

FieldFox Handheld Analyzers

4/6.5/9/14/18/26.5/32/44/50/54 GHz

N9913B	N9950B	N9933B	N9960B
N9914B	N9951B	N9934B	N9961B
N9915B	N9952B	N9935B	N9962B
N9916B	N9953B	N9936B	N9963B
N9917B		N9937B	
N9918B		N9938B	





FieldFox Handheld Analyzers

The Keysight FieldFox handheld analyzers can withstand your toughest working conditions with a ruggedized yet light weight and portable battery powered design for making measurements for RF devices like cables, antennas, filters, amplifiers and signal/spectrum analysis. Create your specialized handheld analyzer solution by selecting FieldFox options and features to address cable and antenna test (CAT) spectrum analysis (SA) or vector network analysis (VNA) real time spectrum analyzer and over the air digital demodulation analysis required for your application. The FieldFox analyzers are always ready to make RF measurements, ensuring every operating mode is flexible enough to meet the needs of novices and experts alike.

This technical overview provides details of the standard FieldFox handheld analyzer features as well as selectable options for addressing your specific application needs.

Why choose FieldFox?

- Ideal 5G deployment and field-testing tool with 100 MHz real-time bandwidth and over-the-air (OTA) measurements
- Ability for 5G, satellite and radar operators to make true RF coverage measurements, up to 54 GHz and beyond, and beamforming verification with phased array antenna support
- Simplified field signal monitoring with wideband capture and recording of fully corrected IQ data
- Highly efficient radar and EW systems diagnostics with spectrum analysis, full 2-port VNA, power meter, pulse and noise figure measurements and results that correlate with high-performance bench top instruments
- Durable handheld analyzers that can withstand your toughest working conditions

Designed for You and the Work You Do Everyday

Carry FieldFox wherever you need to go

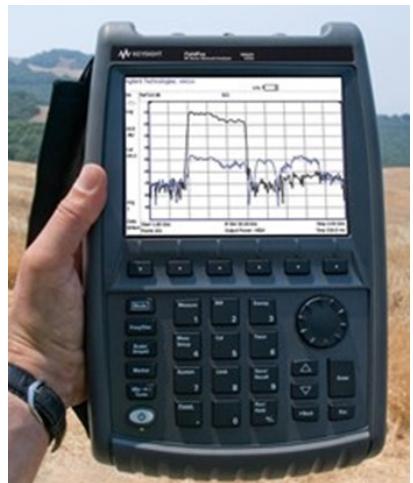
- Kit friendly at 7.35 lb. (3.34 kg) for the N991B/3xB and N995xB/6xB
- Large buttons are easy to operate, even when wearing gloves
- Field swappable battery lasts up to 4 hours
- Non-slip rubber grip securely fits in your hands and won't slide off the hood of your vehicle
- Vertical "portrait" orientation 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
- Intuitively designed user interface 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 transfective display



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



RF and Microwave

Signal Analyzers

Base: Spectrum analyzer

Up to 120 MHz bandwidth

Built-in power meter

Pulse measurements

Channel scanner

GPS receiver

Real-time spectrum analyzer

89600 VSA software connection

Surveyor 4D software connection

I/Q analyzer

Noise figure

Over-the-Air (OTA) LTE FDD/TDD and 5G

Indoor and outdoor mapping

EMF measurements (general and 5G)

Full-band tracking generator

Spectrum analyzer

Full-band preamplifier

Vector network analyzer

USB power sensor

TDR cable measurements

"Combination" Analyzers

Base: Cable and antenna analyzer

Vector network analyzer (VNA)		Spectrum Analyzer	
Frequency range	300 kHz to 54 GHz	Frequency range	5 kHz to 54 GHz
System dynamic range	117 dB	Spur-free dynamic range	>104 dB at 2.4 GHz
Trace noise	0.001 dB	Amplitude accuracy	0.2 dB
Directivity	39 dB	Phase noise	-117 dBc/Hz
Output power	9 dBm	DANL (preamp on)	-163 dBm
Calibrations	CalReady, SOLT, WG, Unknown thru, Response Cal, Ecal	CW/tracking generator	30 kHz to 54 GHz
		Input related spur	-80 dBm
		TOI	+13 dBm @ 2.4 GHz

For details of the selectable options and their features of these high-level configurations and more, see the following topics.

