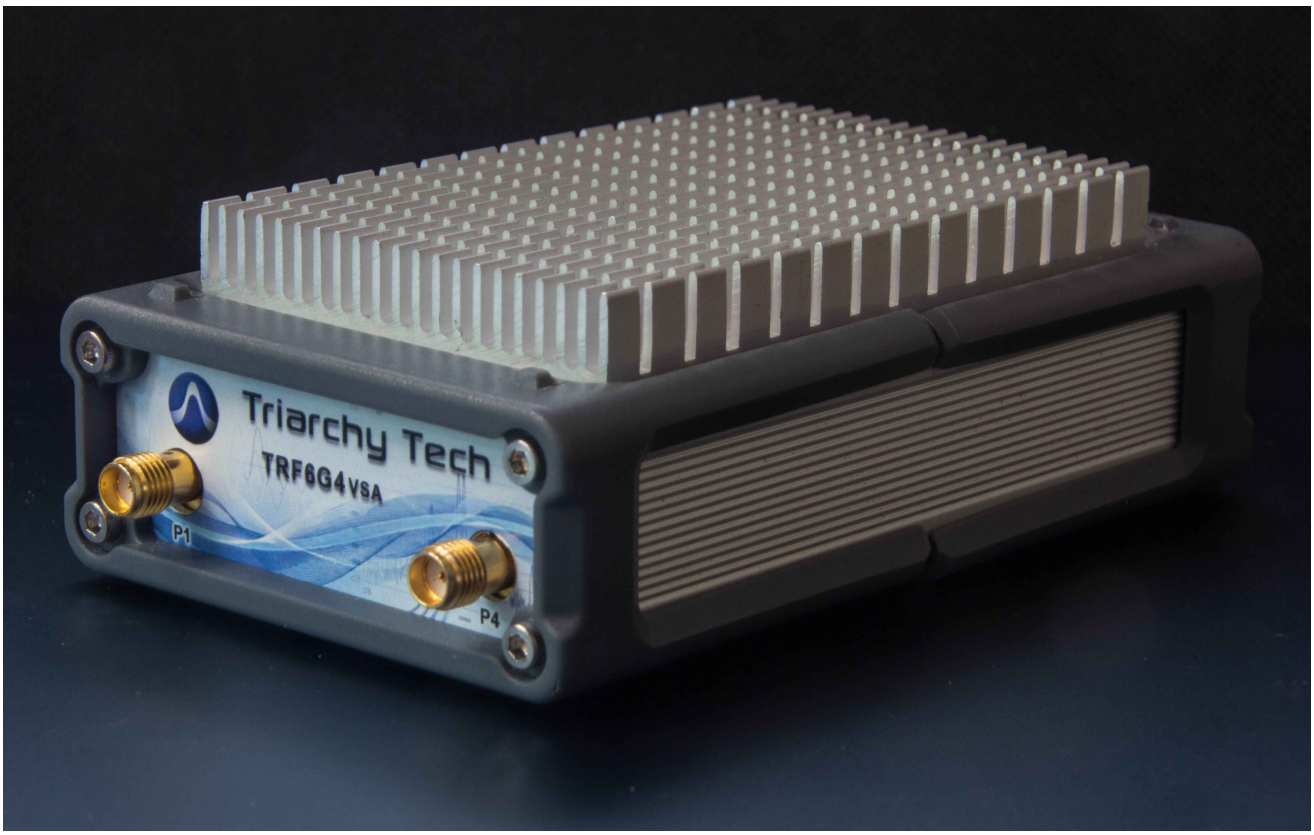
Triarchy® TRF6G4vsa

USB Vector Spectrum Analyzer

Datasheet v1.1

Ultra Compact, Ultra Capable · *High Performance, Unrivalled Value*



Overview

The Triarchy TRF6G4vsa is a compact, USB-powered RF instrument that combines three essential test devices in a single pocket-sized unit. Its primary function is a 5 KHz to 6.4 GHz vector spectrum analyzer, complemented by a 6.4 GHz synthesized signal generator and a pulse signal generator.
This highly integrated design enables fast, versatile and convenient measurements across a wide range of environments. The small form factor makes it ideal for field testing, production lines, education and general RF development. Despite its low cost, the instrument delivers powerful performance and rich functionality, offering exceptional value for engineers, technicians and students.

