

R&S®VSE VECTOR SIGNAL EXPLORER SOFTWARE

Desktop signal analysis



Product Brochure
Version 14.00

ROHDE & SCHWARZ

Make ideas real



AT A GLANCE

The R&S®VSE vector signal explorer software brings the experience and power of Rohde & Schwarz signal analysis to the desktop, offering a wide range of analysis tools for troubleshooting and optimizing designs on your PC. With this software, users analyze and solve problems in analog and digitally modulated signals for a wide range of standards using Rohde & Schwarz signal and spectrum analyzers and oscilloscopes.

The R&S®VSE vector signal explorer software was developed to bring the power of R&S®FSW signal processing to the engineer's PC. It analyzes signals from a wide range of instruments as well as files originating from simulations or recorded measurements.

Thanks to the clearly structured menu concept, it is a quick and easy matter to operate the software and control the instruments, and the flexible arrangement of measurement displays provides new ways to visualize measurement results.

With R&S®VSE, users can analyze and investigate a captured signal over and over again, change parameters and settings, examine the signal in depth and troubleshoot a wide range of signals, from simple BPSK to complex wide-band signals such as IEEE 802.11be and 4096QAM.

R&S®VSE has a clearly laid out user interface and a flat menu structure. Users can arrange results as required, which greatly facilitates result interpretation.

The R&S®VSE signal analysis software enables remote signal analysis and debugging on the desktop. Signals can originate from different instruments that are controlled from one PC. R&S®VSE easily works with files of recorded data or simulations, saving a trip to the lab. When large amounts of data need to be analyzed, R&S®VSE can be remotely controlled and is compatible with the R&S®FSW signal and spectrum analyzer.

R&S®VSE is available in two models. The basic edition serves typical R&D work using a desktop PC together with a single instrument. The enterprise edition adds

connectivity to multiple instruments as well as enhanced capabilities for parallel processing of measurement results typically performed on a server.

For increased flexibility, the R&S®VSE enterprise edition can be used together with a network based license server, enabling networked computers to access a license from a central repository. For simultaneous use, multiple licenses must be purchased.

Key facts

- ▶ Controls multiple instruments from a single PC
- ▶ Remote controllable and compatible with a wide range of Rohde & Schwarz signal and spectrum analyzers, power sensors and oscilloscopes
- ▶ Advanced pulse analysis with R&S®RTO and R&S®RTP oscilloscopes
- ▶ Supports all relevant mobile and wireless communications standards

Supported instruments

R&S®FSL	R&S®FSW
R&S®FPS	R&S®FSWP
R&S®FPL1000	R&S®NRQ
R&S®FSV3000	R&S®RTP
R&S®FSVA3000	R&S®RTO
R&S®FSV	R&S®ZNL
R&S®FSVA	R&S®ETL



SOFTWARE OPTIONS



R&S®VSE-K6
Pulse measurements
▶ page 4



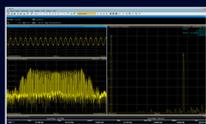
R&S®VSE-K91
WLAN signal analysis
▶ page 13



R&S®VSE-K6A
Pulse analysis across multiple channels
▶ page 5



R&S®VSE-K96
OFDM analysis
▶ page 14



R&S®VSE-K7
Modulation analysis for AM/FM/PM modulated single carriers
▶ page 6



R&S®VSE-K100/-K102/-K104
LTE signal analysis
▶ page 15



R&S®VSE-K8
Bluetooth® signal analysis
▶ page 7



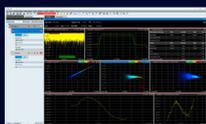
R&S®VSE-K106
LTE narrowband IoT analysis
▶ page 16



R&S®VSE-K10
GSM/EDGE/EDGE Evolution
▶ page 8



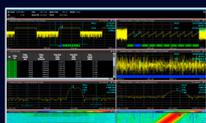
R&S®VSE-K144
5G signal analysis
▶ page 17



R&S®VSE-K18
Amplifier measurements
▶ page 9



R&S®VSE-K146
5G MIMO measurements
▶ page 17



R&S®VSE-K60
Transient analysis
▶ page 10



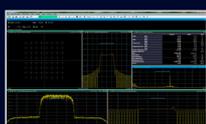
R&S®VSE-K148
5G NR R16 measurements
▶ page 17



R&S®VSE-K70
Vector signal analysis
▶ page 11



R&S®VSE-K175
O-RAN measurements
▶ page 17



R&S®VSE-K72
WCDMA signal analysis
▶ page 12



R&S®VSE-K149
HRP UWB measurements
▶ page 18

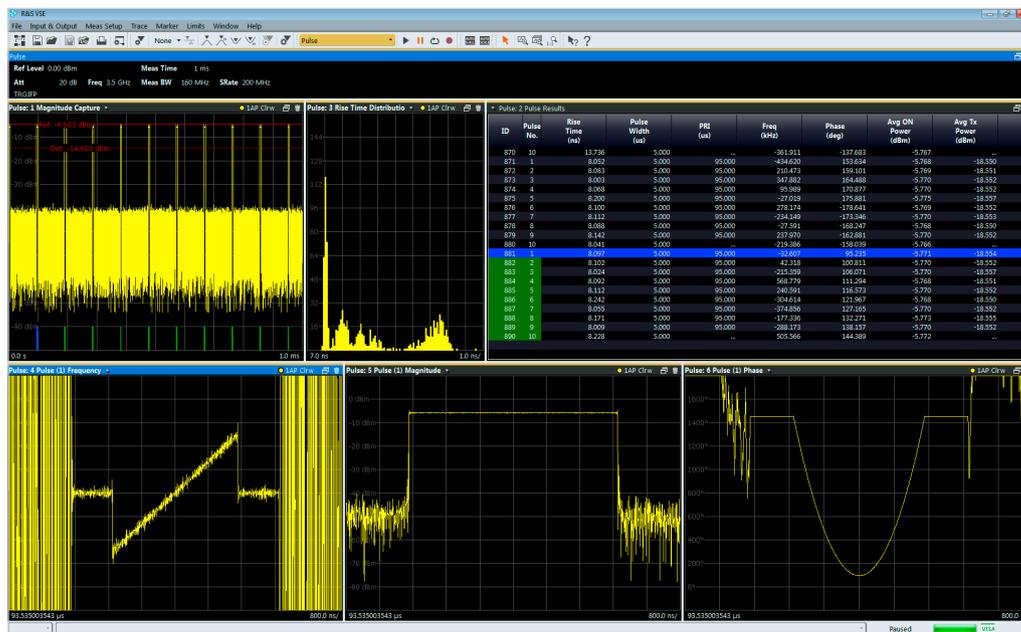
R&S®VSE-K6

Pulse measurements

The R&S®VSE-K6 option measures all relevant parameters such as pulse duration, pulse period, pulse rise and fall times, power drop across a pulse and intrapulse phase modulation, and produces a trend analysis over many pulses. The user selects which results should be displayed simultaneously on the screen. R&S®VSE-K6 delivers a full picture of e.g. a radar system within seconds.

