



The new generation in signal analysis

SignalShark
seven senses for signals



- ▶ Real-Time Spectrum Analyzer
- ▶ Monitoring Receiver
- ▶ RF Direction Finding and Localization System

CAPTURE

The SignalShark's continuous real-time persistence view displays every change in the signal – even in hidden signals.

SignalShark. Seven senses for signals

SignalShark – there's a reason for the name. Just like its namesake, the SignalShark is an extremely efficient hunter, perfectly designed for its task. Its prey: interference signals. Its success rate: Exceptional. The real-time analyzer is a successful hunter, thanks to the interplay of its highly developed seven sensory functions. Seven senses that don't miss a thing, and that make it easy for you to identify and track down interferers in real-time.



More and more devices have to share the available frequency spectrum as a result of new technologies such as the Internet of things (IoT), machine to machine (M2M) or car to car (C2C) communications, and the rapidly growing 4G/5G mobile networks.

It doesn't matter whether you are making a wideband measurement of entire frequency ranges, or searching for hidden signals, or needing to reliably detect very short impulses, or localizing interference signals – SignalShark gives you all the measurement solutions you need to cope with the increasingly complex radio frequency spectrum. Its design and excellent performance make it ideal for on-site measurements as well as for fully-fledged laboratory use.

Make it your device

SignalShark is ready for the future, thanks to its many expansion facilities, and it can be optimally adapted as needed to the widest variety of applications.

SignalShark – the 40 MHz real-time spectrum analyzer

Whether you are in the lab or out in the field, you will have the right analysis tool in hand with the SignalShark. You will be convinced by its truly outstanding RF performance, as well as by its easily understood, application-oriented operating concept. The high real-time bandwidth with very high FFT overlapping ensures that you can reliably capture even extremely brief and infrequent events. The unusually fast scan rate results in very short measurement times even if you need to cover wider frequency bands than the real-time bandwidth. Comprehensive evaluation tools make sure that you can perform current and future measurement and analysis tasks up to laboratory instrument standards reliably, simply, and faster.

SignalShark – the monitoring receiver

The extremely High Dynamic Range (HDR) of the SignalShark ensures that you can reliably detect even the weakest signals in the presence of very strong signals, and not confuse them with the artifacts of a normal receiver.

- Frequency range: 8 kHz to 8 GHz
- Weight: Approx. 4.1 kg / 9 lbs (with one battery)
- Dimensions: 230 x 335 x 85 mm (9.06" x 13.19" x 3.35")

This is a basic requirement for most tasks in the field of radio monitoring. Alongside the real-time spectrum analyzer, there is a receiver for audio demodulation, level measurement, and modulation analysis, which can be tuned to any frequency and channel bandwidth within the 40 MHz real-time bandwidth. And, if you need even more than the analysis tools of the SignalShark, you can process the I/Q data from the receiver externally as a real-time stream and store them on internal or external data storage media.

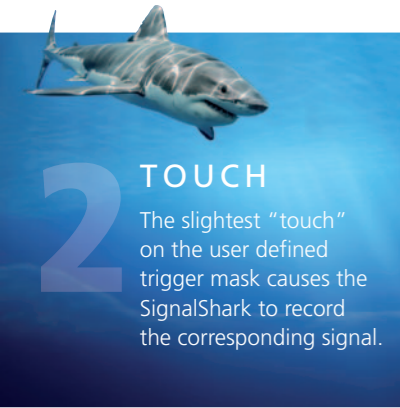
SignalShark – the direction finding and localization system

It is often necessary to locate the position of a signal transmitter once the signals have been detected and analyzed. SignalShark supports the new Automatic Direction-Finding Antennas (ADFA) from Narda, allowing you to localize the source very quickly and reliably. In fact, localization is child's play, thanks to the integrated maps and localization firmware. Conveniently, homing-in using an ADFA mounted on a moving vehicle is also supported. Powerful, state of the art algorithms minimize the effects of false bearings caused by reflections off urban surroundings in real-time. Extremely light weight and easy to use manual direction finding antennas are available for "last mile" localization.



www.youtube.com/watch?v=pSZdR27j5LQ&t=14s





2 TOUCH

The slightest "touch" on the user defined trigger mask causes the SignalShark to record the corresponding signal.