Three instruments in one:

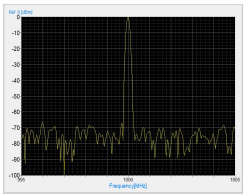
Vector spectrum analyzer	5 Hz – 6.4 GHz, 70 MHz real-time bandwidth
RF signal generator	Synthesized, up to 6.4 GHz, calibrated output
Pulse signal generator	Standalone output via rear AUX1 port

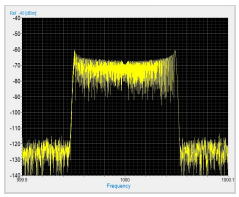
Key Features

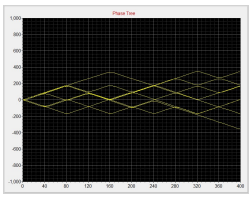
- Frequency range from 5KHz to 6.4 GHz
- 70 MHz real-time bandwidth with 144 MSPS ADC sampling rate
- 70 dB SFDR at 10 MHz span
- EMC pre-test capability using logarithmic frequency sweep
- Short-Time FFT (STFT) with 3D visualization for detailed modulation analysis
- Hopping frequency sweep for combined multi-segment spectrum results
- Up to 20 MSPS I/Q analysis for a wide range of constellation and EVM analysis
- Multiple frequency modulation analysis tools, including phase tree and eye diagram
- Wide-range detection of AM, FM and PM analog modulation, including zero-span mode
- 6.4 GHz full-function RF synthesized signal generator
- Integrated pulse signal generator for additional measurement flexibility
- Ultra-compact, pocket-sized design, powered entirely through a USB port

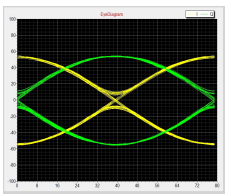
Applications

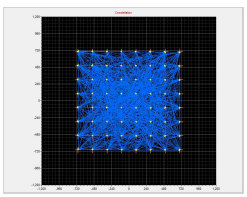
- Professional RF engineers performing detailed measurements outside the laboratory
- Hardware and software engineers verifying RF performance during new product development
- Manufacturing and assembly lines for component-level and functional RF testing
- Students and hobbyists studying RF principles and wireless communication modulation
- Start-up prototyping and validating new technology concepts
- Integration into larger systems as a functional module for complex tasks
- Field testing across a wide range of wireless systems
- FCC and CE pre-compliance testing, helping reduce certification costs
- Global spectrum monitoring nodes using USB-over-IP setups
- Specialized fields such as security, medical devices, mining and exploration

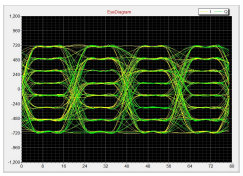

CW signal

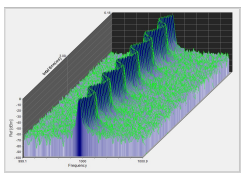

FM modulation Signal

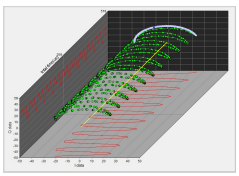

MSK Phase tree

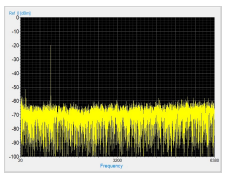

MSK eyes diagram

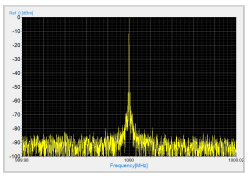

64 QAM constellation


64 QAM eyes diagram


3d FM signal (STFT_AMP)


3d PM signal (STFT_Phase)


Full span spectrum


Narrow span spectrum

Functional Description

1. Basic Spectrum Analyzer

The TRF6G4vsa provides all essential spectrum-analyzer functions across 5 KHz to 6.4 GHz range. Both span and RBW can be set to any continuous value without step limitations, giving exceptional tuning flexibility. In FFT real-time mode, the analyzer supports a maximum 70 MHz span at a 144 MSPS sampling rate for fast, detailed spectrum capture.

2. Vector Signal Analysis (VSA)

Optimized for modulated-signal analysis through high-precision I/Q signal processing. A fully digital IF architecture and digital quadrature mixer deliver highly accurate orthogonal local-oscillator generation, ensuring high-fidelity demodulation and precise vector measurements. The instrument analyses both digital phase modulation (constellation, EVM, eye diagram, I&Q phase waveform) and digital frequency modulation, as well as analog AM, PM and FM signals, including zero-span mode.