Measurement parameters

- ▶ Pulse parameters: pulse width, pulse repetition rate, pulse repetition interval, duty cycle, rise/fall time, settling time
- ▶ Frequency: carrier frequency, pulse-to-pulse frequency difference, chirp rate, frequency deviation, frequency error
- ▶ Power: peak power, average power, peak-to-average power, pulse-to-pulse power
- ▶ Phase: carrier phase, pulse-to-pulse phase difference, phase deviation, phase error
- ▶ Amplitude droop, ripple, overshoot and settling time
- ▶ Point-in-pulse measurements: frequency, amplitude, phase and I/Q
- ▶ Measurement functions: trends, histograms and spectrum for all parameters
- ▶ Pulse statistics: standard deviation, average, maximum, minimum
- ▶ Pulse tables
- ▶ Intrapulse modulation (frequency, amplitude, phase and I/Q) and pulse spectrum traces
- ▶ Pulse-pulse spectrum
- ▶ User-defined measurement parameters



Pulse measurements with split-screen display.

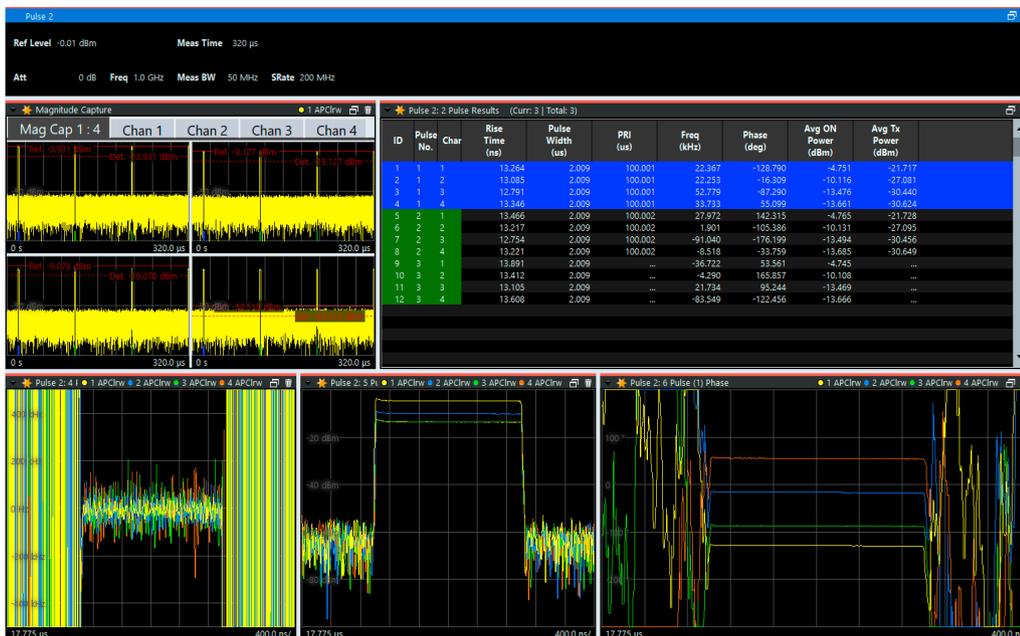
R&S®VSE-K6A

Pulse analysis across multiple channels

The R&S®VSE-K6A option is an extension of the R&S®VSE-K6 pulse analysis option and supports simultaneous signal capture on up to four channels of a high-end R&S®RTO or R&S®RTP oscilloscope. R&S®VSE-K6A compares all R&S®VSE-K6 pulse parameters and statistics over multiple channels. Analyzing multiple channels simultaneously at an early stage in phased array development, for example, helps improve module design, preventing costly and time-consuming modifications at a later stage.

Additional features of R&S®VSE-K6A

- ▶ Fast comparison of all R&S®VSE-K6 results across multiple channels on the same display
- ▶ Multichannel segmented capture to reduce memory consumption
- ▶ Multichannel I/Q recording and playback via files
- ▶ Multichannel user calibration (R&S®VSE-K544 license needed) with user-defined frequency response correction files (.s2p)



Pulse measurements on multiple channels.

R&S®VSE-K7

Modulation analysis for AM/FM/PM modulated single carriers

The R&S®VSE-K7 AM/FM/PM modulation analysis option adds analog modulation analyzer capabilities for amplitude, frequency and phase modulated signals. It measures not only characteristics of the useful modulation, but also factors such as residual FM and synchronous modulation.

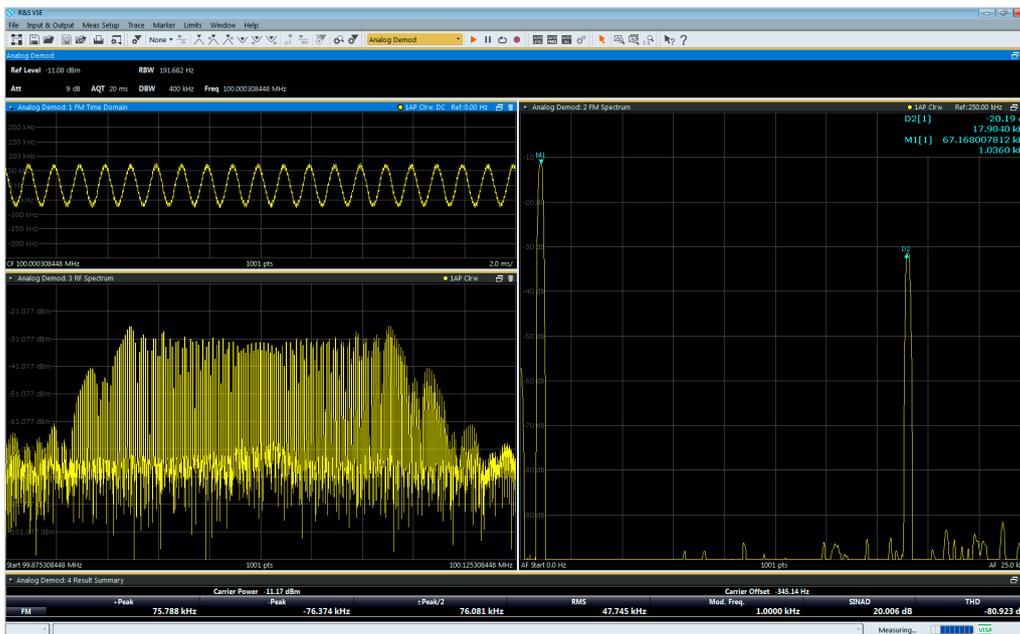
The universal characteristics of the digital measurement demodulator option open up a wide range of applications, for example measuring frequency deviation or the frequency settling time of synthesizers. The FM measurement capability of this option enables the specific modulation measurements needed in development. The R&S®VSE-K7 AM/FM/PM modulation analysis option also performs FFT analysis on the demodulated signal, allowing received signal quality to be determined from the SINAD and THD values. Various filters (highpass, lowpass, deemphasis) are available to simulate real receive signal structures and to accurately characterize analog transmit and receive systems.

