall and playback of data with geo-location information for post analysis (CSV or KML file formats)

Over-the-air (OTA) 5G[1]



- 5G channel / carrier scanning to verify network coverage and cell selection or reselection criteria
- Scan results of 5G NR key performance indicators including Cell ID, SSB Index, SS-RSRP, SS-RSRQ, RSSI, SS-SINR, PSS, SSS, PBCH-DMRS and frequency error
- Configurable display with up to four windows including table, bar chart, magnitude spectrum, and strip chart data formats
- Supports 5G NR conducted EVM measurements to detect synchronization signal block offset from center of the channel and subcarrier spacing
- Supports record, recall and playback of data with geo-location information for post analysis (CSV or KML file formats)
- 5G NR requires 100 MHz analysis bandwidth (Option B10)

[1] 5GTF (Option 377) and 5G NR (Option 378) require external mixer for frequencies above 26.5 GHz to down convert millimeter wave frequency to intermediate frequency (IF). Please see OML Inc. website www.omlinc.com for more information or contact a Keysight representative.

Phased array antenna support[1]

- Supports 64-element, single polarization phased array antenna with coverage from 27.5 to 30 GHz
- Understand gNB beam characteristics by measuring signal power level across azimuth and elevation from base stations
- Reduce measurement complexity with integrated RF probe and phased array solution to capture energy radiated from gNB
- Calibrated millimeter wave phased array antenna simulates 5G UE antenna performance
- Phased array performance verification showing boresight, polar antenna pattern with compass, and heat map (azimuth vs. elevation)
- Battery powered, no internal fans or vents, and IP53 rated design to test 5G gNB under any condition

EMF measurements

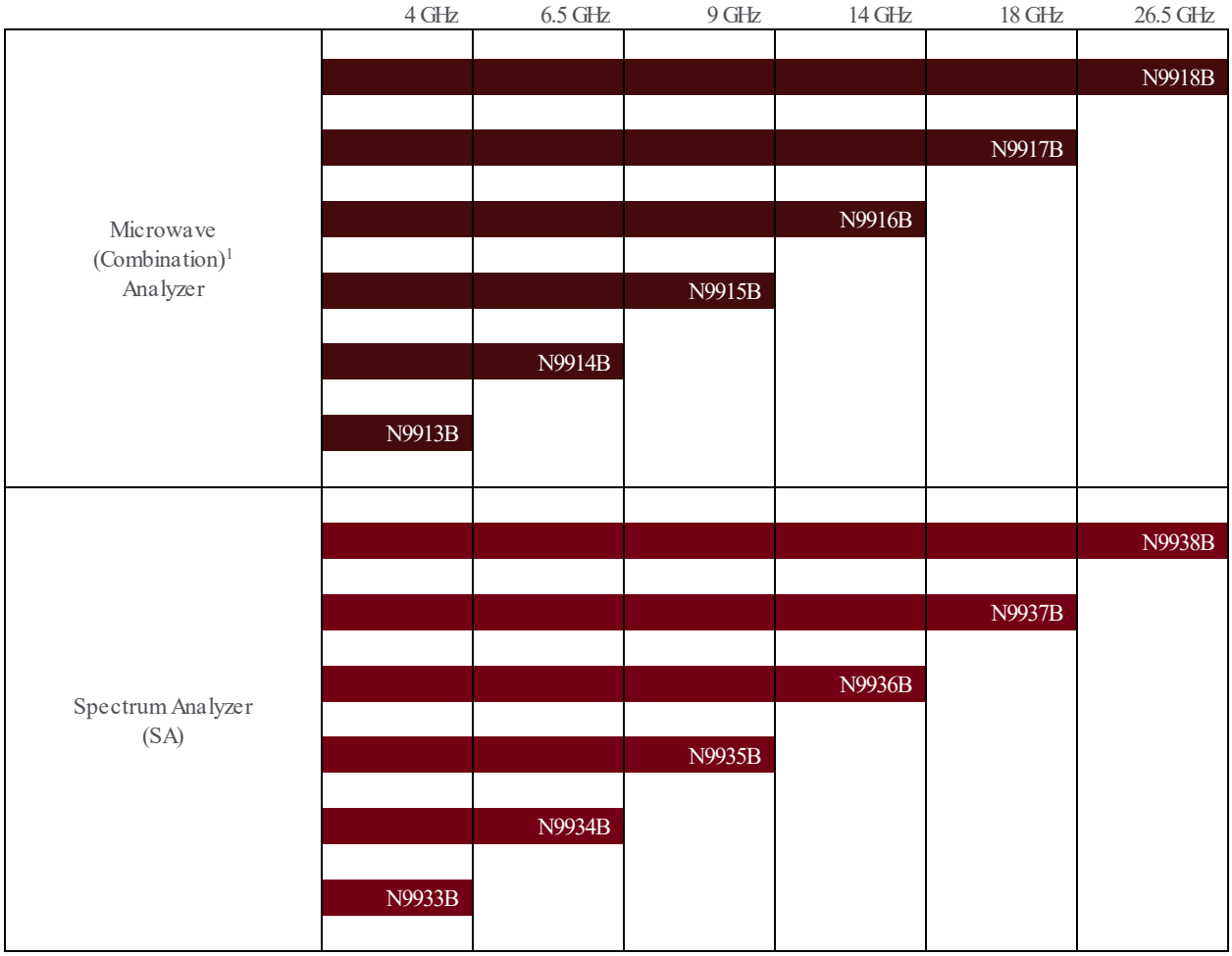
- Portable EMF measurements 30 MHz to 6 GHz for compliance and verification of EMF exposure levels in the field
- EMF spectrum analyzer channel power measurements for various RF/MW networks such as mobile phones, base stations, Wi-Fi, smart meters, IoT device, as well as satellite and radar systems
- EMF measurements on 5G NR control channels show the impact of the 5G signal over total RF exposure
- Supported in spectrum analyzer channel power measurements and 5G NR modes and total field strength can be measured across the frequency band of interest
- Supports connectivity to AGOS Advanced Technologies Triaxial Isotropic Antenna, model SDIA-6000
- Record, recall and playback of data with geo-location information for post analysis

Indoor and outdoor mapping

- Import maps from OpenStreetMap (OSM) or floor or site plan picture files (PNG, JPG, BMP) for indoor or outdoor data collection and mapping
- Auto measure and record data in time or distance intervals and map data results overlaying map on the FieldFox instrument display
- Save maps to the FieldFox internal memory, SD card or USB drive via a direct wired LAN connection or the FieldFox Map Support Tool
- Supported in Channel Scanner, Phased Array Antenna, Over-the-Air LTE FDD, 5GTF and 5G NR modes

[1] Phased array antenna support (Option 360) requires external mixer above 26.5 GHz to down convert millimeter wave 28 GHz frequency to intermediate frequency (IF). Please see OML Inc. website www.omlinc.com for more information or contact a Keysight representative.

Choose the FieldFox that Meets Your Needs



Notes:

- For more information on N991xA, N992xA, N993xA, N995xA, N996xA RF, microwave and milli-meter wave FieldFox models, see Technical Overview (5992-0772EN), Configuration Guide (5990-9836EN) and Data Sheet (5990-9783EN).

[1] Combination analyzer = Cable and antenna tester (CAT) + Vector network analyzer (VNA) + Spectrum analyzer (SA)

Create the Right Configuration for Your Application

Select the capabilities you need today and add more as needs change: features are field-upgradeable and are added via software license keys. RF and microwave analyzers are referred to as combination analyzers in this section.

Feature	Combination Analyzers N9913/4/5/6/7/8B	Spectrum Analyzers N9933/4/5/6/7/8B
CAT / vector network analysis		
Cable and antenna analyzer	✓	VSWR and reflection
VNA transmission/reflection	✓	–
VNA full 2-port S-parameters	✓	–
1-port mixed-mode S-parameters	✓	–
VNA time domain	✓	–
TDR cable measurements	✓	–
Vector voltmeter	✓	–
Spectrum analysis		
Spectrum analyzer	✓	✓
Extended range transmission analysis (ERTA)	✓	✓
Tracking generator	✓	✓
Pre-amplifier	✓	✓
Interference analyzer and spectrogram	✓	✓
Spectrum analyzer time gating	✓	✓
Channel scanner	✓	✓
Analog demodulation	✓	✓
Real-time spectrum analyzer (RTSA)	✓	✓
I/Q analyzer (IQA)	✓	✓
Indoor and outdoor mapping	✓	✓
Noise figure (NF)	✓	✓
EMF measurements	✓	✓
Phased array antenna support	✓	✓
Over-the-Air (OTA) LTE FDD	✓	✓
Over-the-Air (OTA) 5GTF	✓	✓
Over-the-air (OTA) 5G NR	✓	✓
Analysis bandwidth, 40 MHz	✓	✓
Analysis bandwidth, 100 MHz	✓	✓
Power measurements		
USB power sensor meas. versus frequency	✓	✓
USB power sensor support	✓	✓
Pulse meas. with USB peak power sensor	✓	✓
Built-in power meter	✓	✓

Feature	Combination Analyzers N9913/4/5/6/7/8B	Spectrum Analyzers N9933/4/5/6/7/8B
System features		
Remote control capability	✓	✓
GPS receiver	✓	✓
DC bias variable-voltage source	✓	✓
SCPI over LAN and USB	✓	✓
Windows based software		
89600 VSA software	✓	✓

Notes: Some of the features listed here require an option, see the FieldFox Handheld Analyzer Configuration Guide for complete information on all FieldFox products and accessories http://literature.cdn.keysight.com/litweb/pdf/5992-3701EN.pdf

Cable and Antenna Analyzer

Fifty to sixty percent of microwave-link equipment issues are related to cables, antennas and connectors. Degraded feeder lines cause poor coverage, link failures, and reduced sensitivity in the receive path. To maintain the quality of a microwave link, it is critical to keep cable and antenna systems in good working condition. FieldFox is uniquely qualified to provide all the necessary measurements to troubleshoot and maintain these systems.