- [Cable and Antenna Analyzer](#)
- [RTSA, digital demodulation and noise figure](#)
- [Spectrum Analyzer](#)
- [Vector Network Analyzer](#)
- [USB Power Sensor Support](#)
- [Software and System Features](#)

Pick Up FieldFox for its Ergonomics



Portrait design and large buttons for easy operation –

Convenient side strap makes it easy to hold and

Task-driven keys are grouped to easily perform field measurements

Dedicated marker keys for quick marker



Anti-glare 6.5-inch LCD display with LED

11.5 in

Backlit keypad

7.4 in

(188 mm)



For N9913/14/15/16/17/18/33/34/35/37B, and N9938B without Option 100



For N9950/51/52/60/61/62B, N9953/63B (54 GHz) with 1.8 mm (m) connectors.

Quick connect shoulder strap clips

* For N9938B with Option 100 only

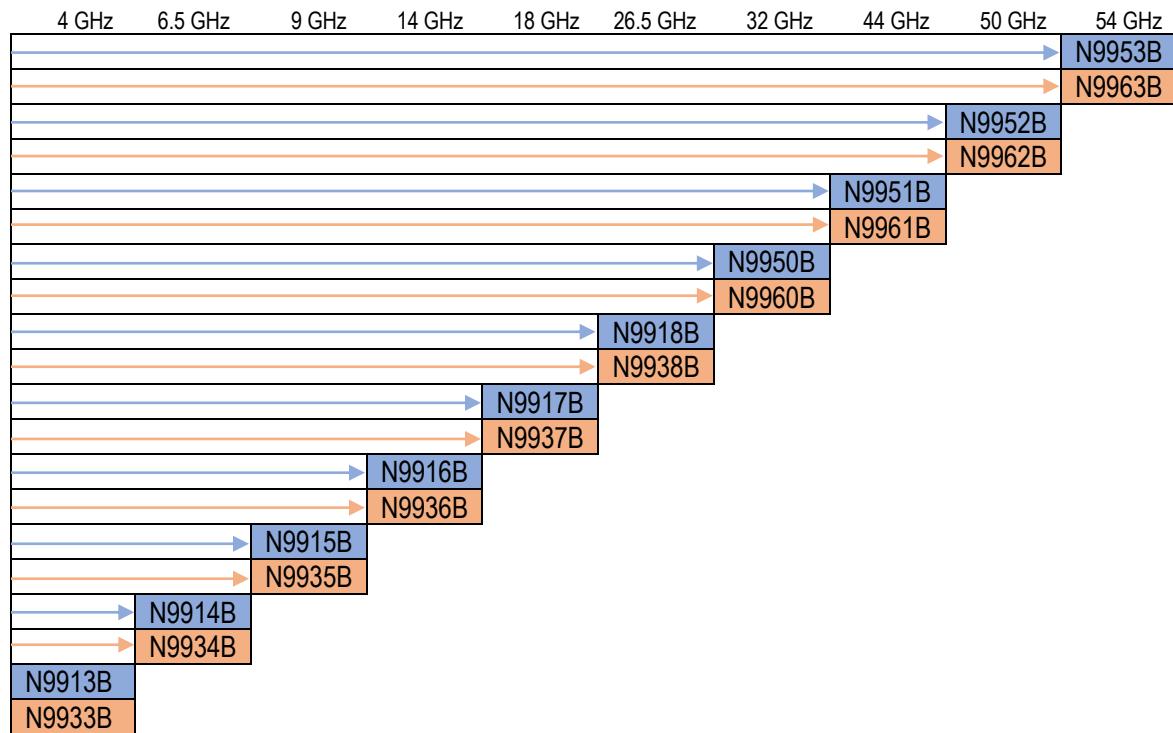


Built-in DC supply for powering external bias-tees, probes, and active devices



Choose the FieldFox that Meets Your Needs

Microwave (Combination) Analyzer Signal Analyzer (SA)



Create the Right Configuration for Your Application

Select the capabilities (FieldFox options) you need today and add field-upgradeable features via software license keys as needs change. In this section, combination analyzers include RF and microwave analyzers. See the [FieldFox Handheld Analyzer Configuration Guide](#) FieldFox product and accessories