Modulation parameters

- ▶ Modulation depth (AM)
- ▶ Frequency deviation (FM)
- ▶ Phase deviation (PM)
- ▶ Modulation frequency
- ▶ THD and SINAD
- ▶ Carrier power

Measurement functions

- ▶ AF spectrum
- ▶ RF spectrum
- ▶ AF scope display
- ▶ AF filters (lowpass and highpass)
- ▶ Weighting filters (CCITT)
- ▶ Squelch



FM signal displayed in time domain, RF spectrum and FM spectrum.

R&S®VSE-K8

Bluetooth® signal analysis

Modern communications devices and smartphones use various radio standards such as LTE, 5G NR, Wi-Fi®, UWB and Bluetooth®. The R&S®VSE-K8 Bluetooth® measurement application supports modulation characteristic measurements in I/Q mode and ACP/in-band trace emission measurements in swept spectrum mode. It also supports Bluetooth® basic rate (BR), Bluetooth® enhanced data rate (EDR) and Bluetooth® Low Energy signal measurements to cover mandatory output power, carrier frequency stability, modulation accuracy and adjacent channel power (ACP).

Supported Bluetooth® standards

- ▶ Bluetooth® BR, version 5.3
- ▶ Bluetooth® EDR, version 5.3
- ▶ Bluetooth® Low Energy, version 5.3

Supported Bluetooth® measurements

- ▶ Automatic detection of
 - Packet type
 - Packet length
- ▶ RF spectrum
- ▶ RF envelope
- ▶ In-band spurious emissions
- ▶ Adjacent channel power
- ▶ Output power
- ▶ Demodulation waveform
- ▶ Delta frequency (Bluetooth® BR, Bluetooth® Low Energy)
- ▶ Frequency drift (Bluetooth® BR, Bluetooth® Low Energy)
- ▶ ICFT (Bluetooth® BR, Bluetooth® Low Energy)
- ▶ Frequency offset (Bluetooth® EDR, Bluetooth® Low Energy)
- ▶ Constellation (Bluetooth® EDR)
- ▶ DEVM (Bluetooth® EDR)
- ▶ Bit error rate (Bluetooth® EDR)
- ▶ Symbols



Analysis of a Bluetooth® (BR) signal with a detailed result summary display.

R&S®VSE-K10

GSM/EDGE/EDGE Evolution

The R&S®VSE-K10 option measures GSM, EDGE, EDGE Evolution and VAMOS signals in line with standards (3GPP TS 45.005, 51.010 and 51.021).

Convenient analysis due to standard-conforming limit checks

The test limits for the spectrum due to modulation and switching transients as well as the test limits for power versus time are automatically configured in line with the standard. After configuring the device type and class (e.g. normal BTS or small MS) as well as the power control level (PCL), the application delivers pass/fail results.

Convenient and comprehensive analysis

The modulation accuracy table is derived from the selected slot in the capture buffer and provides a quick overview of the most important numeric parameters.

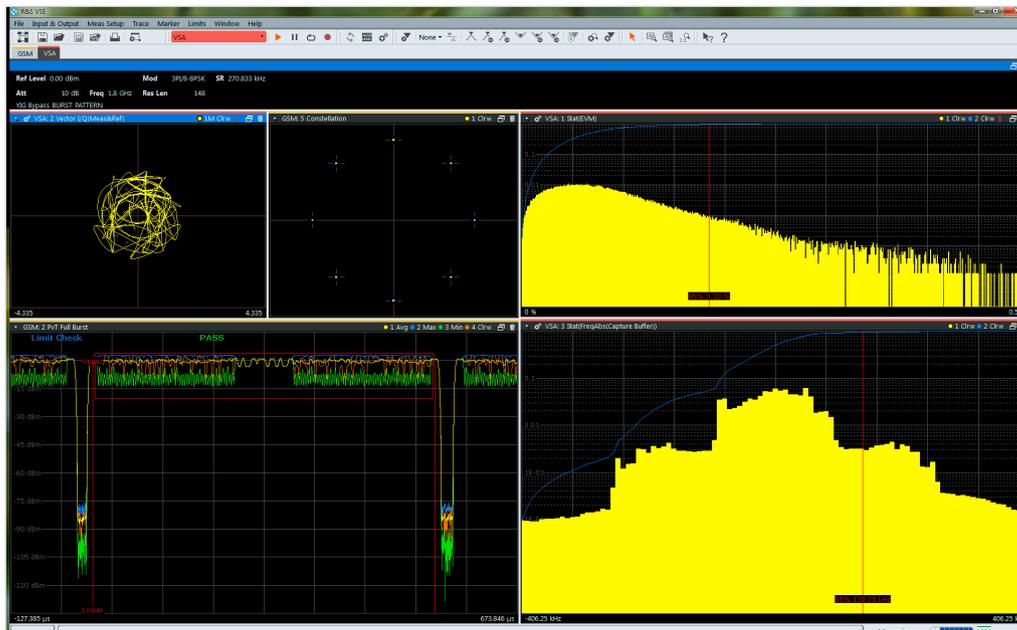
Additional measurements such as phase or magnitude error versus time or EVM versus time and the constellation diagram provide enhanced analysis capabilities.

Numerous modulation parameters

- ▶ Supports GSM, EDGE, EDGE Evolution and VAMOS
- ▶ Supports GMSK, QPSK, A-QPSK, 8PSK, 16QAM and 32QAM
- ▶ Supports normal and high symbol rates
- ▶ Supports normal, micro and pico BTS classes
- ▶ Supports normal and small MS classes
- ▶ Supports frequency bands from T-GSM 380 up to PCS 1900
- ▶ Autodetection of modulation, burst type and training sequence
- ▶ No trigger required

Measurement results

- ▶ Error vector magnitude (EVM)
- ▶ Phase, frequency and magnitude error
- ▶ Power versus time (PvT)
- ▶ Spectrum due to modulation
- ▶ Spectrum due to switching transients
- ▶ Constellation diagram



Demodulation of an EDGE signal with power versus time display and EVM versus symbol display together with numerical results and a constellation diagram.

R&S®VSE-K18

Amplifier measurements

The R&S®VSE-K18 option enables fast and easy characterization of amplifiers.

A combination of a Rohde&Schwarz vector signal generator and analyzer compatible with R&S®VSE can be used to characterize two-port devices such as satellite transponders, power amplifiers and converters. The R&S®VSE-K18 option can either use a CW power sweep or a digitally modulated stimulus signal to perform the required measurements. Applying a signal with the same modulation, bandwidth and crest factor as in the intended application helps to determine how the DUT will perform when operated under real-world conditions.

R&S®VSE-K18 allows the three signal degrading contributors – nonlinearity, frequency response and signal-to-noise ratio – to be analyzed and displayed separately. Furthermore, results for EVM, ACLR, AM/AM and other signal performance parameters can be obtained from a single measurement.

Thanks to the capability of R&S®VSE to analyze a variety of different file formats, R&S®VSE-K18 is also ideal for characterizing RF-to-digital devices, such as integrated frontend modules and digital-to-RF devices.