Insertion loss and cable loss

Insertion loss or cable loss characterizes the loss of a jumper cable, feeder cable, diplexer, or gain of a tower-mounted amplifier (TMA). With FieldFox, you can measure both the 1-port cable loss and 2-port insertion loss. Also, FieldFox's extended range transmission analysis (ERTA) option, is useful for measuring long, lossy in-situ cables.

Return loss/VSWR

Return loss (RL) or VSWR is the single most important parameter used to measure and verify a cable and antenna system. This measurement reflects the power transfer efficiency of a given system.

Distance-to-fault (DTF) and time-domain reflectometry (TDR)

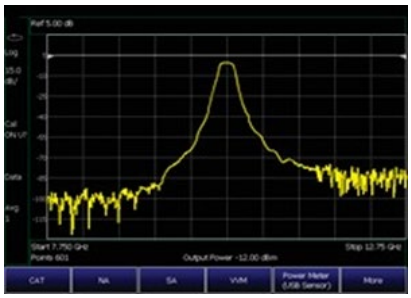
DTF helps you determine the location of discontinuities in feeder lines. TDR helps you determine the nature of the discontinuities, for example, short, open, or water ingress.

With FieldFox, you can make RL and DTF measurements at the same time. This helps you correlate overall system degradation with specific faults in the cable and antenna system. The built-in cable editor lets you edit existing cable types onsite and save them as new cable types with user-defined names.

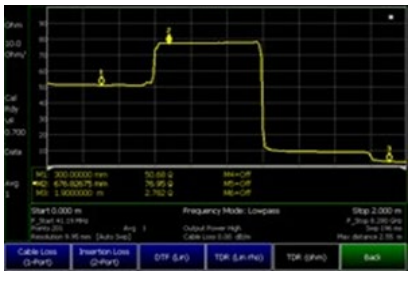
Measure both DTF and TDR in single sweep

FieldFox's TDR complements RL and DTF measurements. TDR measures impedance changes along the cable and helps identify specific faults, RL exposes mismatch issues, and DTF indicates faults and poor connections. FieldFox is the only handheld instrument that can measure both DTF and TDR in a single sweep.

View return loss and DTF simultaneously



Characterize filter insertion loss



Gain insight into faults with TDR measurements

CalReady-calibrated at power on and ready to go

Save time and get right to work with FieldFox's CalReady feature. With CalReady, the analyzer is already calibrated and ready to make measurements such as S11, S22, 1-port cable loss, and DTF/TDR measurements without having to connect and disconnect additional calibration devices.

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 cal kit support

For users who wish to use traditional mechanical calibration kits, FieldFox supports most Keysight/Agilent/HP cal kits, and also allows you to define your own custom calibration kits.

Fast and accurate calibration with ECal

The FieldFox calibration engine supports Keysight's USB ECal modules. ECal support reduces calibration time and the need to make multiple connections during testing, while also providing for greater consistency between measurements. For FieldFox users, that translates into fewer human errors and increased accuracy.

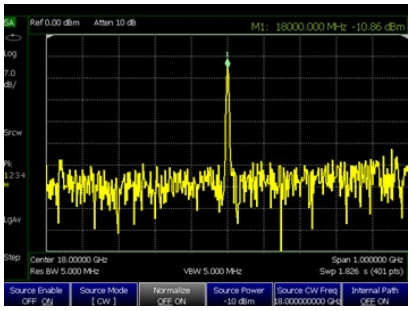
Perform fast and accurate calibrations using ECal

Spectrum Analyzer

In microwave, radar, and satellite communications, and commercial microwave backhaul, you may be responsible not only for hardware installation and maintenance, but also over-the-air signal quality. You may also need to regularly monitor unexpected signals and perform signal surveillance.

FieldFox's spectrum analyzer is optimized to excel in a dynamic spectral environment. You may face measurement challenges such as the need to detect a low-level signal under strong signal conditions (requiring high dynamic range), or close-in small interference signals (requiring excellent phase noise).

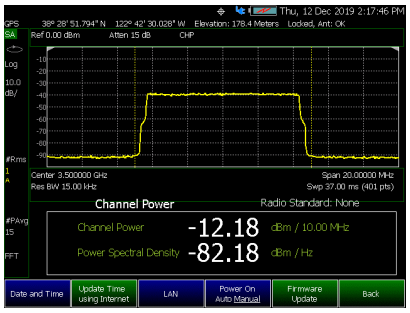
FieldFox's superior dynamic range (TOI +15 dBm), close in phase noise (-117 dBc/Hz at 10 kHz offset), and fast sweep time make these challenging tasks easier. FieldFox's spectrum analyzer also provides a full power measurement suite and complete trace and state control.



Monitor frequency spectra up to 26.5 GHz with FieldFox

Unprecedented amplitude accuracy without instrument warm-up

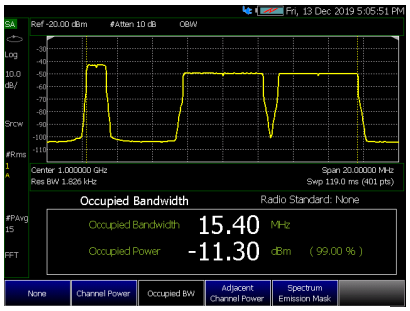
With FieldFox's InstAlign capability, internal amplitude alignments occur automatically as environmental conditions change, without any user intervention. This provides unprecedented amplitude accuracy of ± 0.3 dB for spectrum analysis and power measurements. Better yet, FieldFox provides this accuracy immediately upon instrument turn on - no warm-up required.



Channel power measurement of 5G NR FR1 signal

Channel power measurements

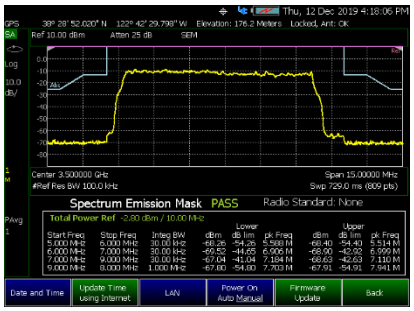
In modern wireless communications, the ability to accurately measure the power of digitally modulated signals enables you to maximize the capacity of a system and improve the quality of communication. For broadband signals, FieldFox offers fast and accurate power measurements that include channel power, occupied bandwidth, adjacent channel power and spectrum emission mask (SEM). When performed manually these measurements can be complicated and time consuming, but the FieldFox power measurement suite makes measurement setup fast and simple.



LTE-A occupied bandwidth measurement

Spectrum Emission Mask (SEM)

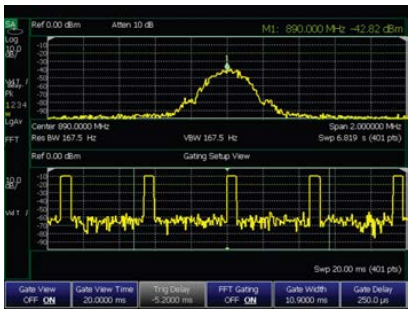
SEM measurement is used for characterizing transmitting signals where the power from in-band and out-of-band emissions is measured at specified frequency bandwidths and at specific offsets relative to the total carrier power. The SEM measurement is performing a segmented sweep, segmenting a different frequency on the lower level and upper level from a reference center frequency. Each segment may have different frequency span, resolution bandwidth (RBW) and integrated channel bandwidth settings. Supports up to 8 offset segments and pass or fail mask with absolute or relative limit lines.



SEM measurement of 5G NR FR1 signal

Spectrum analyzer time gating

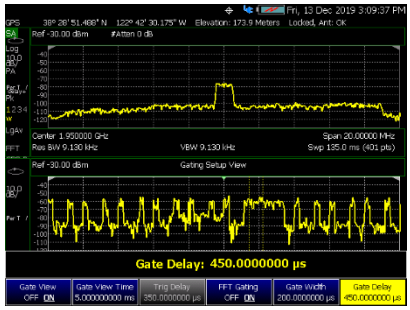
The testing of RF pulses is always challenging because so many instrument settings interact. With Option 238, gated FFT with time gating, FieldFox behaves like a spectrum analyzer and an oscilloscope. This enables you to quickly detect pulses in the time and frequency domains. A gate time of 6 µs to 1.8 s enables simultaneous examination of one or more pulses, or pulse rise and fall times, revealing the effects of spectrum growth due to various pulse shapes. Functions such as video trigger, external trigger and RF burst ensure reliable pulse detection. Automatic trigger-delay and bandwidth settings enhance characterization of RF pulses.