10.4" resistive touch screen

- ▶ Intuitive operation, even when wearing gloves
- ▶ Selectable day / night view
- ▶ Customizable GUI with several views for application-oriented, fast, convenient measurement

Microphone to record voice comments



Top panel connectors

- ▶ Four switchable RF Inputs (1 x N connector, 3 x SMA)
- ▶ PPS / Trigger Input
- ▶ 10 MHz reference input
- ▶ Antenna control connector
- ▶ Input for additional, external global navigation satellite system antenna
- ▶ USB 3.0 host for keyboard, mouse, printer, hard disc, WiFi modem, LTE modem, etc.
- ▶ 1 GigE Ethernet connector for remote control and I / Q streaming
- ▶ MicroSD card (microSDXC)
- ▶ 3.5mm headphone jack
- ▶ DC input / charging connector, plug in / screw on



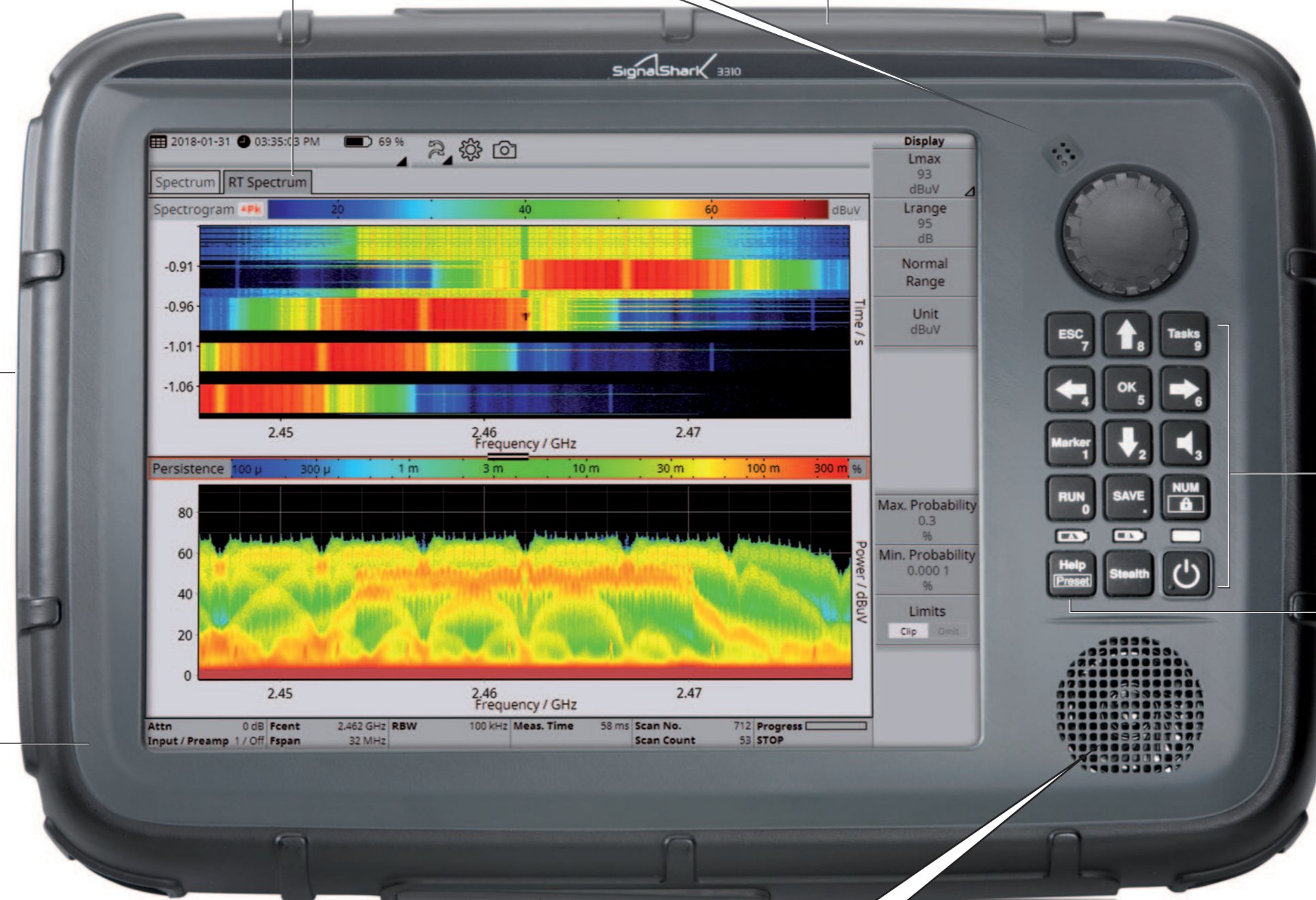
- ▶ 2 x smart technology lithium-ion internal and external rechargeable battery packs
- ▶ Hot-swappable for interruption-free long-term measurements

Rugged design for mobile use, even in harsh environments

- ▶ MIL-PRF-28800F class 2

Baseplate connectors

- ▶ Video display port for external monitor or projector
- ▶ USB 2.0 for keyboard, mouse, printer, etc.