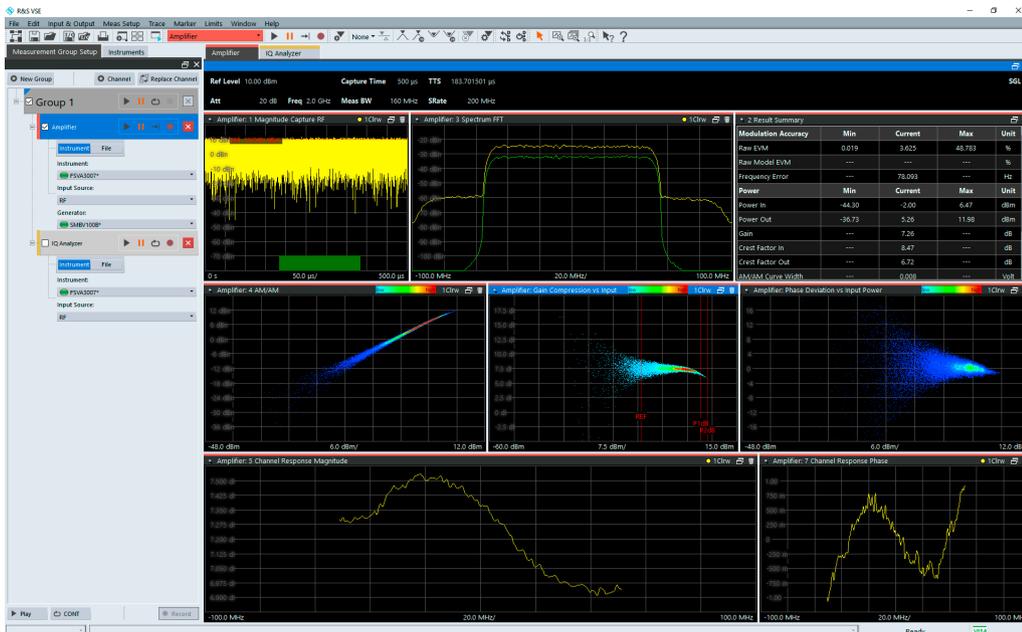
Digital predistortion

The R&S®VSE-K18D option provides direct digital predistortion that linearizes the DUT based on an iterative approach. It minimizes EVM and ACLR and is not limited to a certain DPD algorithm. It is therefore the ideal tool for comparing power amplifiers when being linearized.

The additionally available R&S®VSE-K18M option derives memory polynomial coefficients that can be applied to a waveform played on a signal generator or that can be exported. Exported coefficients can be used to perform real-time DPD on the DUT.

Frequency response measurements

The R&S®VSE-K18F option can be used to investigate the nonlinear behavior of two-port devices. It measures the frequency response of the DUT and displays magnitude, phase and group delay versus frequency, allowing in-depth analysis of the amplifier performance.



The R&S®VSE-K18 option offers a wide range of tools for in-depth analysis of two-port devices.

R&S®VSE-K60

Transient analysis

The R&S®VSE-K60 transient analysis option is ideal for radar system manufacturers and developers who need to characterize frequency agile signals, including analysis of hopping sequences (R&S®VSE-K60H) and chirps or FMCW signals (R&S®VSE-K60C). The R&S®VSE-K60 transient analysis option can be used to measure the phase noise of chirps and hops (R&S®VSE-K60P).

The R&S®VSE-K60C option displays the frequency response and calculates the deviation from the ideal linear phase, even for non-pulsed FMCW radar signals commonly used in automotive radars.

The R&S®VSE-K60H option automatically analyzes the hopping sequence of fast frequency hopping pulsed signals used in automotive, aerospace and defense applications.

The R&S®VSE-K60P option adds intra-chirp and intra-hop phase noise measurements and phase deviation spectrograms to the measurement results.

Measurement parameters

- ▶ Frequency hopping signals with R&S®VSE-K60H option: dwell time, settling time, switching time, frequency deviation, power, phase deviation, power ripple
- ▶ Chirp signals with R&S®VSE-K60C option: frequency deviation, chirp begin, chirp length, chirp rate, chirp state deviation, phase deviation, power, power ripple
- ▶ Spectrogram and section of spectrogram, tabular display, frequency, frequency error, phase and amplitude versus time, FFT spectrum
- ▶ Transient phase noise measurements with R&S®VSE-K60P option: phase-noise spectrum of selected transient, phase deviation spectrogram, phase deviation FFT spectrum of selected transient, frequency deviation spectrogram, frequency deviation FFT spectrum trace result
- ▶ Pan and zoom functions to select analysis region using touch gestures in spectrogram, spectrum and time domain trace displays
- ▶ Trends and histograms for all parameters
- ▶ Hop/chirp statistics: standard deviation, average, maximum, minimum
- ▶ User-defined measurement parameters



Analysis of a chirp signal with different measurement windows.

R&S®VSE-K70

Vector signal analysis

The R&S®VSE-K70 option flexibly analyzes digitally modulated single carriers down to the bit level. The clearly structured operating concept simplifies measurements, despite the wide range of analysis tools.

Flexible modulation analysis from MSK to 4096QAM

Modulation formats:

- ▶ 2FSK, 4FSK, 8FSK
- ▶ MSK, GMSK, DMSK
- ▶ BPSK, QPSK, offset QPSK, DQPSK, 8PSK, D8PSK, $\pi/4$ -DQPSK, $3\pi/8$ -8PSK, $\pi/8$ -D8PSK
- ▶ 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 512QAM, 1024QAM, 2048QAM, 4096QAM
- ▶ 16APSK (DVB-S2), 32APSK (DVB-S2), 2ASK, 4ASK, $\pi/4$ -16QAM (EDGE), $-\pi/4$ -16QAM (EDGE)