Option	Description	Combination Analyzers	Spectrum Analyzers
		N9913/4/5/6/7/8B N9950/51/52/53B	N9933/4/5/6/7/8B N9960/61/62/63B
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	✓	✓
371	Over-the-Air (OTA) LTE TDD	✓	✓
377	Over-the-Air (OTA) 5G TF	✓	✓
378	Over-the-air (OTA) 5G NR	✓	✓
B04	Analysis bandwidth, 40 MHz ⁴	✓	✓
B10	Analysis bandwidth, 120 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 N993x/6xB. A subset of CAT measurements, return loss and VSWR, is available as Option 320.

² Option 320 is not applicable to N991x/5xB. The reflection measurements of return loss and VSWR are included with every N991xB/5xB. So, there is no need for an Option 320 on these analyzers.

³ On the N991x/5xB analyzers, order Options 233 and 210 to obtain a tracking generator with the spectrum analyzer. There is no Option 220 on the N991x/5xB 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	✓	✓	
N6820ES	Surveyor 4D Software	✓	✓	



Cable and antenna analyzer (CAT)

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 microwave link quality, 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 and nature of discontinuities in feeder lines. 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.

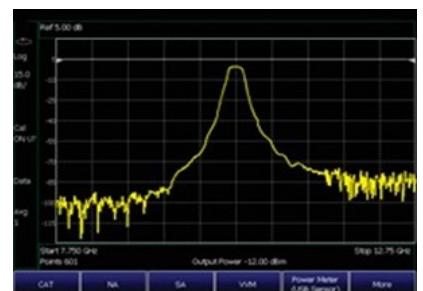
Measure both DTF and TDR in single sweep

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 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, satellite communications, and commercial microwave backhaul, you may be responsible for hardware installation and maintenance as well as over-the-air signal quality. This could require regular monitoring for unexpected signals and performing signal surveillance.

FieldFox's spectrum analyzer will 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.

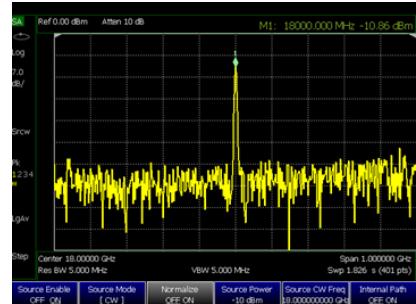
Unprecedented amplitude accuracy without instrument warm-up

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.

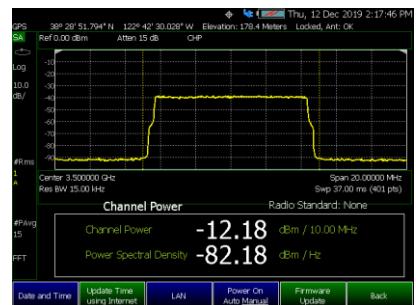
Channel power measurements

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).

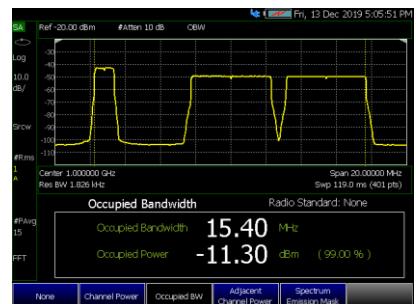
When performed manually these measurements can be complicated and time consuming, but the FieldFox power measurement suite makes measurement setup fast and simple.



Monitor frequency spectra up to 26.5 GHz with FieldFox



Channel power measurement of 5G NR FR1 signal



LTE-A occupied bandwidth measurement



Spectrum Emission Mask (SEM)

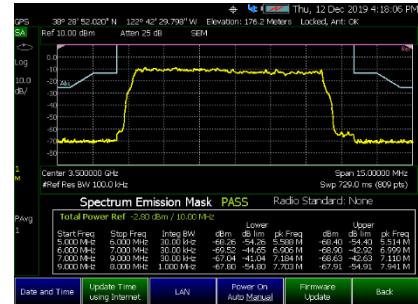
The SEM measurement characterizes transmitting signals where the power from in-band and out-of-band emissions is measured at specified frequency bandwidths and at specific offsets relative to the total carrier power. The SEM measurement is performing a segmented sweep, segmenting a different frequency 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.