3. Logarithmic Frequency Sweep for EMI Pre-test

A flexible logarithmic sweep function allows the sweep range to be configured over any user-defined segment. Two operating bands are supported: a low band from 5 kHz to 36 MHz and a high band from 20 MHz to 6.4 GHz, enabling wide-coverage scanning for both near-field and far-field applications.

4. Short-Time FFT (STFT) with 3D Display

An STFT provides advanced time-frequency analysis. Unlike traditional spectrum analyzers that operate solely in the frequency domain, STFT analyses time and frequency simultaneously, revealing modulation characteristics and transient behavior. Two modes are available: amplitude mode (magnitude from the FFT complex modulus) and phase mode (phase from the FFT complex angle).

5. Hopping Frequency Sweep for Multi-band Test

A hopping frequency sweep mode performs spectrum scanning based on a user-defined frequency table, with each entry set to any frequency within the 36 MHz to 6.4 GHz high band. These suits segmented or non-continuous analysis such as harmonic testing, mixer testing (RF, LO, RF+LO, RF–LO, RF+2LO, 2RF–LO, etc.) and multi-band monitoring (e.g. 900 MHz and 2.4 GHz ISM bands).

6. RF Synthesized Signal Generator

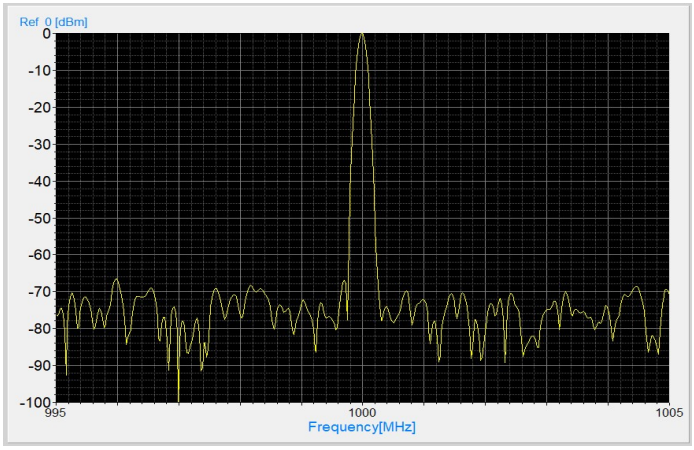
A dedicated TX-path control circuit lets the LO chain operate as a true RF signal generator. Output amplitude is fully calibrated and adjustable, with support for linear and logarithmic frequency sweeps, pulse-modulated RF and signals of controllable amplitude — significantly expanding the instrument's RF testing capability at minimal hardware cost.

7. General Pulse Signal Generator

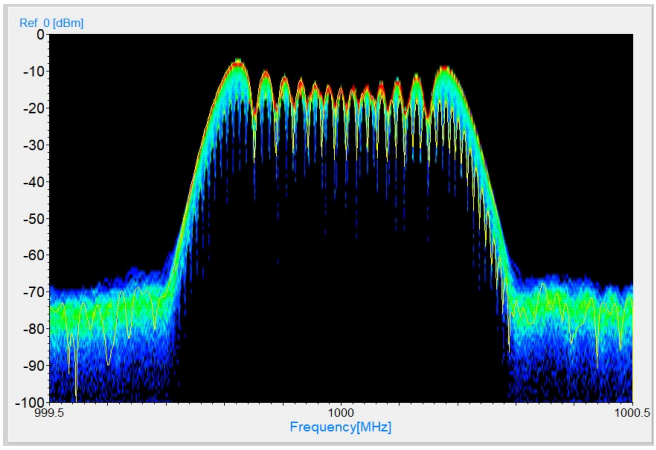
The internal pulse source that drives the RF generator's modulation path is routed to the rear-panel AUX1 port, letting the instrument also serve as a standalone general-purpose pulse generator for external triggering, modulation experiments and system-level testing.