Numerous standard-specific presets

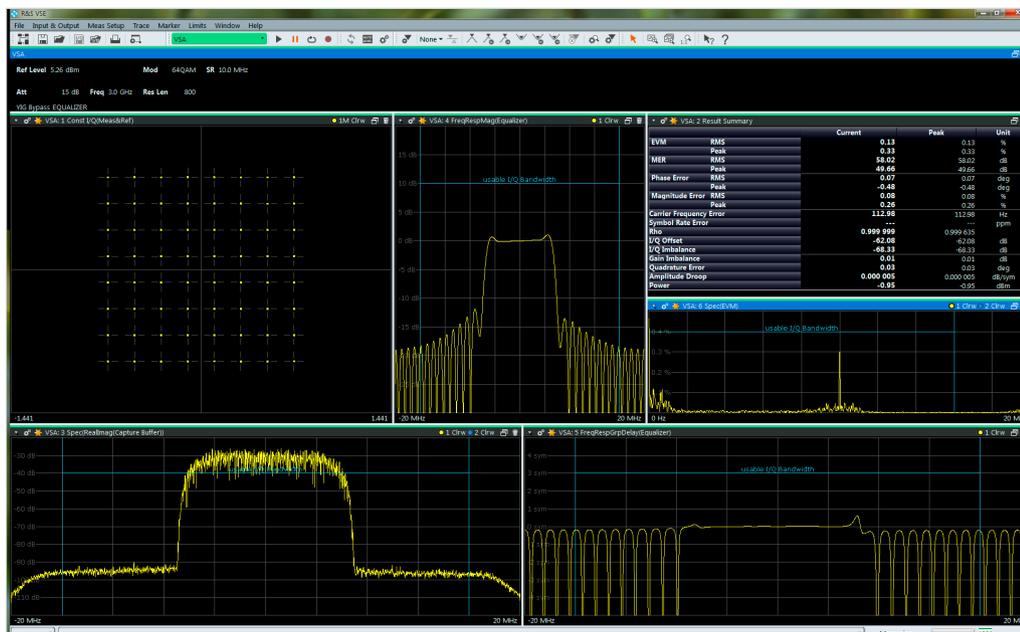
- ▶ User-definable constellations and mappings
- ▶ GSM, GSM/EDGE
- ▶ 3GPP WCDMA, CDMA2000®
- ▶ TETRA, APCO25
- ▶ Bluetooth®, Zigbee
- ▶ DECT, DVB-S2

Easy operation with graphical support

With the clearly visualized demodulation stages and associated settings, even beginners and infrequent users find the correct settings. Based on the description of the signal to be analyzed (e.g. modulation format, continuous or with bursts, symbol rate, transmit filtering), users also quickly find useful settings.

Flexible analysis tools for detailed signal analysis make troubleshooting really easy

- ▶ Display choices for amplitude, frequency, phase, I/Q, eye diagram; amplitude, phase or frequency error; constellation or vector diagram
- ▶ Analysis of RF signals or analog and digital baseband signals
- ▶ Statistical evaluations
- ▶ Histogram representation
- ▶ Standard deviation and 95th percentile in the result summary
- ▶ Spectrum analysis of the measurement and error signal considerably help users find signal errors such as incorrect filtering and interferers
- ▶ Flexible burst search for analyzing complex signal combinations, short bursts or a mix of signals – capabilities that go beyond the scope of many signal analyzers
- ▶ Bit error calculation on known data sequences
- ▶ Equalizer for finding the optimum filter design



Demodulation of a 64QAM signal with frequency and group delay display of the equalizer together with numerical modulation accuracy results.

R&S®VSE-K72

WCDMA signal analysis

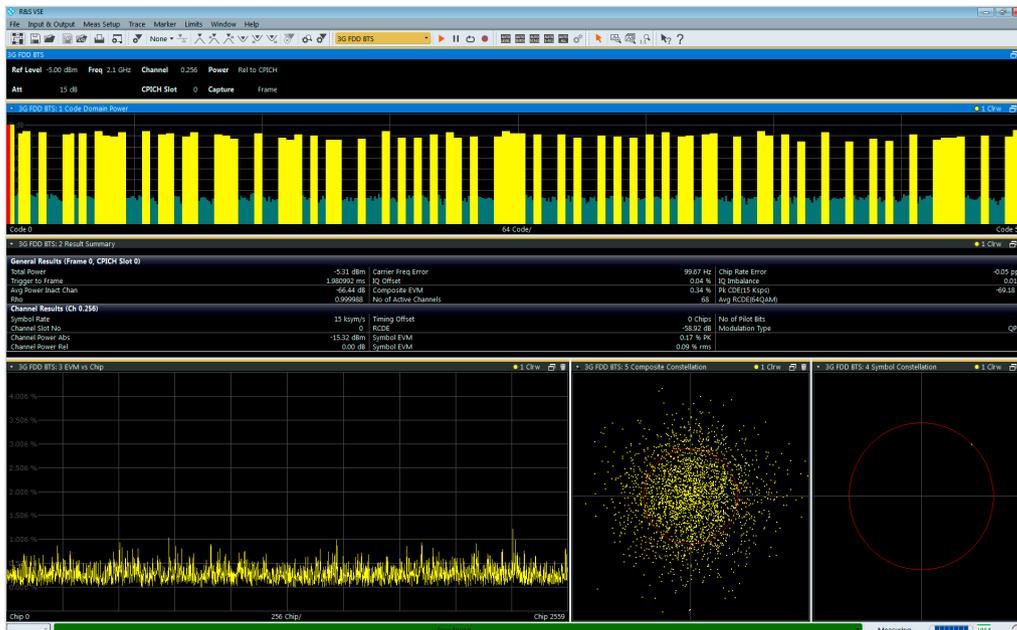
The R&S®VSE-K72 option covers the in-band measurements of the 3GPP WCDMA uplinks and downlinks, including HSDPA, HSUPA and HSPA+.

The main function of R&S®VSE-K72 is to determine the powers of the individual code channels, referred to as code domain power measurement. The power ratios between the individual channels, for instance, can be checked for compliance with the nominal values. This measurement is an efficient way of detecting impairments such as clipping or intermodulation that are not obvious from the spectrum alone. The power of the different codes is shown versus the code number.

Code domain power measurement

The code domain power measurement offers in-depth analysis for a WCDMA signal with several active channels. The composite EVM measurement returns a modulation error value for the total signal. The symbol EVM function yields the individual vector errors of the active channels.

- ▶ Code domain power versus time
- ▶ CCDF
- ▶ Constellation diagram
- ▶ Modulation quality
- ▶ EVM
- ▶ Peak code domain error
- ▶ Residual code domain error constellation diagram
- ▶ I/Q offset
- ▶ I/Q imbalance
- ▶ Gain imbalance
- ▶ Center frequency
- ▶ Automatic detection of
 - Active channels and decoding of useful information
 - Scrambling code
 - HSDPA modulation format
- ▶ Supports
 - Compressed mode signals
 - HSPA and HSPA+ (HSDPA+ and HSUPA+)



Demodulation of a downlink signal with numerical results as well as EVM versus symbol, constellation diagram of the composite signal and symbol constellation diagram of the CPICH.