Built-in loudspeaker gives clear, loud sound reproduction, even in noisy environments

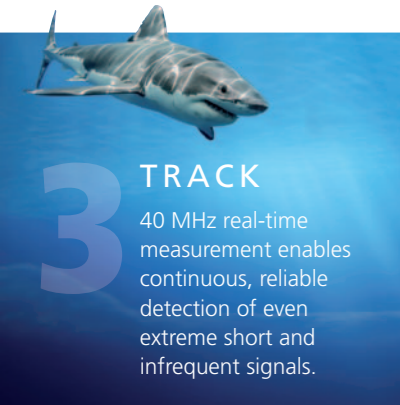
- ▶ Illuminated keyboard for operation in low ambient light

- ▶ Built-in help function
- ▶ Stealth and keyboard lock



www.youtube.com/watch?v=0jqrwU_jPcs

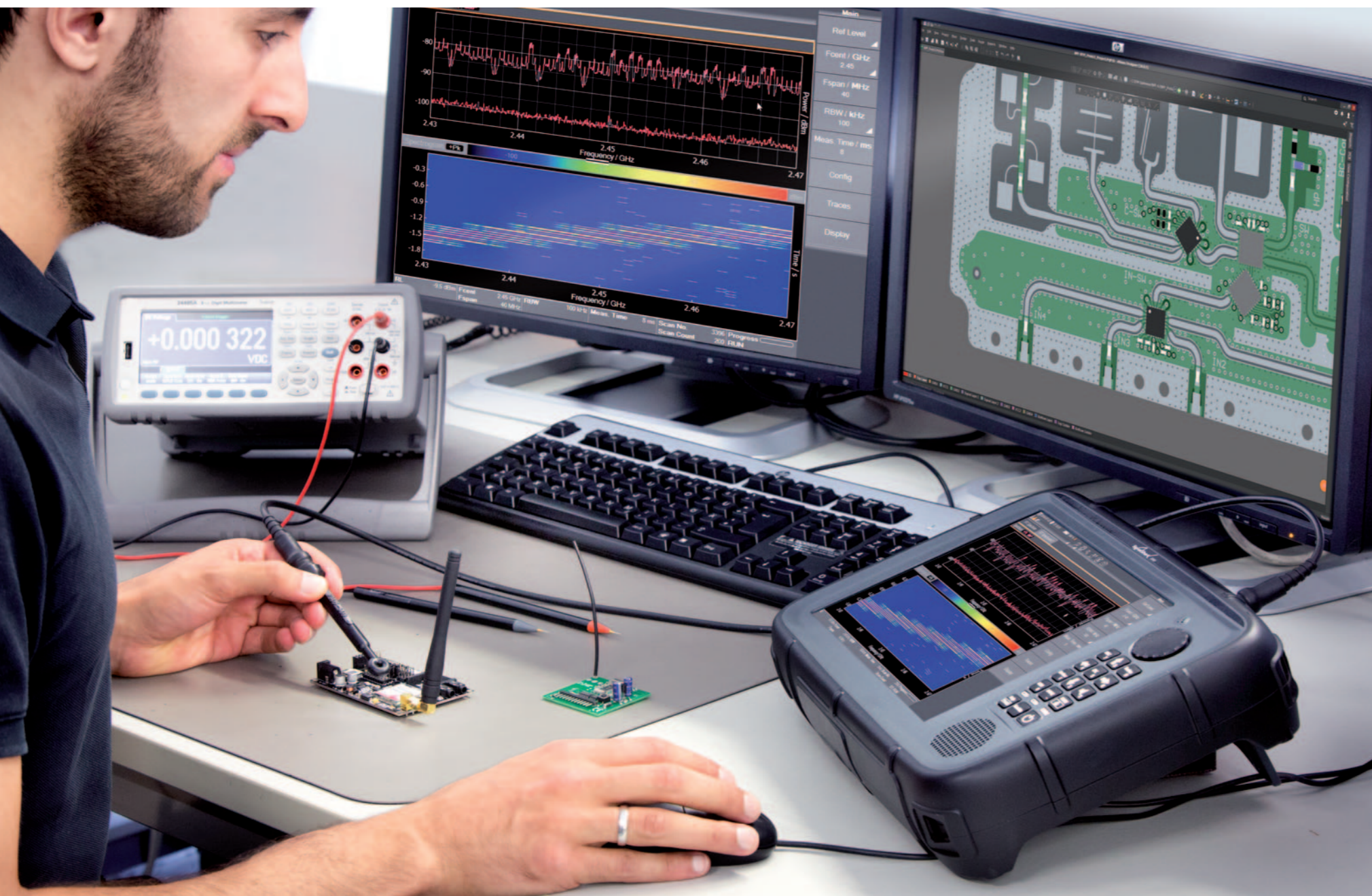
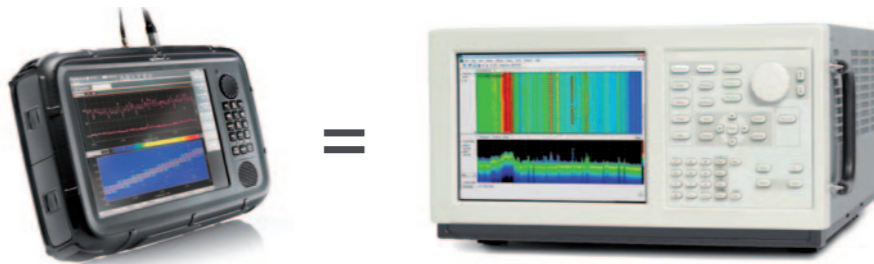




3 TRACK

40 MHz real-time measurement enables continuous, reliable detection of even extreme short and infrequent signals.

SignalShark is a handy, portable, battery powered measuring device, yet it boasts performance that is otherwise only found in large, heavy laboratory grade equipment. It can be readily used instead of such expensive equipment because of its wide range of connection facilities and measurement functions.