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 μ s 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.

Periodic frame trigger synchronized with GPS

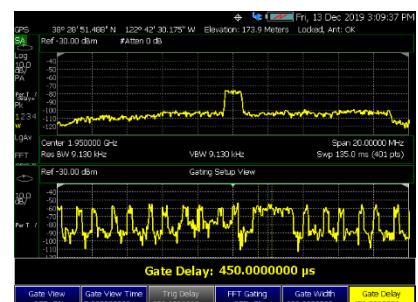
Periodic frame trigger allows for trigger execution at a fixed interval between successive executions. Modern communication systems like 5G use TDD for spectrum access, periodic trigger with time gating can help to differentiate uplink and downlink signals, this is particularly useful to find uplink 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.



SEM measurement of 5G NR FR1 signal



Analyze pulsed RF signals using the time-gating option



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



Real-time spectrum analyzer (RTSA)

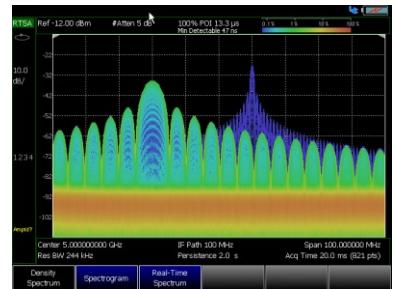
With the widespread increase of wireless technologies in commercial and military networks, various types of interference fill the spectral environment. The interfering signals result in network quality deterioration and communication link breakdowns. Additionally, use of digital modulation and burst-transmission methods have made it difficult to reliably detect interference sources. RTSA in FieldFox helps by combining a fast, overlapping FFT processing technique, gap-free data acquisition, and 120 MHz of real-time bandwidth to detect signals as short as 5.52 μ s with 100% POI and full amplitude accuracy. Detecting signals, independent of amplitude accuracy, can be a critical factor. 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 using color to show the detected number of frequency and amplitude points during a capture interval for a clear view of the frequency band's spectral occupancy. For example, with RTSA you can detect a low-level signal in the presence of a high-power transmitter using the spectrum density view. Find an elusive signal quickly using FieldFox's recording and playback to analyze saved data offline. With RTSA in FieldFox, you can shift to real-time capabilities with one key press.

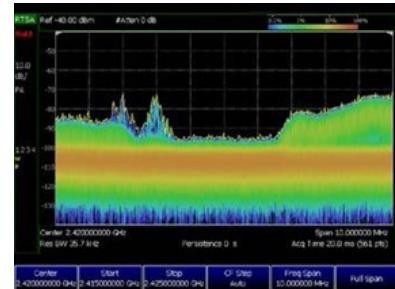
N6820ES Surveyor 4D software

Turn FieldFox into a portable, battery operated spectrum monitoring system by adding the N6820ES Surveyor 4D software that allows you to configure up to four high-resolution, flexible spectral displays. Simultaneously view different parts of the spectrum in either a traditional view or full-color spectrogram. Surveyor 4D includes features to automatically detect signal energies, extract their parameters and log the information to a database. The optional FieldFox modulation recognition feature provides a powerful signal classifier with 25 different analog and digital modulation formats that are recognized from a live spectrum or previously recorded IQ times-series data.

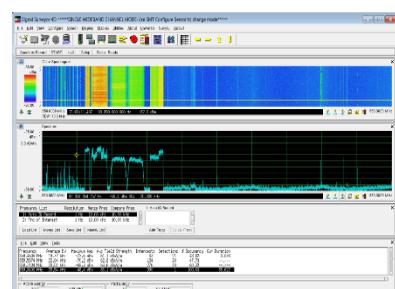
Surveyor 4D's alarm function can trigger actions (recordings, email, etc.) based criteria derived from the extracted signal parametric data. Configurable in automatic or manual operating modes, Surveyor 4D software dramatically steps up the spectrum monitoring capabilities of the FieldFox.