R&S®VSE-K91

WLAN signal analysis

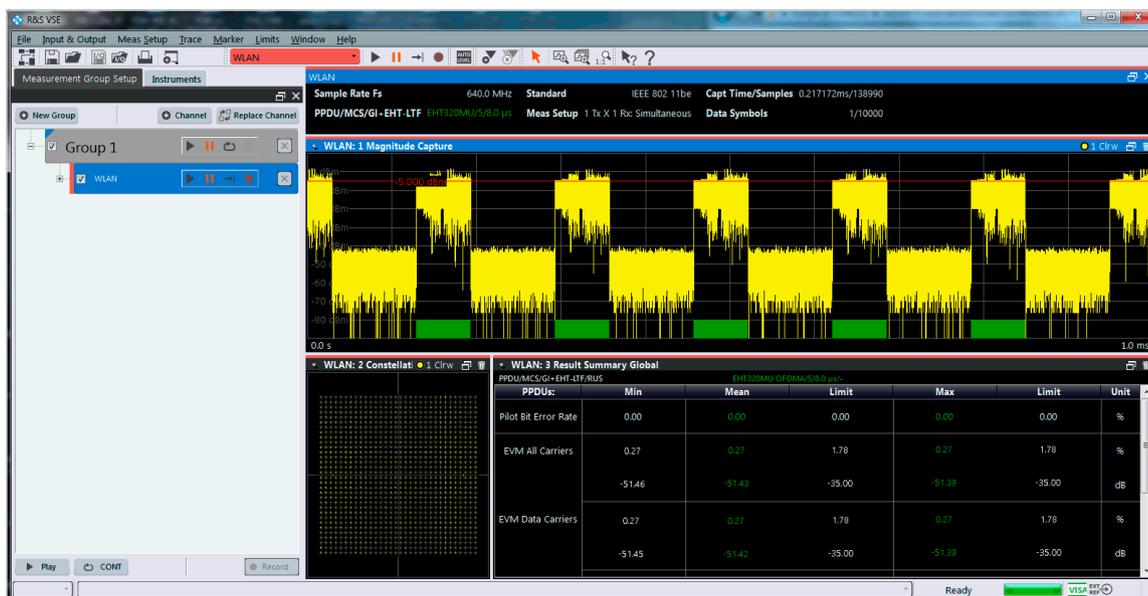
The R&S®VSE-K91 options demodulate all types of WLAN signals. For MIMO measurements, they support simultaneous capture of up to sixteen channels with supported analyzers, and up to four channels with the high-end R&S®RTO and R&S®RTP oscilloscopes. The R&S®VSE-K91 application software covers standard tests and further evaluations for in-depth analysis during development for signals in line with WLAN IEEE 802.11a/b/g/j/p/n/ac/ax/be.

Supported WLAN standards

- ▶ R&S®VSE-K91 supports IEEE 802.11a/b/g
- ▶ R&S®VSE-K91p supports IEEE 802.11p
- ▶ R&S®VSE-K91n supports IEEE 802.11n
- ▶ R&S®VSE-K91ac supports IEEE 802.11ac
- ▶ R&S®VSE-K91ax supports IEEE 802.11ax
- ▶ R&S®VSE-K91be supports IEEE 802.11be

Supported WLAN measurements

- ▶ EVM (pilot, data)
- ▶ EVM versus carrier
- ▶ EVM versus symbol
- ▶ Constellation diagram
- ▶ I/Q offset
- ▶ I/Q imbalance
- ▶ Gain imbalance
- ▶ Center frequency error
- ▶ Symbol clock error
- ▶ Group delay
- ▶ PPDU power
- ▶ Crest factor
- ▶ Bitstream
- ▶ Signal field
- ▶ Constellation versus carrier
- ▶ Automatic detection of
 - Burst type
 - MCS index
 - Bandwidth
 - Guard interval
- ▶ Estimation of payload length from burst



Demodulation of an IEEE 802.11be signal with 1024QAM.

R&S®VSE-K96

OFDM analysis

The R&S®VSE-K96 OFDM analysis software enables modulation measurements on general OFDM signals. The OFDM demodulator is user-configurable and not dependent on any standards.

The software analyzes OFDM signals that are either user-defined or compliant with standards such as IEEE802.11a/g/n/ac (WLAN) and DVB-T. It also supports development engineers in analyzing proprietary signals in the initial phases of upcoming OFDM standards. This includes the following:

- ▶ Wizard with a step-by-step guide for easy creation of a configuration file from a captured signal
- ▶ Support of OFDM and OFDMA
- ▶ Support of any PSK and QAM modulation format (up to 4096QAM)

User-configurable and independent of standards

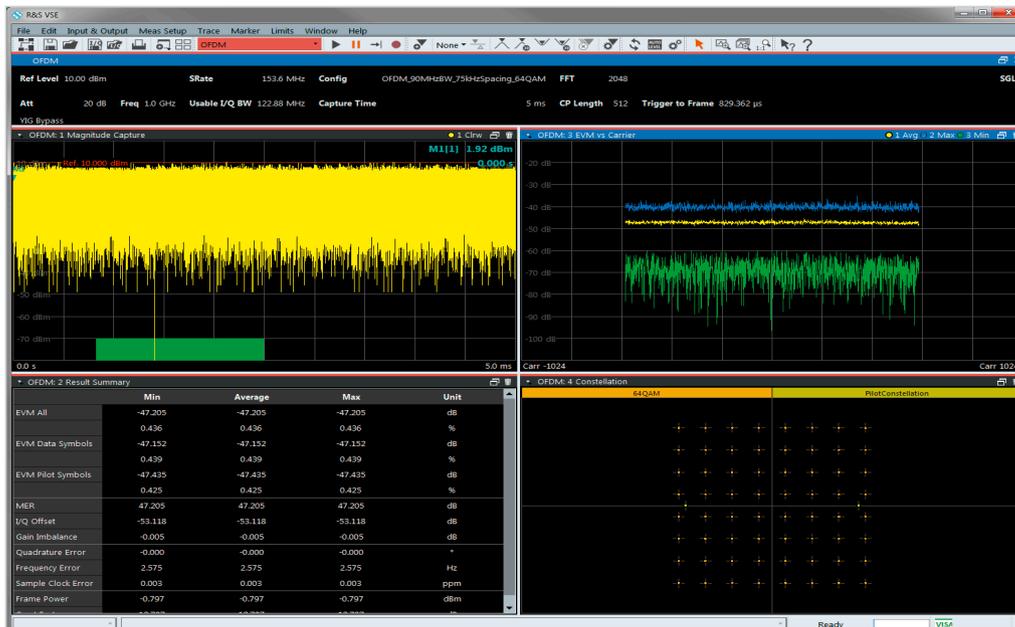
The software offers a high degree of freedom regarding measurement parameters.

User-definable OFDM parameters:

- ▶ General OFDM parameters such as signal bandwidth, sample rate, FFT length, cyclic prefix length
- ▶ Preamble structure
- ▶ Position of pilots and data carriers
- ▶ Modulation format of data carriers
- ▶ Flexible assignment of cyclic prefix length (e.g. for LTE)

Configuration file wizard for quick extraction of all necessary parameters from a signal

The integrated wizard guides users through the process of creating a configuration file that describes the OFDM system. It allows users to extract the necessary parameters directly from a signal recorded with R&S®VSE-K96 and creates a corresponding configuration file. At the same time, it visualizes the signal structure.



Demodulation of a 90 MHz wide OFDM signal with 64QAM, using an FFT of 2048.

R&S®VSE-K100/-K102/-K104

LTE signal analysis

The R&S®VSE-K10x options cover 3GPP LTE and LTE-Advanced in-band measurements. The R&S®VSE-K100/-K102/-K104 options provide convenient analysis due to automatic detection of modulation formats. Each signal subframe is analyzed, and the QPSK, 16QAM and 64QAM modulation formats plus the length of the cyclic prefix are automatically detected and used in the analysis. The cell identity can also be automatically detected. This minimizes the number of user settings.