Reliable detection of extremely short and rare events in a 40 MHz real-time bandwidth

A real-time analyzer calculates the spectrum by applying the FFT on overlapping time segments of the underlying I/Q data within its real-time bandwidth. The real-time bandwidth is only one of the key parameters for a real-time analyzer. The probability of intercept, POI, is easily just as important. This parameter describes the minimum time that the signal must be present for it to be always detected without any reduction in level. This time is affected by the maximum resolution bandwidth RBW and the FFT overlap. The SignalShark is a match for established laboratory analyzers with its minimum duration of 3.125 μ sec for 100 % POI and full amplitude accuracy. The minimum detectable signal duration is < 5 nsec. SignalShark accomplishes this by a large signal immunity in combination with a very low intrinsic noise as well as a high FFT overlap and its large resolution bandwidth. That is outstanding for a hand-held analyzer. To accomplish this, SignalShark generally operates with an 87.5 % overlap, which is again outstanding for a hand-held analyzer. This means that even the shortest impulses are detected and the full signal to noise ratio is maintained for longer signals.

Spectrogram shows more details than ever

With SignalShark, you can use up to three detectors at the same time for the Spectrogram view. This makes it possible for you to easily visualize impulse interference on broadcast signals and get much more information from the spectrogram. The extraordinarily fine time resolution of 31.25 μ s means that you can completely reveal the time signatures of many signals. With the I/Q Analyzer option, you can resolve the spectrogram even more, to less than 200 ns.

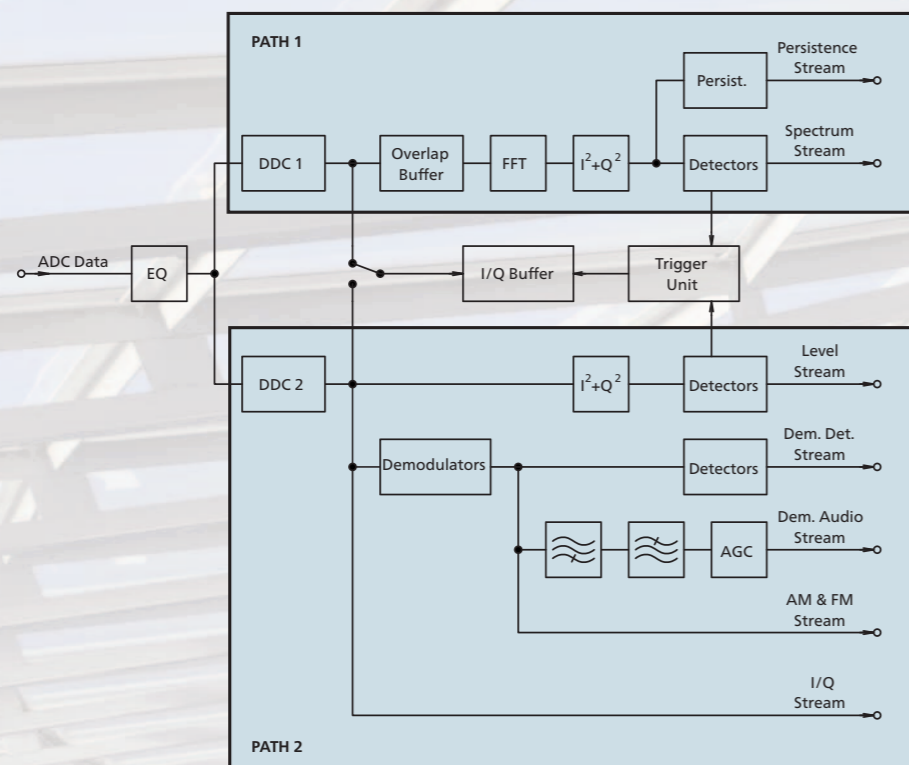
Persistence View

A color display of the spectrum shows how often the displayed levels have occurred. This enables you to detect signals that would be masked by stronger signals in a normal spectrum view.

SignalShark – the real-time spectrum analyzer

- HDR: extremely low noise and distortion, simultaneously
- real-time bandwidth: 40 MHz
 - FFT overlap: 75 % (Fspan > 20 MHz)
 - FFT overlap: 87.5 % (Fspan \leq 20 MHz, RBW \leq 400 kHz)
 - FFT size: up to 16,384
- Minimum signal duration for 100 % POI: 3.125 μ s at full amplitude accuracy
- Minimum detectable signal duration: < 5 ns
- Persistence: up to 1.6 million spectrums per second
- Spectrogram time resolution: down to 31.25 μ s
- Spectrogram detectors: up to three at the same time
- RBW: 1 Hz - 800 kHz in real-time spectrum mode, 1 Hz - 6.25 MHz in scan spectrum mode
- Filters conforming to CISPR and MIL for EMC measurements
- Scan speed: Scan rate up to 50 GHz/s
- Detectors: +Pk, RMS, Avg, -Pk, Sample
- Markers: 8, additional noise power density and channel power function
- Peak table: shows up to 50 highest spectral peaks

SignalShark is not just a very powerful real-time spectrum analyzer. It is also the ideal monitoring receiver, thanks to its near ITU-ideal spectrum monitoring dynamic capabilities, second receiver path and demodulators.