Analyze pulsed RF signals using the time-gating option

Periodic frame trigger synchronized with GPS

Periodic frame trigger allows for trigger execution at a fixed interval between successive executions. Modern communication systems like 5G use TDD for spectrum access, periodic trigger with time gating can help to differentiate uplink and downlink signals, this is particularly useful to find uplink interference in TDD networks. When the measurement is triggered by a frame boundary, which can be synchronized with GPS, then the data is captured only within the designated boundary.



LTE FDD control channel captured with periodic frame trigger synched to GPS

Real-time spectrum analyzer (RTSA)

With the widespread increase of wireless technologies in commercial and military networks, the spectral environment is filled with intentional and unintentional interference.

The interfering signals result in network quality deterioration and communication link breakdowns. Additionally, the prevalent use of digital modulation and burst-transmission methods have made it difficult to reliably detect interference sources.

This is where RTSA in FieldFox can help. With the combination of a fast, overlapping FFT processing technique, gap-free measurement, and a 100 MHz real-time bandwidth, FieldFox is able to detect signals as short as 5.52 µs with 100% POI with full amplitude accuracy.

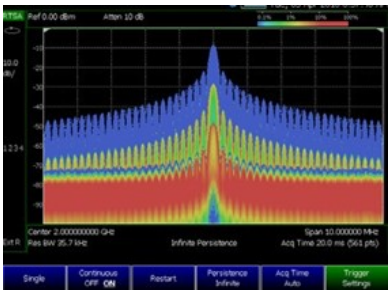
In some applications, detecting signals is the critical factor, independent of amplitude accuracy. In such cases, FieldFox can detect signals as short as 47 ns.

The spectrum density view displays three-dimensional data on a two-dimensional display. It uses color to show the number of times a frequency and amplitude point is detected during a capture interval.

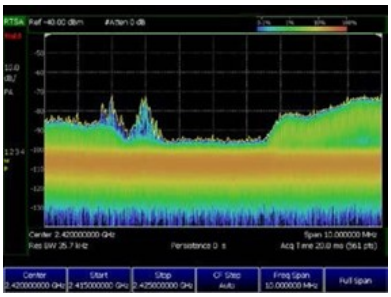
This is an excellent way to understand and visualize the spectral occupancy of the frequency band. For example, with RTSA you can detect a low-level signal in the presence of a high-power transmitter using the spectrum density view.

Finding an elusive signal can typically take hours or days. With FieldFox's recording and playback, data can be saved for further analysis offline at a later date.

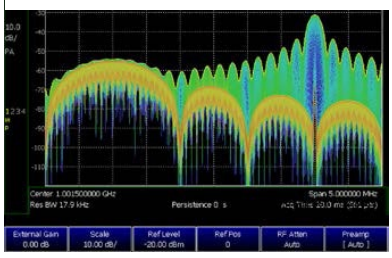
With RTSA in FieldFox, you can now eliminate the need for a separate, dedicated instrument. When needed, just shift to real-time capabilities in the same unit with one key press.



Density display with settable persistence



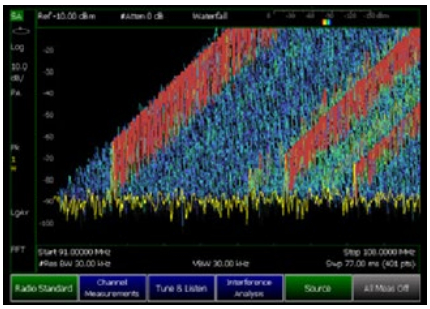
Identify multiple types of signals in the same band (Bluetooth and WiFi)



Multi-pulse detection with the density display

Interference analyzer

Interference can be internal or external, uplink or downlink, and has a direct impact on the quality of service (QoS) of a communication network. FieldFox's interference analyzer is designed to identify interfering signals quickly. Spectrogram and waterfall displays detect intermittent signals or monitor signals over a period of time. You can record signal traces into internal memory or external flash memory devices and play back the saved traces for offline processing. It has excellent dynamic range.



Waterfall display makes interference hunting easier

Channel scanner

Channel scanner allows users to make multiple channel power measurements simultaneously. It is used to verify wireless network coverage, path loss and potential interference issues. It also can be used to measure primary carriers and their intermodulated products. Each instrument state can be a custom set of frequencies with each frequency having a unique integrating bandwidth. Users can record and playback the data with data logging. Using time interval logging along with geotagging, files can be exported to Google Earth for network coverage analysis.

Scan up to 20 channels simultaneously with the channel scanner option

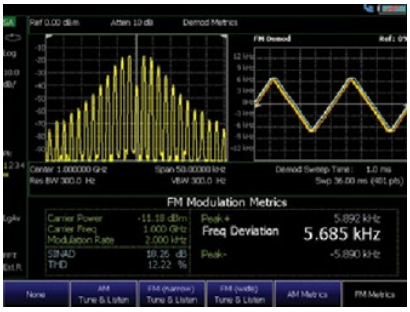
Noise figure (NF)

Communication system capacity is limited by internally generated noise. This noise will impact link budget, increase investment on the transmitter design, or will increase antenna cost at the receiver. One of the key performance indicators for a receiver is its sensitivity, which is the ability to reliably discern small signals that are close to the noise floor. The performance of a communication system is also based on signal-to- noise-ratio (SNR). While vector network analyzer S-parameter measurements and spectrum analyzer channel power and adjacent channel power measurements may be used to evaluate the signal behavior, additional evaluation of internally generated noise is necessary to have a full picture of the total system performance. As such, noise figure measurements can be used to quantify the degradation in SNR caused by components in the link. The FieldFox noise figure mode uses the industry proven Y-factor technique to accurately verify and characterize the noise figure of devices. FieldFox can also provide real-time feedback on measurement integrity with built-in uncertainty calculator error bars that can be displayed on the measurement data.

Accurately characterize noise figure of devices

AM/FM analog demodulation

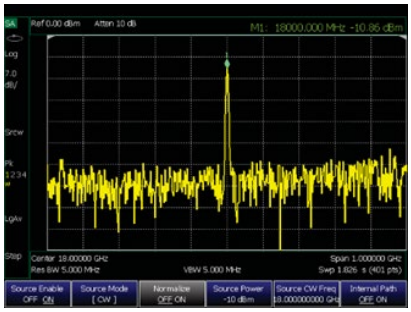
Using FieldFox's analog demodulation, users maintaining AM/FM radio transmitters can demodulate and characterize AM and FM transmitters. They can tune to the signal and listen to the audio tones using FieldFox's built-in speakers or a headphone. They can also measure the RF spectrum, the demodulated waveform and AM/FM metrics such as carrier power, modulation rate, and SINAD.



Characterize AM/FM signals using AM/FM demodulation

IF signal output

FieldFox provides a spectrum analyzer IF output with 10 MHz bandwidth (narrowband path) or an optional 100 MHz bandwidth (wideband path). This enables use as a frequency downconverter and digitize the signal using external test equipment like real time scope, or 89600 VSA software to perform deep signal analysis.



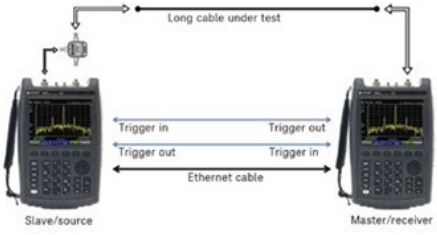
Use the internal microwave signal source for transponder testing

Field strength measurements

To characterize the electric and magnetic fields, the gain and loss of the antenna and cables must be accounted for. With FieldFox, you can load antenna factors and cable loss data using either the front panel or the complimentary Data Link software.

Independent signal source

FieldFox has a built-in independent signal source, with a frequency range up to 26.5 GHz and high output power over 8 dBm. The signal source can be tuned to any frequency, independent of the spectrum analyzer frequency. You can use the signal source to create a test signal to measure coverage, antenna isolation, antenna direction alignment, shielding effectiveness, and to verify frequency-offset devices.



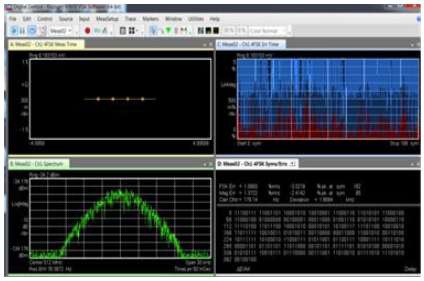
Measure long, lossy cables using ERTA

Extended range transmission analysis (ERTA)

Measuring long in-situ microwave cables such as those on ships is a challenging task and requires instruments with high dynamic range and fast measurement speed. These measurements were traditionally done using benchtop scalar analyzers, which are cumbersome to operate in the field. Using FieldFox's ERTA, users can measure dynamic ranges of 108 dB (at 6 GHz) or 77 dB (at 26.5 GHz), with a portable analyzer that requires no calibration and no warm-up. ERTA uses two FieldFox, one deployed at each end of the cable. One FieldFox acts as a source, while the other acts as a receiver. By taking advantage of Keysight's proprietary InstAlign technique, this configuration can be used to make cable loss measurements with accuracy of ± 0.7 dB.