Supported LTE capabilities

- ▶ R&S®VSE-K100:
 - Uplink and downlink capabilities for LTE FDD
- ▶ R&S®VSE-K104:
 - Uplink and downlink capabilities for LTE TDD
- ▶ R&S®VSE-K102:
 - MIMO and LTE-Advanced capabilities added to the R&S®VSE-K100/-K104 options

Extensive TDD support

R&S®VSE-K104 provides many TDD-specific features such as power versus time measurement, special subframe configurations and measurements on downlink dual layer beamforming signals using UE-specific reference signals. Users can verify all important aspects of a TDD transmitter.

Supported LTE measurements

- ▶ EVM
- ▶ Constellation diagram
- ▶ I/Q offset
- ▶ Gain imbalance
- ▶ Quadrature error
- ▶ Center frequency error (symbol clock error)
- ▶ Bitstream
- ▶ Allocation summary list
- ▶ Averaging over multiple measurements

With R&S®VSE-K102 option, additionally

- ▶ MIMO demodulation
- ▶ MIMO time alignment for R&S®VSE-K100/-K104
- ▶ Interband carrier aggregation time alignment



An LTE downlink signal with modulation results and in-band measurement results such as bitstreams and information gained by control channel decoding.

R&S®VSE-K106

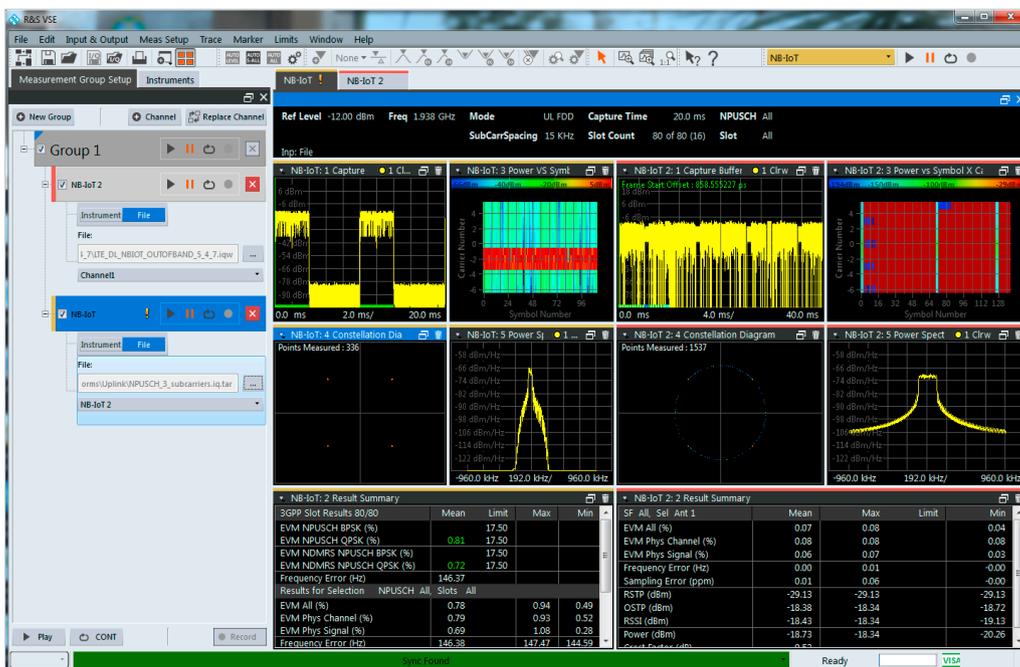
LTE narrowband IoT analysis

The R&S®VSE-K106 option covers the modulation measurements for narrowband IoT (NB-IoT) specified by 3GPP for base stations and user equipment.

NB-IoT focuses specifically on indoor coverage, low cost and long-life battery devices. The NB-IoT technology can be deployed “in-band” in a spectrum allocated to LTE within a normal LTE carrier or standalone for deployments in a dedicated spectrum specifically targeting GSM refarming.

Supported LTE measurements

- ▶ EVM
- ▶ Constellation diagram
- ▶ I/Q offset
- ▶ Gain imbalance
- ▶ Quadrature error
- ▶ Center frequency error (symbol clock error)
- ▶ Bitstream
- ▶ Allocation summary list



R&S®VSE-K106 uplink and downlink measurements.

R&S®VSE-K144/-K146/-K148/-K175

5G signal analysis

The R&S®VSE-K144 option covers 3GPP 5G NR in-band measurements in the uplink and downlink. Each signal subframe is analyzed, and a wide range of measurement results is provided, including EVM, frequency and power of different channels and signals. The R&S®VSE-K146 option enables true 5G MIMO measurements.

R&S®VSE-K144 supports all specified 5G signal bandwidths from 5 MHz to 400 MHz with multiple numerologies, multiple bandwidth parts and modulation formats from QPSK to 256QAM.

Supported 5G measurements

- ▶ EVM
- ▶ Constellation diagram
- ▶ I/Q offset
- ▶ Gain imbalance
- ▶ Quadrature error
- ▶ Center frequency error (symbol clock error)
- ▶ Allocation summary list
- ▶ Channel decoder results
- ▶ Averaging over multiple measurements

5G MIMO measurements

R&S®VSE-K146 measures, among other things, the demodulation and decoding of MIMO signals and the phase differences between antennas. Using antenna mapping, crosstalk can be compensated and OTA measurements performed. The R&S®RTP high-performance oscilloscope is recommended when up to four MIMO streams need to be captured with one instrument.

O-RAN measurements

R&S®VSE-K175 enables the validation of 5G O-RAN radio units. The option supports analysis beyond the requirements of 3GPP in order to ensure the interoperability of network equipment from different vendors. It offers pre-defined test models and all relevant test parameters as defined by the O-RAN alliance.



5G MIMO measurement application.