Multi-pulse detection using density display with settable persistence



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



Portable monitoring system covering VLF to 5G millimeter wave bands



Interference analyzer

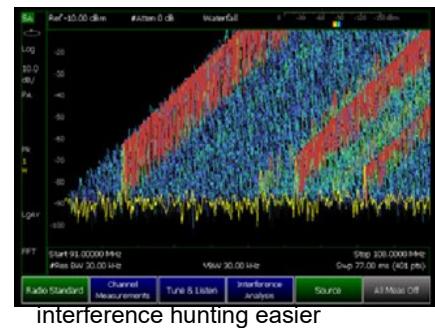
Interference can be internal or external, uplink or downlink, and has a direct impact on the quality of service (QoS) of a communication network. FieldFox's interference analyzer has an excellent dynamic range and identifies interfering signals quickly. Spectrogram and waterfall displays detect intermittent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

Channel scanner

Make multiple channel power measurements simultaneously and verify wireless network coverage, path loss and potential interference issues with the channel scanner. Also, measure primary carriers and their intermodulated products. Configure instrument states with a custom set of frequencies, each with a unique integrating bandwidth. Use data logging to record and playback the data. Use time interval logging along with geotagging to export files to Google Earth for network coverage analysis.

Noise figure (NF)

Internally generated noise can limit communication system capacity and impact link budget, increase investment on the transmitter design, or will increase receiver antenna. A key receiver performance indicator is sensitivity, the ability to reliably discern small signals that are close to the noise floor. A communication system performance is also based on signal-to-noise-ratio (SNR). Signal behavior analysis uses a combination of vector network analyzer S-parameter measurements, spectrum analyzer channel power and adjacent channel power measurements. However, additional evaluation of internally generated noise is necessary for a complete system performance overview. To address this need, use noise figure measurements to quantify the SNR degradation caused by components in the link. The FieldFox noise figure mode uses the industry proven Y-factor technique to accurately verify and characterize device noise figures and can also provide real-time measurement integrity feedback on measurement data that includes built-in uncertainty calculator error bars.



San up to 20 channels simultaneously with the channel scanner option



Accurately characterize noise figure of devices



AM/FM analog demodulation

Use FieldFox's analog demodulation to characterize AM/FM radio transmitters, or tune to a signal and listen to the audio tones with the built-in speakers or a headphone. Measure an RF spectrum, demodulated waveform, or AM/FM metrics such as carrier power, modulation rate, and SINAD.

IF signal output

FieldFox provides a spectrum analyzer IF output with 10 MHz bandwidth (narrowband path) or an optional 120 MHz bandwidth (wideband path) to use as a frequency downconverter to digitize a signal using external test equipment like a real time scope, or 89600 VSA software to perform deep signal analysis.

Field strength measurements

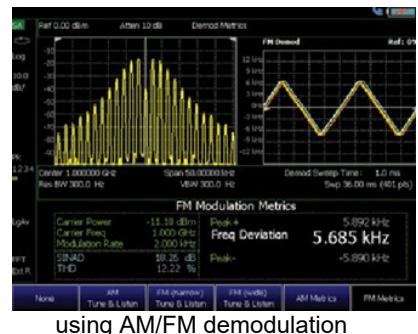
To characterize the electric and magnetic fields, you must account for the gain and loss of the antenna and cables. Load antenna factors and cable loss data via the FieldFox front panel or using the complimentary Data Link software.

Independent signal source

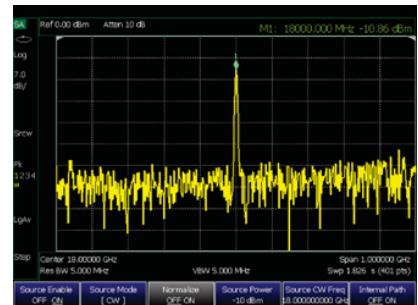
FieldFox has a built-in independent signal source, with a frequency range up to 54 GHz and high output power over 8 dBm. You can tune the signal source to any frequency, independent of the spectrum analyzer frequency. Use the signal source to create a test signal to measure coverage, antenna isolation, antenna direction alignment, shielding effectiveness, and to verify frequency-offset devices.