The block circuit diagram shows the two, independent digital down converters (DDC). These make it possible e.g. to observe the spectrum of the signal spectrum and demodulate it at the same time independently within the real-time bandwidth.

The benefit of HDR

The extremely high dynamic range (HDR) of the SignalShark ensures that you can reliably detect even the weakest signals in the presence of very strong signals. The SignalShark's pre-selector allows it to suppress frequencies that would otherwise interfere with the measurement. The excellent dynamic range of the SignalShark is the result of the ideal combination of the displayed averaged noise level (DANL) with the so-called large-signal immunity parameters, i.e. the second and third order intermodulation intercept points (IP_2 and IP_3). It is important that these three factors are always specified for the same device setting (e.g. no attenuation, no pre-amplifier), as they vary considerably according to the setting.

DDC 2, the additional receiver path

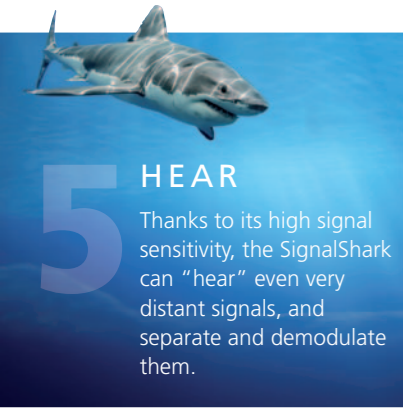
The tuning frequency and the channel bandwidth of an additional receiver path, DDC 2, can be set independently from the real-time spectrum analyzer path, DDC 1, within the real-time bandwidth of the SignalShark. The I/Q data can be streamed to external devices in real-time, or they can be processed by the SignalShark itself for level measurements, audio demodulation, and modulation measurements. The very steep cutoff channel filters capture 100 % of the signal in the selected channel without any degradation while completely suppressing the adjacent channels.

CISPR compliant EMC detectors now also available for on-site applications

The facility for selecting all the filters and detectors necessary for CISPR or MIL compliant EMC measurements is also available for the receiver as well as for the spectrum. If an interferer is detected, you can now decide on the spot whether or not the device needs to be taken out of service because of violating EMC regulations.

SignalShark – the monitoring receiver

- HDR: extremely low noise and distortion, simultaneously
- CBW: 25 Hz - 40 MHz (Parks-McClellan, $\alpha = 0.16$)
- Filters for EMC measurements: CISPR, MIL
- Detectors: +Pk, RMS, Avg, -Pk, Sample
- EMC detectors: CPk, CRMS, CAvg (compliant with CISPR)
- Level units: dBm, dB μ V, dB(μ V/m) ...
- Level uncertainty: $< \pm 2$ dB
- AFC
- Audio demodulators: CW, AM, Pulse, FM, PM, LSB, USB, ISB, I/Q
- AGC & squelch for audio demodulators
- Modulation measurements: AM, FM, PM
- I/Q streaming: Vita 49 (sample rate $\leq 25,6$ MHz)
- Remote control protocol: SCPI



5 HEAR

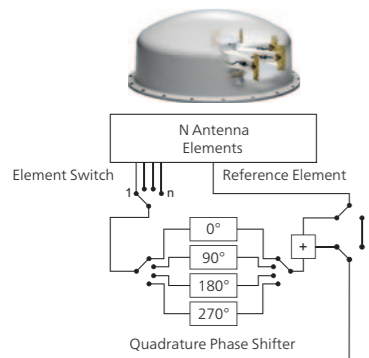
Thanks to its high signal sensitivity, the SignalShark can "hear" even very distant signals, and separate and demodulate them.

Narda offers a large number of automatic and directional antennas for the SignalShark. Their unique characteristics combined with the SignalShark makes them unbeatable.