Measurement Examples

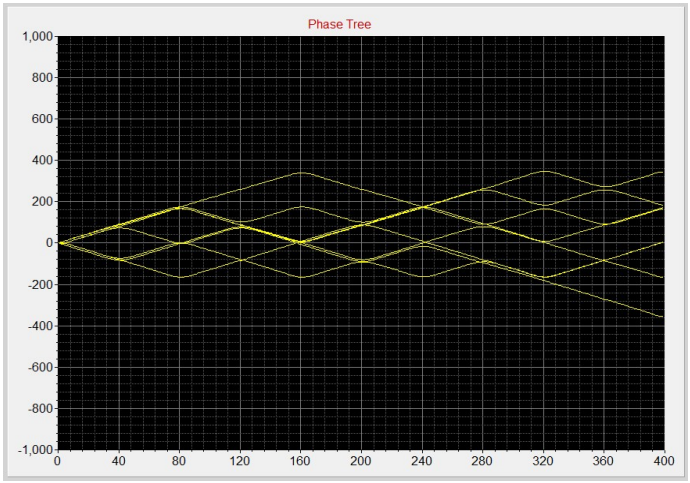
Representative measurements captured with the TRF6G4vsa across its analysis modes.



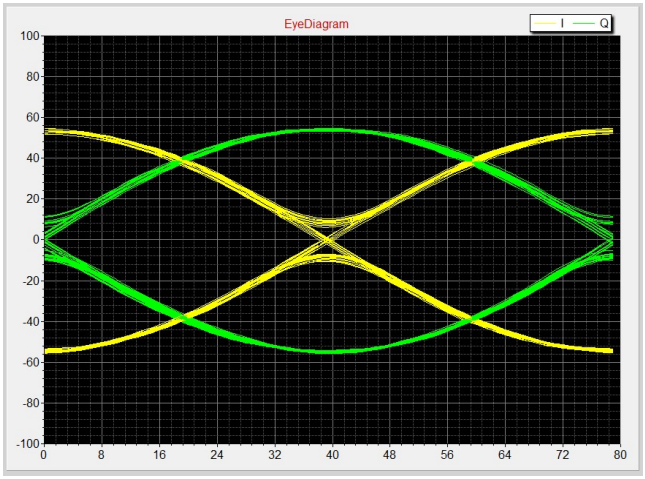
CW signal



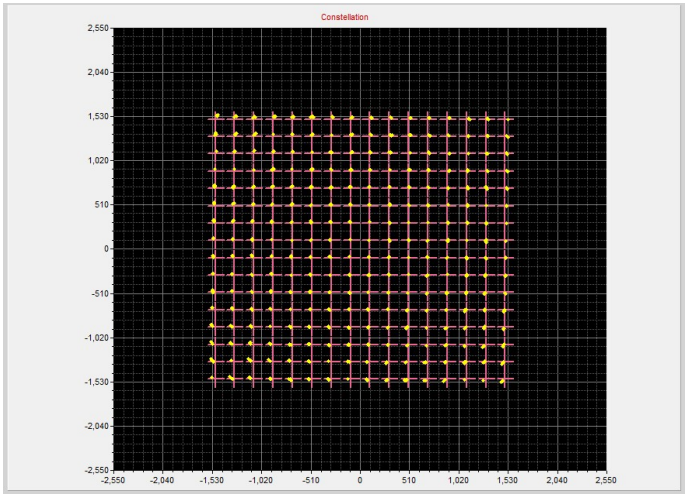
FM modulation



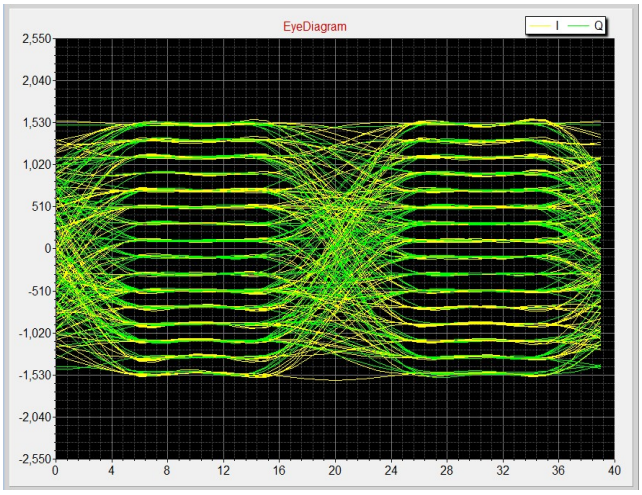
MSK phase tree