Extended range transmission analysis (ERTA)

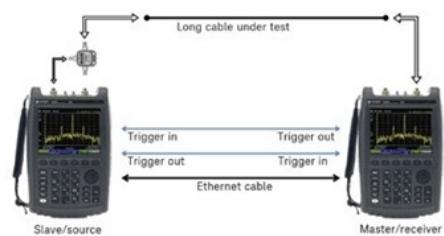
Measuring long in-situ microwave cables such as those on ships is a challenge and requires instruments with high dynamic range and fast measurement speed. Historically, these measurements used benchtop scalar analyzers, which are cumbersome to operate in the field. FieldFox's ERTA can measure dynamic 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. Make cable loss measurements, with accuracy of ± 0.7 dB, by taking advantage of Keysight's proprietary InstAlign technique.



using AM/FM demodulation



Use the internal microwave signal source for transponder testing



Measure long, lossy cables using ERTA



Digital modulation signal quality verification

Modern wireless communication signals include digital modulation to improve system capacity and counter interference. To improve system capacity and spectrum efficiency, there are many modulation schemes deployed. A key challenge to evaluate overall system performance is to correlate RF component performance to signal quality over-the-air.

Traditionally we measure the transmitter power, frequency response, 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 with 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.

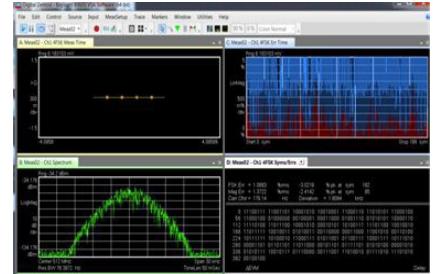
The peak power can push the amplifier into a nonlinear region and induce degradation of signal modulation quality. Like poor error vector magnitude (EVM), this signal degradation makes it much harder for mobile devices to demodulate transmitted signals. Signal quality examination requires more information. 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 connects to the 89600 VSA software (Keysight model number 89601B) via Ethernet to a Windows based PC or tablet. FieldFox requires a spectrum analysis option to connect with the 89600 VSA software.

I/Q analyzer

The I/Q analyzer mode helps to verify final signal chain integration or troubleshoot signal quality degradation. Frequency and time domain measurements provide demodulated I/Q data for analysis with customizable multi-domain displays. Captured I/Q data is analyzed using 89600 VSA software, MATLAB, Python tool kit and other third-party demodulation software. I/Q captured data of an RF signal environment can also 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.



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



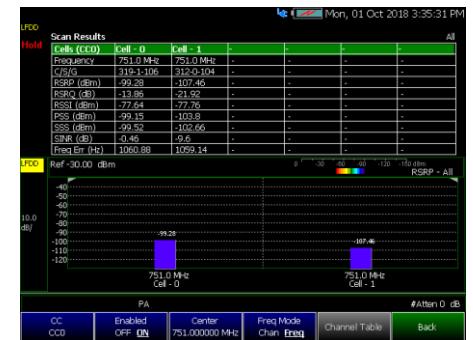
Over-the-Air (OTA) Measurements for LTE FDD or TDD

Wireless networks have become more complex with the roll out of 4G and 5G. A key question is “what network coverage is”, since today’s wireless networks are comprised of macrocells, microcells, and picocells, and deployment of these cells occurs 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 enough neighbors to handle various communication scenarios from mobile users, like coverage for voice, text messages and data services.

At any location, a mobile phone sees all types of cells at the same time and must determine the ones intended for that 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.