Automatic Direction Finding Antenna ADFA 1

The frequency range of ADFA 1 makes it particularly suitable for localizing interferers, e.g. in mobile communications networks:

- ▶ Frequency range: 200 MHz - 2.7 GHz
- ▶ Nine dipoles arranged on a 380 mm diameter circle for DF
- ▶ A central monopole is used as a reference element for DF or as an omnidirectional monitoring antenna
- ▶ Built-in phase shifter and switch matrix
- ▶ Direction finding method: correlative interferometer
- ▶ Bearing uncertainty: 1° RMS (typ.)
- ▶ Built-in electronic compass
- ▶ Built-in GNSS receiver with antenna and PPS output
- ▶ Diameter: 480 mm



Automatic Direction Finding Antenna ADFA 2 (available 2019)

This ADFA is suitable for a wide range of localization tasks due to its wide frequency range:

- ▶ Frequency range: (500 kHz) 10 MHz - 8 GHz
- ▶ Two crossed coils for DF at low frequencies
- ▶ Nine dipoles arranged on a 380 mm diameter circle for DF at medium frequencies
- ▶ Nine monopoles arranged on a 125 mm diameter circle for DF at high frequencies
- ▶ A central monopole is used as a reference element for DF or as an omnidirectional monitoring antenna
- ▶ Built-in phase shifter and switch matrix
- ▶ Direction finding method: Watson-Watt or correlative interferometer
- ▶ Bearing uncertainty (10 MHz - 200 MHz): 2° RMS (typ.)
- ▶ Bearing uncertainty (200 MHz - 8 GHz): 1° RMS (typ.)
- ▶ Built-in electronic compass
- ▶ Built-in GNSS receiver with antenna and PPS output
- ▶ Diameter: 480 mm

Automatic Direction Finding Antenna ADFA accessories

- ▶ Connecting cable, length 5 m or 15 m, low loss
- ▶ Tripod including mounting accessories
- ▶ Mounting kit for magnetic attachment to a vehicle roof
- ▶ Mounting kit for mast attachment

Automatic Direction Finding Antenna ADFA 1 + 2



After you have localized the signal by SignalShark and ADFA using the car, you will need for last mile or to enter a building Narda's handy, feather-light directional antennas and active antenna handle. They are the ideal choice in this situation. The antenna handle does more than just hold the antenna. Among other features, it has a built-in operating button that allows you to perform the main steps during manual direction finding, making the combination unbeatable.

- ▶ The Narda antenna handle and directional antennas are extremely light, making for fatigue-free signal searches.
- ▶ The convenient plug-in system allows you to change antennas very quickly.
- ▶ SignalShark recognizes the antenna and applies the appropriate antenna factors for field strength measurements automatically.
- ▶ SignalShark receives the azimuth, elevation and polarization of the antenna from the 3D electronic compass built into the handle, so manual direction finding could hardly be simpler.
- ▶ The preamplifier built into the handle is activated and deactivated by SignalShark, so you can further reduce SignalShark's low noise figure to detect and take bearings on very weak or distant signals. The preamplifier gain is taken into account automatically when you make field strength or level measurements.
- ▶ The integrated operating button lets you make the main steps in the manual direction finding process.
- ▶ The following antennas to fit the antenna handle are available:
 - Loop Antenna: 9 kHz - 30 MHz
 - Directional Antenna 1: 20 MHz - 250 MHz
 - Directional Antenna 2: 200 MHz - 500 MHz
 - Directional Antenna 3: 400 MHz - 8 GHz
- ▶ A plug-in adapter with male N connector allows you to take advantage of the features of the handle even when you are using third-party antennas or external filters.



Active antenna handle with integrated compass and preamplifier
9 kHz - 8 GHz
470 g / 1.04 lbs



Adapter, male N connector



Loop antenna
9 kHz - 30 MHz
380 g / 0.84 lbs



Directional antenna 1
20 MHz - 250 MHz
400 g / 0.88 lbs



Directional antenna 2
200 MHz - 500 MHz
300 g / 0.66 lbs



Directional antenna 3
400 MHz - 8 GHz
350 g / 0.77 lbs



6 SMELL

The automatic DF antenna lets the SignalShark sniff out the direction of a detected signal in seconds.

You will often need to locate the position of a signal transmitter once the signals have been detected or analyzed. SignalShark combined with Narda's new automatic direction finding antennas (ADFA) and the very powerful map and localization firmware provides reliable bearings in the twinkling of an eye. The bearing results are processed by the SignalShark without needing an external PC. Reliable localization of transmitters has not been possible before with so few hardware components.