Digitally modulated signal quality verification

Most modern wireless communication signals are digitally modulated to improve system capacity and enhance the ability to counter interference. In order to improve system capacity/spectrum efficiency, increasingly higher order modulation schemes are deployed. One of the key challenges to evaluating overall system performance is to correlate RF component performance to signal quality over-the-air.



Public safety transmitting signal quality test – P25 C4FM demodulation with FieldFox

Traditionally we measure transmitter power, frequency response and operating bandwidth, and 1 dB gain compression to examine the transmit chain of the system. However, for digitally modulated signals, these measurements may not be enough. This is because the current measurements are based on a continuous wave test signal having a peak to average ratio of 0 dB. For digitally modulated signals, this ratio is much higher (could be easily 3 to 10 dB), which means peak power could be much higher than the test signals used to evaluate the above-mentioned metrics.

The peak power can push the amplifier into a nonlinear region and induce degradation of signal modulation quality. Similar to poor error vector magnitude (EVM), this signal degradation makes it much harder for mobile devices to demodulation transmitted signals. Therefore, we need more information in order to examine the signal quality, demodulating and recovering the digital signal helps to provide insight as to why the system sometimes fails.

Keysight's 89600 VSA software can analyze digitally modulated signals simultaneously in the modulation, time and frequency domains providing useful insight to modulation quality with measurement displays views including spectrum, IQ constellation, EVM, frequency error and many more. The 89600 VSA link provides a powerful combination of hardware and software for design and troubleshooting of devices using signal formats such as APCO-25, TETRA for public safety radio, IEEE 802.11p for wireless vehicular communications, low power wide area networks and other IoT formats, as well as cellular communications including 5G NR, LTE-A, WCDMA, GSM and more.

FieldFox can connect to the 89600 VSA software (Keysight model number 89601B) via Ethernet to a Windows based PC or tablet. In order to connect with the 89600 VSA software, FieldFox requires a spectrum analysis option.

I/Q analyzer

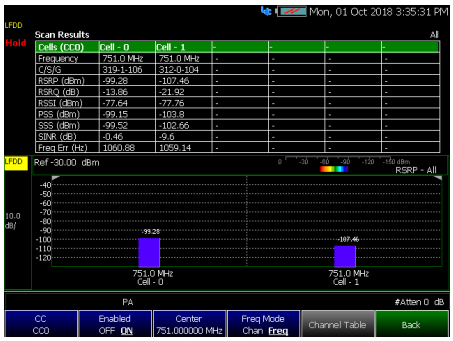
I/Q analyzer mode is the ideal capturing tool to verify final signal chain integration or troubleshoot signal quality degradation due to hardware or software issues. Frequency and time domain measurements provide demodulated I/Q data that can be analyzed with customizable multi-domain display views. I/Q data can also be captured on the instrument and analyzed using 89600 VSA software, MATLAB, Python tool kit and other third-party demodulation software. Additionally, I/Q capture data of an RF signal environment can be re-generated and played back using a vector signal generator. Features such amplitude and IF alignment before capture and single or continuous capture allow for enhanced performance and flexibility.

Over-the-Air (OTA) Measurements for LTE FDD

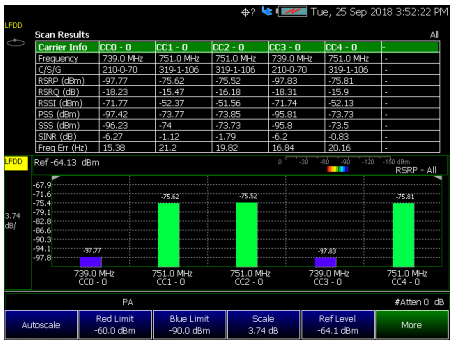
Our wireless networks have become ever-increasingly complex with the roll out of 4G and upcoming 5G. One of the key challenges is the question of “what network coverage is”, since today’s wireless networks are comprised of macrocells, microcells, and picocells, and these cells are deployed in layers. The macrocell provides overall coverage, while the microcell and picocell deliver high data throughputs to end users.

To guarantee smooth handover from various cells and frequencies, it is essential to make sure each cell has sufficient neighbors to handle various communication scenarios from mobile users, like coverage for voice, text messages and data services.

At any given location, a mobile phone likely sees all types of these cells at the same time and must determine which ones are intended for the phone. With the OTA measurement on FieldFox, engineers can scan the area to determine how many type cells are available and which cells are good neighbors.

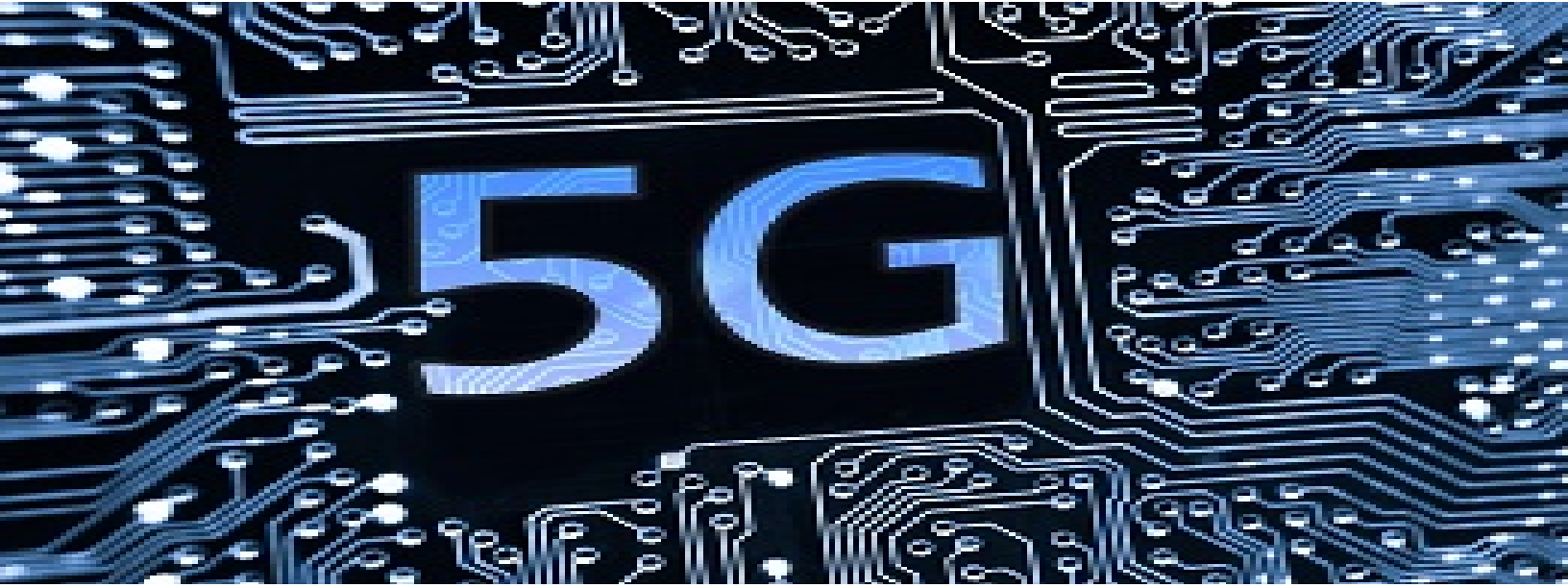


Multicell measurement with cell ID on single carrier frequency



Multiple carrier frequencies measurements with strong cell display

FieldFox LTE FDD OTA demodulation can provide insights to available cells with physical cell ID (PCI) on any given frequency, or often times this is called component carrier. This measurement demodulates and decodes all available cells on a single component carrier allowing engineers to see if any additional cells are available to use, thereby addressing the common problem of finding missing neighbors. In addition to single carrier multicell measurements, FieldFox also displays the strongest cell on different component carriers (up to a maximum of 6 cells, if present). This greatly expedites the process to find out which frequencies are the best for any given location and optimizes inter-frequency handover. LTE FDD OTA measures and decodes cell ID, RSRP, RSRQ, RSSI, PSS, SSS, SINR and frequency error.