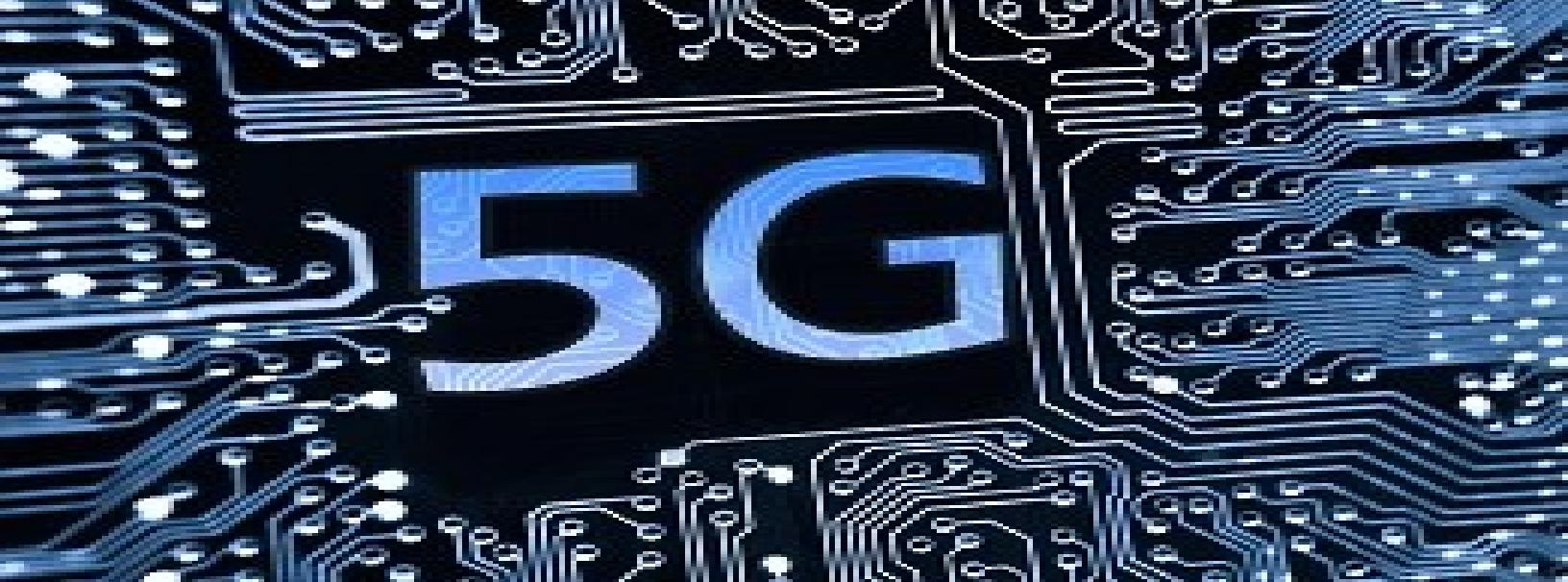
FieldFox LTE FDD OTA or LTE TDD OTA demodulation can provide insights to available cells with physical cell ID (PCI) on any given frequency, or the component carrier. This measurement demodulates and decodes all available cells on a single component carrier allowing engineers to see if any additional 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 or LTE TDD OTA measures and decodes cell ID, RSRP, RSRQ, RSSI, PSS, SSS, SINR and frequency error.



Multicell measurement with cell ID on single carrier frequency



Multiple carrier frequencies measurement with strong cell display



Over-the-Air Measurements for 5G

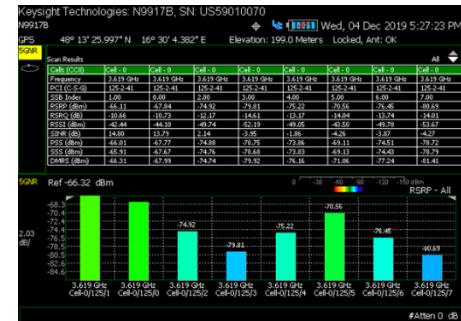
5G technologies provide dramatic network speed improvement and super-fast connection time. 5G NR is the 3GPP standard for the wireless network running on the sub 6 GHz frequency band (FR1) and the millimeter-wave frequency band (FR2) that offers gigabyte data rates. The key challenges for 5G network 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, you 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. This information enables users to identify 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, it can be challenging to determine the location of the 5G signal. Switching into the FieldFox RTSA mode quickly and reliably detects 5G signals, control channels and provides insights to beamforming performance.

5G has two modes of implementation, non-standalone (NSA) and standalone (SA). NSA requires LTE as an anchor to provide a control plane. This improves 5G network reliability because widely deployed LTE has better coverage. For quick 5G coverage deployments, 5G implements dynamic spectrum sharing (DSS) that allows 5G to run on existing 4G LTE physical channels without disrupting LTE operation. However, operators must ensure 5G coverage on the same channel is similar, to and minimize efficiency impact due to higher overhead RRM activities.

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5G NR OTA measures control channels and displays cell ID



5G DSS on LTE channel

Top: 5G NR channel scan with cell ID
Bottom: LTE channel scan with cell ID



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 to minimize 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 120 MHz of real-time bandwidth and frequency coverage up to 54 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.