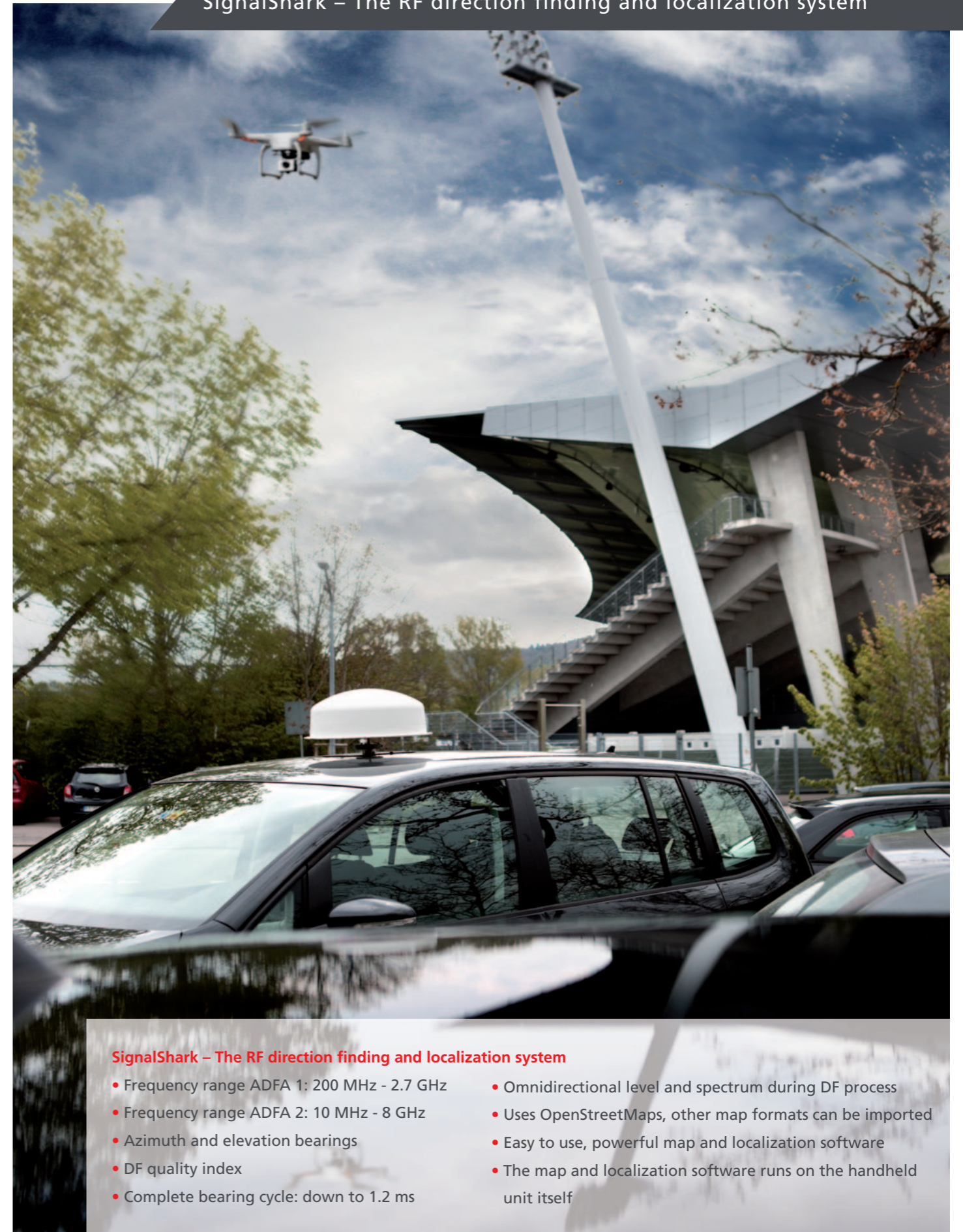
Transmitter localization

SignalShark simplifies transmitter localization by autonomously evaluating all the available bearing results and plotting them on a map, using a statistical distribution of bearing lines. The result is a so-called "heat map", on which the possible location of the transmitter is plotted and color-coded according to probability. SignalShark also draws an ellipse on the map centered on the estimated position of the transmitter and indicating the area where the transmitter has a 95 % probability of being located. The algorithm used by SignalShark to calculate the position of an emitter is extremely powerful. It can determine the position of the emitter by continuous direction finding when moving around in a vehicle, even in a complex environment such as an inner-city area.

The calculation is continuous in real-time, so you can view the changing heat map on the screen of the SignalShark and thus determine the route to be taken.

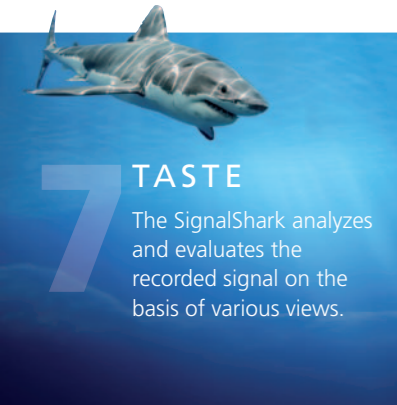
Fast automatic direction finding

SignalShark supports the new automatic direction finding antennas (ADFA) from Narda, which let you take a complete bearing cycle in as little as 1.2 ms. The omnidirectional channel power and the spectrum are also measured during a bearing cycle, so you can monitor changes in the signal level or spectrum concurrently with the bearings. The AFDA's use different antenna arrays, depending on the frequency range. At low frequencies, a pair of crossed coils are used for the Watson-Watt method of direction finding. At medium and high frequencies, a circular array of nine dipoles or monopoles is used for the correlative interferometer direction finding method.



SignalShark – The RF direction finding and localization system

- Frequency range ADFA 1: 200 MHz - 2.7 GHz
- Frequency range ADFA 2: 10 MHz - 8 GHz
- Azimuth and elevation bearings
- DF quality index
- Complete bearing cycle: down to 1.2 ms
- Omnidirectional level and spectrum during DF process
- Uses OpenStreetMaps, other map formats can be imported
- Easy to use, powerful map and localization software
- The map and localization software runs on the handheld unit itself



7 TASTE

The SignalShark analyzes and evaluates the recorded signal on the basis of various views.