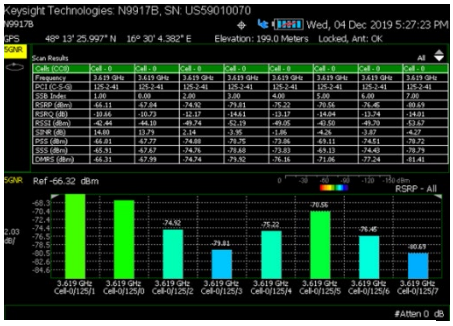


Over-the-Air Measurements for 5G

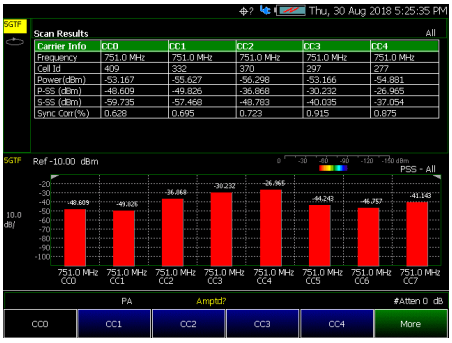
5G technologies provide dramatic network speed improvement and super-fast connection time. 5G NR is the 3GPP standard for the wireless network running on the sub 6 GHz frequency band (FR1) and the millimeter-wave frequency band (FR2) that offers gigabyte data rates. The key challenges for 5G network deployment are characterizing air interface pathloss and beam coverage. Since 5G network technology uses beamforming and massive MIMO to achieve high data rates, its control channels are on beam steering and are not always on.

When transitioning to 5G, operators must verify the quality of their network and beam performance so that users can connect without issue. To do this, you need a solution in your field kit that is capable of reading and displaying important metrics from several base stations in the vicinity. To measure the effective coverage, FieldFox 5G OTA can measure and decode PSS, SSS, beam indexes, cell ID and various signal quality metrics, which are key parameters to verify 5G coverage. From this information, users can identify any frequency drifting, isolate power issues, investigate performance problems, and verify Inter- RAT handovers. These measurements are especially imperative in optimizing network coverage for 5G.

Since 5G control channels are not always on and they are using initial access beam sweeping, this can make it challenging to determine the location of the 5G signal. Switching into RTSA mode on FieldFox can quickly and reliably detect 5G signals, detect control channels and provide insights to beamforming performance.



5G NR OTA measures control channels and displays cell ID



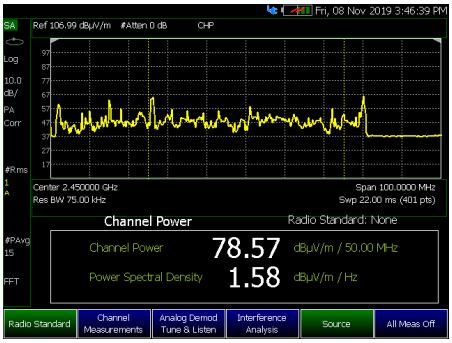
5GTF OTA supports Verizon's pre-5G networks

EMF Measurements

Radio frequency electromagnetic fields (EMF) are key tests to evaluate total RF exposure in any given area due to deployment of various RF/MW networks, such as mobile phones, base stations, Wi-Fi, smart meters, IoT devices, as well as satellite and radar systems.

Exposure limits for electromagnetic field (EMF) radiation differ by country. Many countries around the world base their regulations on findings from research organizations like the International Commission on Non-Ionizing Radiation Protection (ICNIRP), the Institute of Electrical and Electronics Engineers (IEEE), and the Federal Communication Commission (FCC).

Compliance and verification of exposure levels set by these government and regulatory agencies need to be verified in the field. FieldFox with EMF measurements supports connectivity to AGOS Advanced Technologies Triaxial Isotropic Antenna. EMF measurements are supported in spectrum analyzer and over-the-air (OTA) 5G NR modes and total field strength can be measured across the frequency band of interest.



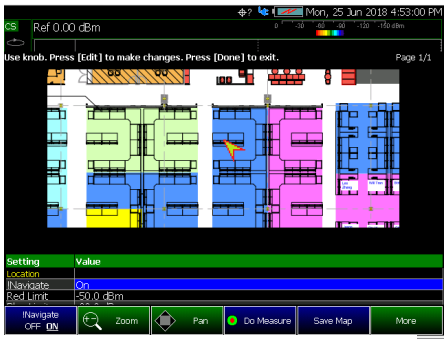
EMF measurement using spectrum analyzer channel power mode

Indoor and outdoor mapping

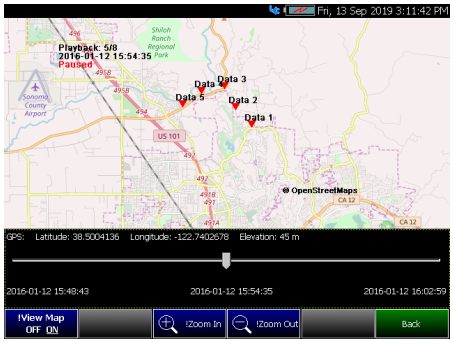
To verify network coverage or identify interference in any particular area, it is essential to combine receiver measurements with GPS location tags or from indoor markers. FieldFox can import maps from OpenStreetMap (OSM) for data collection and mapping to the FieldFox instrument display. The FieldFox indoor and outdoor mapping feature resides at the System level and can be enabled within the following modes:

Channel Scanner
Phased Array Antenna Support
Over-the-Air (OTA) LTE FDD
Over-the-Air (OTA) 5GTF
Over-the-Air (OTA) 5G NR

Maps can be saved to the FieldFox internal memory, SD card or USB drive. This can be done via a direct wired LAN connection or OSM maps can be downloaded and saved to FieldFox using the FieldFox Map Support Tool.



Imported indoor site map PNG file



Outdoor map of OTA LTE synched with GPS

Vector Network Analyzer

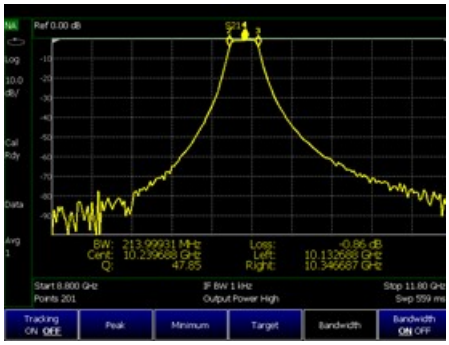
FieldFox can be configured with VNA transmission/reflection (T/R) capability for S11 and S21 measurements, or with full 2-port capability for measurements of all four S-parameters and full 2-port calibration.

With a full 2-port network analyzer, you can measure the forward and reverse characteristics of your component without having to disconnect, turn around, and reconnect it to the analyzer. Additionally, the full 2-port calibration gives you the best measurement accuracy possible.

FieldFox's four independent, sensitive receivers provide 117 dB of dynamic range for measurement of high rejection, narrowband devices such as cavity filters. The receivers also enable full 2-port error correction with the unknown thru method, allowing users to measure non-insertable devices accurately and easily.

FieldFox's calibration engine is the same engine that powers the well-respected Keysight ENA and PNA network analyzers. FieldFox leverages Keysight microwave expertise to deliver consistent measurements with Keysight benchtop VNAs.

Simultaneously measure and view all four S-parameters, with a single connection



Use the marker bandwidth/Q factor function to simplify filter testing and tuning

Calibration

FieldFox's guided Cal Wizard takes guessing out of calibration and allows you to easily perform the following calibrations:

- Full 2-port unknown thru
- Full 2-port QSOLT
- OSL, response, enhanced response
- TRL, LRL, offset short

Network analyzer 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.

Waveguide support

Waveguides are widely used to provide transmission links between microwave transmitters and antennas, as waveguides have less loss than coax. Keysight offers both high-performance and also economical waveguide calibration kits. The economical kits are ideal for field maintenance and troubleshooting because they provide good measurement results at a lower cost.

Vector voltmeter

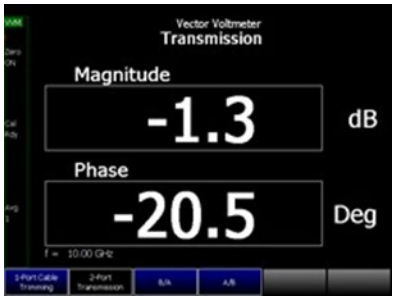
Using FieldFox's vector voltmeter (VVM), you can measure the phase shift and electrical length of a device. You can view results on the large display as far as ten feet or three meters away. VVM also provides ratio measurements of magnitude and phase of two channels, A/B or B/A. You can use this capability to verify the magnitude and phase differences between multiple signal paths such as in an antenna or phased array.

FieldFox offers all the key functionalities of the HP 8508A in a handheld form factor, and without the need for the source, bridge and accessories required with the 8508A.

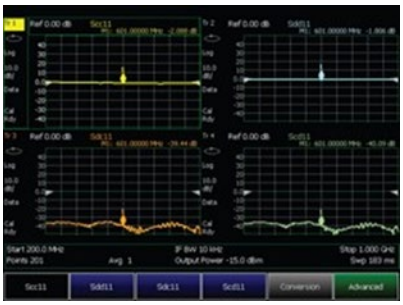
Mixed-mode S-parameters

With FieldFox, you can measure the common- and differential-mode reflections of a device. Mixed-mode S-parameters are also known as balanced measurements. This measurement requires the full 2-port VNA and 2-port cal functionality.