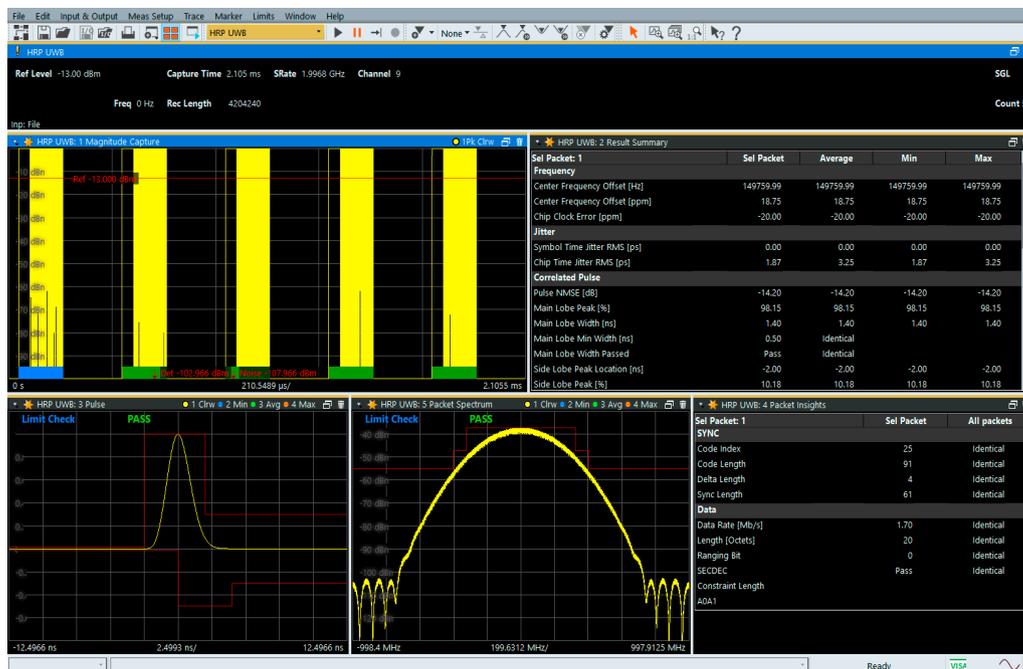
R&S®VSE-K149

HRP UWB signal analysis

The R&S®VSE-K149 option measures all relevant parameters such as normalized cross-correlation, chip time jitter, pulse and packet spectrum in line with IEEE 802.15.4/4z. Automatic detection of preamble information makes measurements convenient to configure. A detailed result summary provides a full overview of the signal quality.

Supported HRP UWB measurements

- ▶ PPDU power
- ▶ SHR power
- ▶ Power versus time
- ▶ Center frequency offset
- ▶ Chip clock error
- ▶ Chip and symbol time jitter
- ▶ Normalized cross-correlation
- ▶ Pulse (mask, monotonically increasing)
- ▶ NRMSE (SHR, PHR, PSDU, STS)
- ▶ Pulse level (PHR, PSDU, STS)
- ▶ RMARKER (ranging)
- ▶ Packet spectrum
- ▶ PSD mask



Analysis of a 499.2 MHz wide HRP UWB signal.

ORDERING INFORMATION

Designation	Type	Order No.
Vector signal explorer base software, basic edition	R&S®VSE	1345.1011.06
Vector signal explorer base software, enterprise edition	R&S®VSE	1345.1105.06
Software options		
Pulse measurement application	R&S®VSE-K6	1320.7516.06
Phased array measurements	R&S®VSE-K6A	1345.1286.06
AM/FM/PM modulation analysis	R&S®VSE-K7	1320.7539.06
Bluetooth® BR/EDR/Low Energy measurements	R&S®VSE-K8	1345.1970.06
GSM measurements	R&S®VSE-K10	1313.1368.06
Amplifier measurements	R&S®VSE-K18	1345.1434.06
Direct DPD measurements	R&S®VSE-K18D	1345.1440.06
Frequency response measurements	R&S®VSE-K18F	1345.1457.06
Memory polynomial DPD	R&S®VSE-K18M	1345.1492.06
Transient measurements	R&S®VSE-K60	1320.7868.06
Transient chirp measurements (requires R&S®VSE-K60)	R&S®VSE-K60C	1320.7874.06
Transient hop measurements (requires R&S®VSE-K60)	R&S®VSE-K60H	1320.7880.06
Transient phase noise measurements	R&S®VSE-K60P	1345.2230.06
Vector signal analysis	R&S®VSE-K70	1320.7522.06
Multi-modulation analysis	R&S®VSE-K70M	1345.1211.06
PRBS bit error rate measurements	R&S®VSE-K70P	1345.1228.06
3GPP FDD measurements	R&S®VSE-K72	1320.7580.06
IEEE 802.11a/b/g measurements	R&S®VSE-K91	1320.7597.06
IEEE 802.11p measurements	R&S®VSE-K91p	1320.7680.06
IEEE 802.11n measurements	R&S®VSE-K91n	1320.7600.06
IEEE 802.11ac measurements	R&S®VSE-K91ac	1320.7616.06
IEEE 802.11ax measurements	R&S®VSE-K91ax	1345.1411.06
IEEE 802.11be measurements	R&S®VSE-K91be	1345.1428.06
OFDM signal analysis	R&S®VSE-K96	1320.7922.06
EUTRA/LTE FDD uplink and downlink measurement application	R&S®VSE-K100	1320.7545.06
EUTRA/LTE-Advanced and MIMO (downlink)	R&S®VSE-K102	1320.7551.06
EUTRA/LTE TDD uplink and downlink measurement application	R&S®VSE-K104	1320.7568.06
EUTRA/LTE narrowband IoT analysis	R&S®VSE-K106	1320.7900.06
5G uplink and downlink measurement application	R&S®VSE-K144	1309.9574.06
5G MIMO measurements	R&S®VSE-K146	1345.1305.06
5G NR R16 measurements	R&S®VSE-K148	1345.1392.06
HRP UWB measurements	R&S®VSE-K149	1345.1463.06
3GPP 5G NR release 17 extension, for uplink and downlink	R&S®VSE-K171	1345.1663.06
O-RAN measurements	R&S®VSE-K175	1350.7020.06
OneWeb reverse link	R&S®VSE-K201	1345.2001.06
Frequency response correction	R&S®VSE-K544	1309.9580.06
Cadence® AWR® VSS integration, for digital signal creation and analysis with R&S®WinIQSIM2 and R&S®VSE	R&S®VSESIM-VSS	1345.1511.52
License dongles		
License dongle	R&S®FSPC	1310.0002.03
License dongle, for floating licenses	R&S®FSPC-FL	1310.0002.04
Service option		
Software maintenance	R&S®VSE-SWM	1320.7622.81

Free trial

A download with a selected number of recorded signals is available free of charge at www.rohde-schwarz.com. Download your trial today!

Always up to date

To keep up with continually changing standards and technologies, Rohde&Schwarz offers a subscription service with automatic notification of new firmware releases. The subscriptions periods are 12, 24, 36 months.

The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks by Rohde&Schwarz is under license. CDMA2000® is a registered trademark of the Telecommunications Industry Association (TIA-USA). Wi-Fi® is a registered trademark of Wi-Fi Alliance®.

Service at Rohde & Schwarz You're in great hands

- ▶ Worldwide
- ▶ Local and personalized
- ▶ Customized and flexible
- ▶ Uncompromising quality
- ▶ Long-term dependability

Rohde & Schwarz

The Rohde&Schwarz technology group is among the trailblazers when it comes to paving the way for a safer and connected world with its leading solutions in test & measurement, technology systems and networks&cybersecurity. Founded 90 years ago, the group is a reliable partner for industry and government customers around the globe. The independent company is headquartered in Munich, Germany and has an extensive sales and service network with locations in more than 70 countries.

www.rohde-schwarz.com

Sustainable product design

- ▶ Environmental compatibility and eco-footprint
- ▶ Energy efficiency and low emissions
- ▶ Longevity and optimized total cost of ownership

Certified Quality Management

ISO 9001

Certified Environmental Management

ISO 14001

Rohde & Schwarz training

www.training.rohde-schwarz.com

Rohde & Schwarz customer support

www.rohde-schwarz.com/support