The SignalShark is a very powerful platform that Narda is continuously expanding. Options that will be available for delivery in 2019 are described below. Only the firmware of the SignalShark will be used to realize these options, which will be capable of on-site activation.

SignalShark I/Q analyzer

SignalShark has a ring buffer for up to 200 million I/Q samples. The receiver I/Q data are normally written continuously to the ring buffer. The recording can be stopped by a trigger event. The recorded I/Q data are then transferred to the CPU of the SignalShark, where they are further processed.

You can of course also save the I/Q data as a data set, and you can even stream the data directly to permanent storage media in order to make very long recordings of the I/Q data. You can then replay such long-term recordings using the integrated I/Q analyzer, or process them externally.

The following trigger sources are available:

- ▶ Frequency mask trigger
- ▶ Receiver level
- ▶ External trigger source
- ▶ Timestamp
- ▶ User input
- ▶ Free run

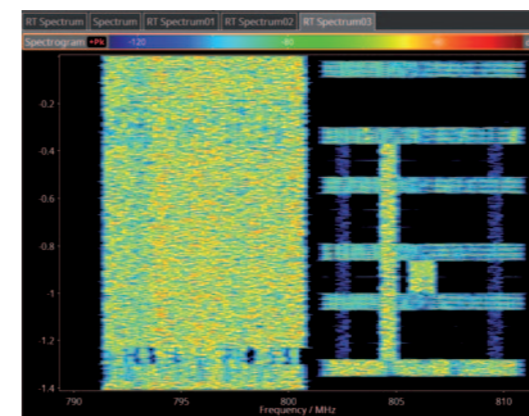
The following I/Q data views are available:

- ▶ I and Q versus time
- ▶ Magnitude versus time (Zero-span)
- ▶ Vector diagram
- ▶ High time resolution spectrogram
- ▶ Persistence



High time resolution spectrogram HTRS also available in the spectrum path

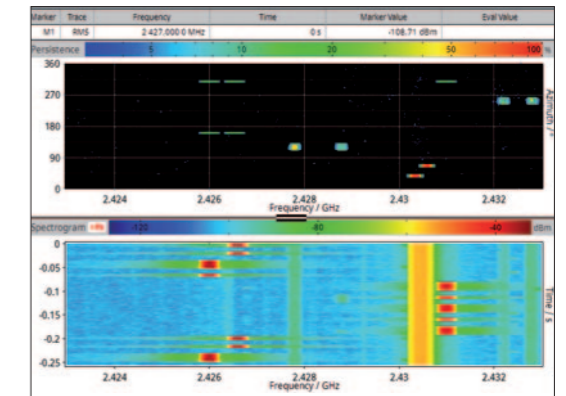
In real-time spectrum mode, the ring buffer of the SignalShark records the I/Q data from the real-time spectrum path rather than from the receiver I/Q data. If you or a trigger event halts the real-time analyzer, the last up to 200 million I/Q samples of the monitored frequency range are available. This corresponds to a timespan of at least 4 s, so you can zoom in on the spectrogram with a resolution of better than 200 ns when the analyzer is halted. The FFT overlap can be up to 93.75 %, and no detectors are needed that could reduce the time resolution. You can even subsequently alter the RBW. The persistence view also adjusts so that it exactly summarizes the spectrums in the time period covered by the zoomed segment. This ensures that all the time or spectral details in the I/Q data can be made visible. You can of course also save the I/Q data of the zoomed segment.



2 x 10 MHz LTE signal recorded in a HTRS. Time resolution 1 μ s. The extremely high time resolution renders the signal transparent at low traffic levels (right), so you can spot possible interference within the frame structure.

DF Spectrum

The SignalShark can find the directions of several transmitters simultaneously in DF spectrum evaluation mode. This mode offers a persistence spectrum and a spectrogram of the azimuth in addition to the usual level spectrum and spectrogram view. You can also monitor frequency ranges that are wider than the real-time bandwidth of the SignalShark. You can distinguish between different transmitters much more easily than before by means of DF spectrum mode, because the SignalShark shows you the direction of incidence as well as the level of each frequency bin.



More Information about technical details and accessories like transport case and car charger unit can be found in the SignalShark data sheet.





SignalShark
seven senses for signals

Narda is a leading supplier ...

... of measuring equipment in the RF test and measurement, EMF safety and EMC sectors.

The RF test and measurement sector covers analyzers and instruments for measuring and identifying radio sources. The EMF safety product spectrum includes wideband and frequency-selective measuring devices, and monitors for wide area coverage or which can be worn on the body for personal safety. The EMC sector offers instruments for determining the electromagnetic compatibility of devices under the PMM brand. The range of services includes servicing, calibration, accredited calibration, and continuous training programs.

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