Easily use waveguides with FieldFox



Simplify cable trimming with the vector voltmeter capability



Characterized common and differential mode reflections with mixed-mode S-parameter measurements

USB power sensor support

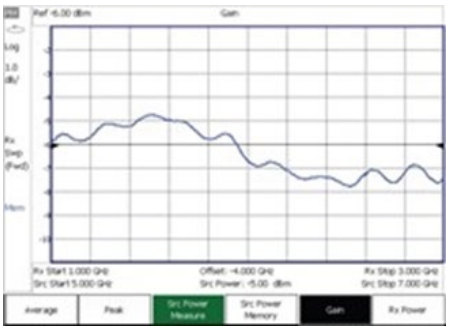
FieldFox can connect with Keysight USB power sensors to make RF and microwave power measurements. Using USB peak power sensors, you can measure both the average and the peak power of a modulated signal.

Simplify power measurements with USB power sensors

USB power measurements versus frequency

In addition to power measurements at a single CW frequency, you can measure power versus frequency - a swept measurement. FieldFox's source frequency can be set equal to the sensor/receiver frequency, or with an offset. 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.

This capability is useful for characterization of the scalar transmission response of devices such as mixers and converters. The FieldFox source stimulates the DUT and the power sensor is used as the measurement receiver.



Characterize mixers with FieldFox and a USB power sensor

Pulse measurements

FieldFox's pulse measurement option allows you to efficiently characterize pulsed RF signals such as those used in radar and electronic warfare systems, leveraging the Keysight USB peak power sensors. Measurements include peak power, peak to average ratio, and pulse profile parameters such as rise time, fall time and pulse repetition frequency.

Use FieldFox to characterize pulses

Software and System Features

Remote control capability with iPad and iPhone

Engineers and technicians can now remotely monitor and control their FieldFox using their iOS device such as an iPhone, iPad, or iPod Touch. FieldFox's Remote Viewer iOS app emulates the front panel of the unit, letting you simply press any FieldFox key right from your iOS device. The app also allows you to instantly access technical documents such as data sheets.

Control and view your FieldFox via your iPad

FieldFox's Data Link software makes report generation and documentation easier

FieldFox's complimentary Data Link software provides data transfer, data definition and report generation. You can add markers and limit lines to traces, and you can load cable files and antenna factors using Data Link.

Remote control via LAN and FieldFox programming

All FieldFox models can be controlled using SCPI over LAN and USB.

Built-in variable voltage DC bias

FieldFox has a built-in variable voltage DC bias source. The DC bias source can provide DC power to amplifiers under test and bias tower mounted amplifiers (TMA) when you need to sweep through the TMA to reach the antenna (bias tees available separately).

Obtain geolocation data with the built-in GNSS/GPS capability

Built-in GNSS/GPS

A built-in GNSS/GPS receiver provides geo- location tags to measurements. The geo data-time, latitude, longitude, and elevation-can be displayed and saved in data files. In addition to location information, the GPS provides an external reference to improve FieldFox frequency accuracy.

USB keyboard and mouse support

FieldFox supports use of USB keyboards and mice to simplify the input of text such as file names while working in the field.

Simplify text entry with a USB keyboard and mouse

Designed for You and the Work You Do Everyday

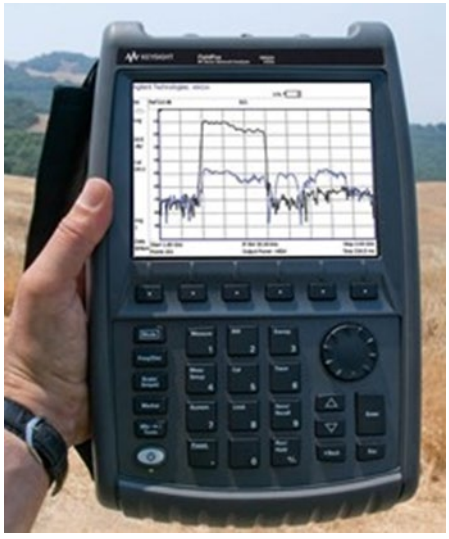
Carry FieldFox wherever you need to go

- Kit friendly at 7.35 lb. (3.34 kg) for the N991/3xB
- Large buttons are easy to operate, even when wearing gloves
- Field swappable battery lasts up to
- 4 hours
- Non-slip rubber grip securely fits in your hands and won't slide off the hood of your vehicle
- Vertical "portrait" orientation makes it easy to hold and operate at the same time

Field-proof usability for better answers in less time

- Bright, low-reflection display and backlit keys enable easy viewing in direct sunlight or darkness
- Intuitive user interface is designed for your workflow, enabling measurements in fewer key presses
- One-button measurements simplify complex setups and ensure quick, accurate results with confidence
- Calibration Wizard guides user to ensure simple and accurate calibrations
- Standard three-year warranty ensures field confidence, especially in harsh environments
- 5, 7- and 10-year warranties are also available

Easily operate FieldFox, even when wearing gloves, through the large front panel keys



Read measurements in direct sunlight with the transflective display

Designed for Your Toughest Working Conditions

- Rugged enough to meet MIL-specs
- Completely sealed instrument enclosure provides measurement stability in harsh environments, -10 to +55 ºC (14 to 131 ºF)
- Specially designed to protect instrument from damage due to drops, shock or other external impacts
- Water-resistant chassis, keypad and case withstand wide temperature ranges and salty, humid environments
- Meets MIL-PRF-28800F Class 2 requirements
- Type tested and meets MIL-STD-810G, Method 511.5, Procedure I requirements for operation in explosive environments
- Type tested and meets IEC/EN 60529 requirements for ingress protection

Count on extended instrument reliability with FieldFox's dust-free design: no vents or fans.

Configuration in Brief

See the FieldFox Handheld Analyzer Configuration Guide for complete information on all FieldFox products and accessories http://literature.cdn.keysight.com/litweb/pdf/5992-3701EN.pdf.

Option	Description	Combination Analyzers N9913/4/5/6/7/8B	Spectrum Analyzers N9933/4/5/6/7/8B
CAT / vector network analysis			
010	VNA time domain	✓	—
210	VNA transmission/reflection	✓	—
211	VNA full 2-port S-parameters	✓	—
212	1-port mixed-mode S-parameters	✓	—
215	TDR cable measurements	✓	—
305	Cable and antenna analyzer	Base model	—[1]
308	Vector voltmeter	✓	—
320	Reflection meas. (RL, VSWR and scalar meas.)	—[2]	✓
Spectrum analysis			
209	Extended range transmission analysis (ERTA)	✓	✓
220	Tracking generator	—[3]	✓
233	Spectrum analyzer	✓	Base model
235	Pre-amplifier	✓	✓
236	Interference analyzer and spectrogram	✓	✓
238	Spectrum analyzer time gating	✓	✓
312	Channel scanner	✓	✓
350	Real-time spectrum analyzer (RTSA)	✓	✓
351	I/Q analyzer (IQA)	✓	✓
352	Indoor and outdoor mapping	✓	✓
355	Analog demodulation	✓	✓
356	Noise figure (NF)	✓	✓
358	EMF measurements	✓	✓
360	Phased array antenna support	✓	✓
370	Over-the-Air (OTA) LTE FDD	✓	✓
377	Over-the-Air (OTA) 5GTF	✓	✓
378	Over-the-air (OTA) 5G NR	✓	✓
B04	Analysis bandwidth, 40 MHz[4]	✓	✓
B10	Analysis bandwidth, 100 MHz[4]	✓	✓
Power measurements			
208	USB power sensor meas. versus frequency	✓	✓
302	USB power sensor support	✓	✓
310	Built-in power meter	✓	✓
330	Pulse meas. with USB peak power sensor	✓	✓

[1] Option 305 is not available on the N993xB. A subset of CAT measurements, return loss and VSWR, is available as Option 320.
[2] Option 320 is not applicable to N991xB. The reflection measurements of return loss and VSWR are included with every N991xB. So, there is no need for an Option 320 on these analyzers.
[3] On the N991xB analyzers, order Options 233 and 210 to obtain a tracking generator with the spectrum analyzer. There is no Option 220 on the N991xB analyzers. Option 233 provides the spectrum analyzer capability and Option 210 the "tracking" capability.
[4] 10 MHz standard.

System features			
030	Remote control capability	✓	✓
307	GPS receiver	✓	✓
309	DC bias variable-voltage source	✓	✓
Windows based software			
89601B	89600 VSA software	✓	✓

Specifications in Brief

See the FieldFox Handheld Analyzer Data Sheet for a complete listing of the specifications:
http://literature.cdn.keysight.com/litweb/pdf/5990-3702EN.pdf.
Cable and antenna tester are referred to as CAT and vector network analyzer is referenced as VNA in this section.