EMF Measurements

Radio frequency electromagnetic fields (EMF) tests 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 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).

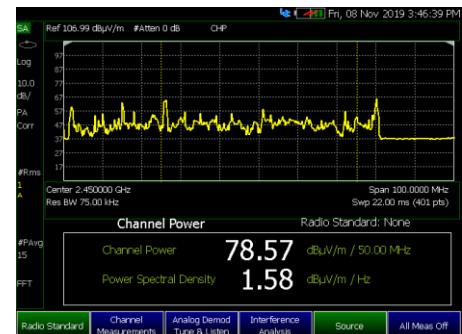
Field verification is required for compliance to exposure levels set by these government and regulatory agencies. FieldFox with EMF measurements supports connectivity to AGOS Advanced Technologies Triaxial Isotropic Antenna. The spectrum analyzer and over-the-air (OTA) 5G NR modes support EMF measurements that measure the total field strength across the frequency band of interest.

Indoor and outdoor mapping

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

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

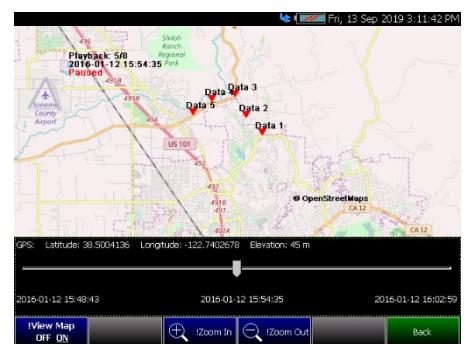
Save maps to the FieldFox internal memory, SD card or USB drive. Use the FieldFox Map Support Tool download OSM maps or use a direct wired LAN connection.



EMF measurement using spectrum analyzer channel power mode



Imported indoor site map PNG file



Outdoor map of OTA LTE synched with GPS



Vector Network Analyzer

FieldFox includes options for 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.

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

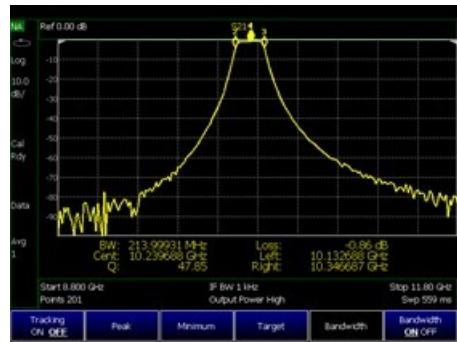
Full 2-port QSOLT

OSL, response, enhanced response

TRL, LRL offset short



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



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. You can remove unwanted responses such as connector mismatch or cable discontinuities using Time-domain gating and display the results in either time or frequency domain.

Waveguide support

Waveguides better provide transmission links between microwave transmitters and antennas than coax cables due to lower loss. Keysight offers both high-performance and economical waveguide calibration kits. The economical kits are ideal for field maintenance and troubleshooting because they provide good measurement results at a lower cost.



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

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.



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

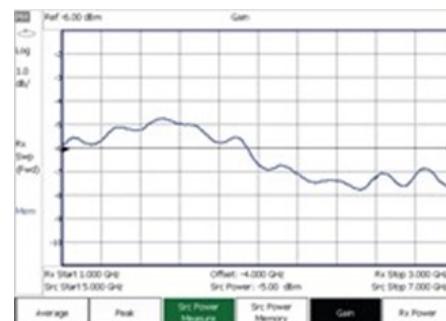
USB power measurements versus frequency

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 swept source and receiver frequencies 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 measurement receiver is a 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.



Characterize mixers with FieldFox and a USB power sensor



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 and turn the knob 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.



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

Remote control via LAN and FieldFox programming

You can control all FieldFox models using SCPI over LAN and USB.



Simplify text entry with a USB keyboard and mouse

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).

Built-in GNSS/GPS

A built-in GNSS/GPS receiver provides geo-location tags to measurements. You can display and save the geo data-time, latitude, longitude, and elevation 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.

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/3x/5x/6xB, Data Sheet	5992-3702EN
FieldFox Handheld Analyzers N991x/3x/5x/6xB, Configuration Guide	5992-3701EN

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