Model	CAT and VNA frequency	Spectrum analyzer	Test port connectors
RF & microwave (combination) analyzers			
N9913B	30 kHz to 4 GHz	9 kHz to 4 GHz	Type-N (f)
N9914B	30 kHz to 6.5 GHz	9 kHz to 6.5 GHz	Type-N (f)
N9915B	30 kHz to 9 GHz	9 kHz to 9 GHz	Type-N (f)
N9916B	30 kHz to 14 GHz	9 kHz to 14 GHz	Type-N (f)
N9917B	30 kHz to 18 GHz	9 kHz to 18 GHz	Type-N (f)
N9918B	30 kHz to 26.5 GHz	9 kHz to 26.5 GHz	3.5 mm (m)
Spectrum analyzers			
N9933B	—	9 kHz to 4 GHz	Type-N (f)
N9934B	—	9 kHz to 6.5 GHz	Type-N (f)
N9935B	—	9 kHz to 9 GHz	Type-N (f)
N9936B	—	9 kHz to 14 GHz	Type-N (f)
N9937B	—	9 kHz to 18 GHz	Type-N (f)
N9938B	—	9 kHz to 26.5 GHz	Type-N (f)[2]

[1] Usable to 5 kHz.
[2] Order Option 100 for 3.5 mm (m) test port connectors. With N9938B-100, the spectrum analyzer is built with 3.5 mm test port connectors instead of the standard Type-N (f). Option 100 is a prerequisite for Option 320 for N9938B.

Cable and antenna analyzer (CAT) and vector network analyzer (VNA)

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

Model	N9913/ 14/ 15/ 16/ 17/ 18B
Measurements	
CAT	Distance-to-fault (dB), return loss, VSWR, DTF (VSWR), cable loss (1 port), optional insertion loss (2 port), DTF (linear), DTF / return loss dual display
TDR cable measurements	TDR (rho), TDR (ohm), DTF / TDR
VNA T/R	S11, S21 and insertion loss
VNA full 2 port	S11, S21, S22, S12 mag and phase, VSWR, linear, phase, Smith chart, polar, group delay, unwrapped phase, real/imaginary
Calibration types	CalReady, 1-port OSL, frequency response, enhanced response, QSOLT, unknown thru 2-port, Ecal, QuickCal (not available in N995xA models)
Number of traces	4
Number of markers	6
Marker functions	Peak, minimum, target, bandwidth measurement with Q, marker tracking
Data points	101, 201, 401, 601, 801, 1001 ,1601, 4001, 10,001
Frequency reference: -10 to 55 °C	
Accuracy	± 0.7 ppm (spec) + aging ± 0.4 ppm (typical) + aging
Accuracy, when locked to GPS	± 0.01 ppm (spec)
Aging Rate	± 1 ppm/year for 20 years (spec), will not exceed ± 3.5 ppm

Cable and antenna analyzer (CAT) and vector network analyzer (VNA) (continued)

Model	N9913/ 14/ 15/ 16/ 17/ 18B	
Test port output power (high power)		
Frequency	**Typical (Port 1)**	**Typical (Port 2)**
30 kHz to 500 kHz	-4	-2
> 500 kHz to 10 MHz	0	0
> 10 MHz to 1 GHz	9	8
> 1 to 5 GHz	8	7
> 5 to 10 GHz	7	7
> 10 to 18 GHz	6	5
> 18 to 26.5 GHz	3	2
Test port output power (low power)	**Typical (Port 1 or Port 2)**	
30 kHz to 26.5 GHz	-50 dBm (flattened), ±0.5 dB	
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.		
Power level accuracy[1]	**Typical (Port 1 or Port 2 at -15 dBm)**	
30 kHz to 10 MHz	± 0.7 dB	
> 10 MHz to 26.5 GHz	± 0.5 dB	
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)	

[1] N991xB power levels are calibrated based on PNA-X's tuned receiver, which means primarily the fundamental is included (for frequencies ≥ 10 MHz). For frequencies < 10 MHz, power levels are calibrated in the factory using a broadband power sensor.

Cable and antenna analyzer (CAT) and vector network analyzer (VNA) (continued)

Model	N9913/ 14/ 15/ 16/ 17/ 18B			
System dynamic range [1,2] (dB), high power, 300 Hz IFBW, 100-point average, Port 1 or Port 2 (-10 to 55°C)				
Frequency	**S12 Spec**	**S12 Typical**	**S21 Spec**	**S21 Typical**
30 kHz to 1 MHz	--	114 (nominal)	--	113 (nominal)
> 1 to 6.34 MHz	105	114	104	111
> 6.34 MHz to 16 GHz	108	114	106	116
> 16 to 18 GHz	109	117	104	114
> 18 to 24 GHz	105	115	102	113
> 24 to 26.5 GHz	102	113	97	109
Trace noise[3], high power, 300 Hz IFBW, Port 1 or Port 2, spec, -10 to 55 °C				
Frequency	**Magnitude (dB rms)**	**Phase (deg rms)**		
30 kHz to 100 kHz	0.0008 (nominal)	0.007 (nominal)		
≥ 100 kHz to 5 GHz	0.0010	0.005		
> 5 to 15 GHz	0.0014	0.014		
> 15 to 26.5 GHz	0.0020	0.027		
IF Bandwidth[4]				
Bandwidth	3 Hz, 10 Hz, 30 Hz, 100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz			

[1] System dynamic range is measured in the factory with loads on the test ports after a thru normalization.
[2] 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.
[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.
[4] VNA mode only. Recommend using averaging in CAT mode.

Spectrum analyzer

The performance listed in this section applies to the spectrum analyzer capabilities.

Model	N9913/ 14/ 15/ 16/ 17/ 18B N9933/ 34/ 35/ 36/ 37/ 38B	
Measurements		
Spectrum analyzer	Spectrum, channel power, adjacent power, occupied bandwidth, analog demodulation, tune and listen	
Number of traces	Same as network analyzer (see page 31)	
Number of markers	Same as network analyzer (see page 31)	
Interference analysis	Spectrogram, waterfall and record/playback	
Input attenuator range	0 to 40 dB, in 5 dB steps	
Frequency span	Resolution: 1 Hz	
Frequency reference: -10 to 55°C	Same as network analyzer (see page 31)	
Preamplifier	The preamplifier covers the full-band with nominal gain of 20 dB	
Tracking generator	Built in, full-band based on the model maximum frequency	
Resolution bandwidth (RBW), 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		
Video bandwidth (VBW)		
1 Hz to 5 MHz in 1, 1.5, 2, 3, 5, 7.5, 10 sequence		
Phase noise: Stability, SSB phase noise at 1 GHz (N991xB, N993xB)		
Offset	**Spec (-10 to 55°C)**	**Typical (-10 to 55°C)**
10 kHz	-111	-117
30 kHz	-110	-115
100 kHz	-105	-111
1 MHz	-119	-124
3 MHz	-123	-128
5 MHz	-124	-129

Spectrum analyzer (continued)

Model	N9913/ 14/ 15/ 16/ 17/ 18B N9933/ 34/ 35/ 36/ 37/ 38B	
50 MHz absolute amplitude accuracy (dB)		
0 dB attenuation, input signal -40 to -5 dBm, peak detector, preamplifier off, 300 Hz RBW, all settings auto-coupled.		
No warm-up required.	**Spec (-10 to 55 ºC)**	**Typical (-10 to 55 ºC)**
	± 0.50	± 0.17
Total absolute amplitude accuracy		
10 dB attenuation, input signal -15 to -5 dBm, peak detector, preamplifier off or on[1], 300 Hz RBW, all settings auto-coupled, includes frequency response uncertainties. No warm-up required.		
N991xB, N993xB[2]	**Spec (-10 to 55°C)**	**Typical (-10 to 55°C)**
9 kHz to 100 kHz[3]	± 2.00	± 0.25
> 100 kHz to 500 MHz[4]	± 0.80	± 0.20
> 500 MHz to 16.3 GHz[4]	± 1.00	± 0.20
>16.3 GHz to 18 GHz[4]	± 1.00	± 0.30
> 18 GHz to 26.5 GHz[5]		
Displayed average noise level (DANL) - (dBm)		
Input terminated, RMS detection, log averaging, 0 dB input attenuation, reference level of -20 dBm, normalized to 1 Hz RBW, measured at non-zero frequency span		
Preamp on	Spec (-10 to 55°C)	Typical (-10 to 55°C)
9 kHz to 2 MHz	-129	-148
≥ 2 MHz to 2.1 GHz	-156	-163
≥ 2.1 to 2.6 GHz	-155	-160
≥ 2.6 to 4.5 GHz	-156	-162
≥ 4.5 to 7.5 GHz	-152	-160
≥ 7.5 to 13 GHz	-156	-161
≥ 13 to 18 GHz	-153	-158
≥ 18 to 22 GHz	-152	-157
≥ 22 to 25 GHz	-149	-155
≥ 25 to 26.5 GHz	-146	-152

[1] Preamplifier on is specified using 20 dB attenuation, input signal -25 to -15 dBm.
[2] N9938B units with Type-N connectors are tested using a system calibrated in 3.5 mm, with a precision 3.5 mm to Type-N adapter. With this adapter there are nominally four modes between 18GHz and 26.5GHz. The effect of these modes is included within these specifications.
[3] For frequencies 9 to 100 kHz, total absolute amplitude accuracy (Typical value) is 0.8 dB with preamplifier on.
[4] For frequencies > 100 kHz to 18 GHz, total absolute amplitude accuracy (Spec and Typical values) apply with preamplifier off or on.
[5] For frequencies > 18 to 26.5 GHz, total absolute amplitude accuracy (Spec value) is ± 1.20 dB with preamplifier on.

Spectrum analyzer (continued)

Model	N9913/ 14/ 15/ 16/ 17/ 18B N9933/ 34/ 35/ 36/ 37/ 38B
Third order intermodulation distortion (TOI) – (dBm) **Two -15 dBm signals, 100 kHz spacing at input mixer, – 10 to 55°C**	
	Frequency / **Typical**
	50 MHz to 500 MHz / +8.5
	≥ 500 MHz to 2 GHz / +11
	≥ 2 to 2.4 GHz / +13
	≥ 2.4 to 2.5 GHz / +13.5
	≥ 2.5 to 7.5 GHz / +9.5
	≥ 7.5 to 10 GHz / +11
	≥ 10 to 20 GHz / +13
	≥ 20 to 26.5 GHz / +15

Real-time spectrum analyzer (RTSA)

Model	N9913/ 14/ 15/ 16/ 17/ 18B N9933/ 34/ 35/ 36/ 37/ 38B		
Real-time Analysis			
Maximum real-time bandwidth	Standard	Option B04	Option B10
	10 MHz	40 MHz	100 MHz
Measurements	Density Spectrum, Spectrogram, Real-time Spectrum		
Resolution bandwidth	1 Hz to 500 kHz	1 Hz to 2 MHz	1 Hz to 5 MHz
Minimum signal duration with 100% probability of intercept (POI) at full amplitude accuracy	9.13 us	6.13 us	5.52 us
Minimum detectable signal	11 ns	11 ns	47 ns
Spurious-free dynamic range across maximum BW	66 dB	62 dB	59 dB
FFT rate	190,000 FFT/s		
Min. acquisition time (Density spectrum)	20 ms	20 ms	20 ms
Max. acquisition time (Density spectrum)	540 ms	337 ms	336 ms

Real-time spectrum analyzer (RTSA) (continued)

Model	N9913/ 14/ 15/ 16/ 17/ 18B N9933/ 34/ 35/ 36/ 37/ 38B
Traces	
Number of traces	4: all four can be active simultaneously and in different states
Detectors	Normal, positive peak, negative peak, sample, average (RMS)
States	Clear/write, max. hold, min. hold, average, view, blank
Markers	
Number of markers	6
Type	Normal, delta, peak
Marker →	Peak, next peak, center frequency, reference level, minimum
Trigger	
Trigger type	Free run, external video, RF burst, periodic

Analysis bandwidth [1, 2]

Model	N9913/ 14/ 15/ 16/ 17/ 18B N9933/ 34/ 35/ 36/ 37/ 38B		
Bandwidth options	10 MHz (Standard)	40 MHz (Option B04)	100 MHz (Option B10)
	Typical	Typical	Typical
IF flatness			
Magnitude	± 0.1 dB	± 0.1 dB	± 0.1 dB
Phase deviation from linearity[3]	0.4° peak-to-peak 0.4° rms	0.5° peak-to-peak 0.5° rms	5.0° peak-to-peak 3.0° rms
Group delay flatness (peak-to-peak)[3]	1 ns	0.6 ns	1.2 ns

[1] Analysis bandwidth is the instantaneous bandwidth available around a center frequency over which the input signal can be digitized for further analysis or processing in the time, frequency, or modulation domain.
[2] Analysis bandwidth capability supported with I/Q analyzer mode and 89600 VSA Software.
[3] Not guaranteed below 50 MHz

Analysis bandwidth [1, 2] (continued)

Model	N9913/ 14/ 15/ 16/ 17/ 18B N9933/ 34/ 35/ 36/ 37/ 38B		
Bandwidth options	10 MHz (Standard)	40 MHz (Option B04)	100 MHz (Option B10)
	Nominal	Nominal[3,4]	Nominal[3,4]
EVM (at center frequency 1 GHz)			
5G NR 64 QAM	—	—	0.70%
LTE-A FDD TM3.1 (10 MHz)	0.5%	0.5%	0.5%
LTE-A FDD TM3.1 (20 MHz)	—	0.40%	0.40%
WCDMA TM4 (5 MHz)	0.7%	0.7%	0.7%
EVM (at center frequency 2.1 GHz)			
LTE-A FDD TM3.1 (10 MHz)	0.7%	0.7%	0.7%
LTE-A FDD TM3.1 (20 MHz)	—	0.50%	0.50%
WCDMA TM4 (5 MHz)	0.75%	0.75%	0.75%
EVM (at center frequency 3.5 GHz)			
5G NR 64 QAM	—	—	0.85%
LTE-A FDD TM3.1 (20 MHz)	—	0.80%	0.80%
EVM (at center frequency 5.8 GHz)			
5G NR 64 QAM	—	—	1%
EVM (at center frequency 24 GHz)			
5G NR 64 QAM	—	—	2%

General Information

Model	N9913/ 14/ 15/ 16/ 17/ 18B N9933/ 34/ 35/ 36/ 37/ 38B
Weight	3.34 kg or 7.35 lb. including battery (approx.)
Dimension H x W x D	292 x 188 x 82 mm (11.5 in x 7.4 in x 3.2 in) (approx.)
Battery	Lithium ion, 10.8 V, 6.4 A-h, 70 Wh, 4 hours (typical)
Calibration cycle	1 year
Warranty	3-year warranty standard on all FieldFox instruments
Environmental	
MIL-PRF-28800F Class 2	Operating temperature, storing temperature, storing temperature, operating humidity, random vibration, functional shock, bench drop
MIL-STD-810G, Method 511.5	This product has been type tested to meet the requirements for operating in explosive environments in accordance with MIL-STD-810G, Method 511.5, Procedure 1.

[1] Analysis bandwidth is the instantaneous bandwidth available around a center frequency over which the input signal can be digitized for further analysis or processing in the time, frequency, or modulation domain.
[2] Analysis bandwidth capability supported with I/Q analyzer mode and 89600 VSA Software.
[3] These numbers were generated from room temperature results (23° C).
[4] Results generated from precise calibration when fast channel equalization (default) is OFF.

General Information (continued)

Model	N9913/ 14/ 15/ 16/ 17/ 18B N9933/ 34/ 35/ 36/ 37/ 38B
Ingress protection	This product has been type tested to meet the requirements for ingress protection IP53 in accordance with IEC/EN 60529 (IP rating for instrument by itself with no cover).
Complies with European Radio Equipment Directive	IEC/EN 61326–1 EN 301 489-1, EN 301 489-19 CISPR Pub 11 Group 1, Class B AS/NZS CISPR 11 ICES/NMB–001

Accessories in Brief

See the FieldFox Handheld Analyzer Configuration Guide for a comprehensive list of all FieldFox accessories.
http://literature.cdn.keysight.com/litweb/pdf/5992-3701EN.pdf

Model	N9913/ 14/ 15/ 16/ 17/ 18B N9933/ 34/ 35/ 36/ 37/ 38B
RF and microwave accessories	
Cables	
N9910X-709	Phase stable cable (3.5 mm (f) to 3.5 mm (f), 26.5 GHz, 3.28 ft or 1 m)
N9910X-810	Phase stable cable (Type-N (m) to Type-N (m), 6 GHz, 5 ft or 1.5 m)
Calibration kits	
N9910X-800	3-in- OSL calibration kit (DC to 6 GHz, Type-N (m) 50 ohm)
85520A	4-in-1 OSLT calibration kit (DC to 26.5 GHz, 3.5 mm (m) 50 ohm)
N4690C	Electronic calibration module (ECal), 300 kHz to 18 GHz, Type-N, 50 ohm, 2-port
Antennas	
N9910X-820	Directional antenna (multiband 800 MHz to 2.5 GHz, 10 dBi, Type-N (f))
N9910X-821	Telescopic whip antenna (70 MHz to 1 GHz, 10 dBi, BNC (m))
Preamplifiers	
U7227A USB Preamplifier, 10 MHz to 4 GHz	www.keysight.com/find/U7227A
U7227C USB Preamplifier, 100 MHz to 26.5 GHz	www.keysight.com/find/U7227C
U7227F USB Preamplifier, 2 to 50 GHz	www.keysight.com/find/U7227F
U7228A USB Preamplifier, 10 MHz to 4 GHz	www.keysight.com/find/U7228A
U7228C USB Preamplifier, 100 MHz to 26.5 GHz	www.keysight.com/find/U7228C
U7228F USB Preamplifier, 2 to 50 GHz	www.keysight.com/find/U7228F
Noise sources	
346A/B/C/K01/K40 Noise Source Family	www.keysight.com/find/346noisesources

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 precise microwave and millimeter-wave measurements- wherever you need to go. Add FieldFox to your kit and carry precision with you.

Related Literature	Number
FieldFox Handheld Analyzers N991x/3xB, Data Sheet	5992-3702EN
FieldFox Handheld Analyzers N991x/3xB, Configuration Guide	5992-3701EN

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