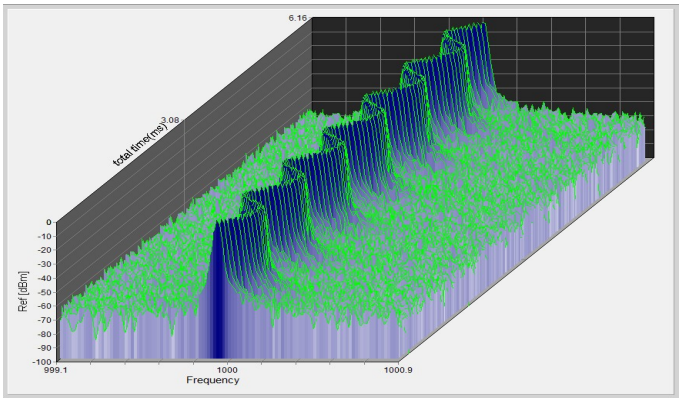
MSK eyes diagram



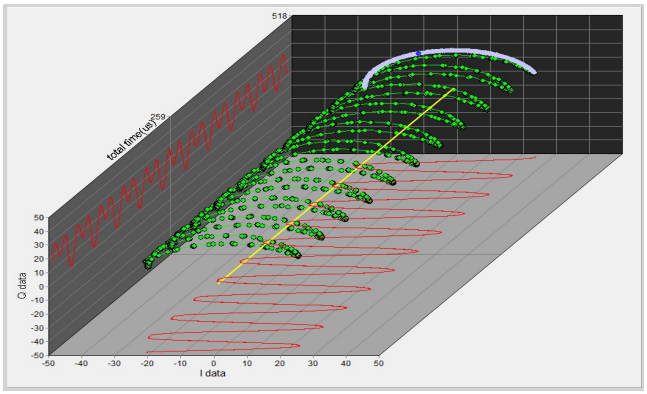
256-QAM Constellation



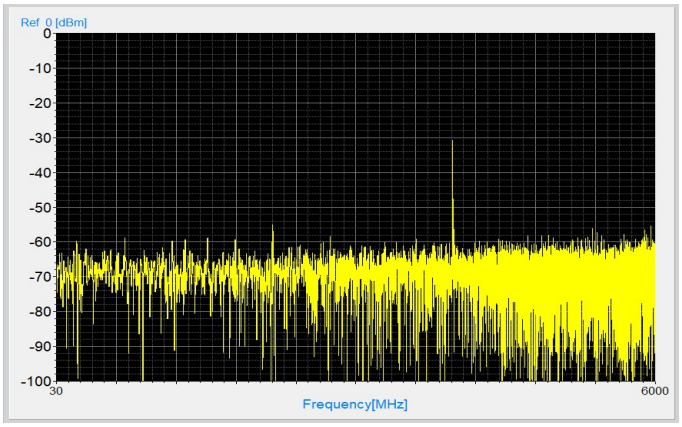
256-QAM eyes diagram



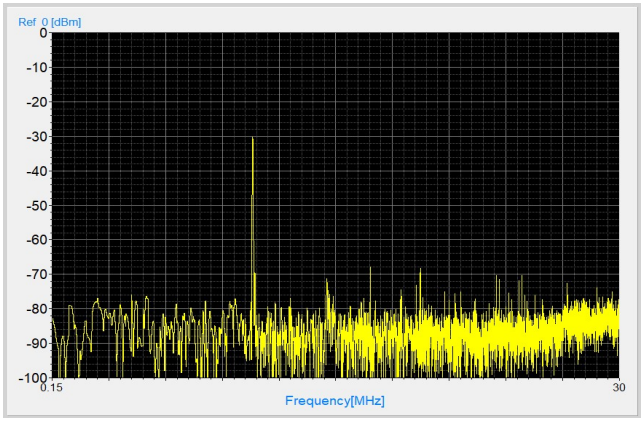
3D FM Signal (STFT amplitude)



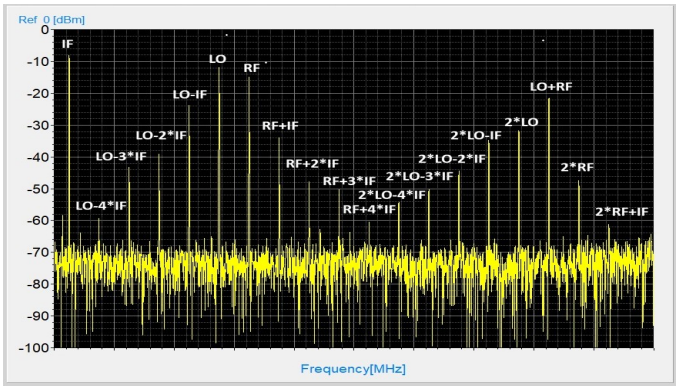
3D PM Signal (STFT phase)



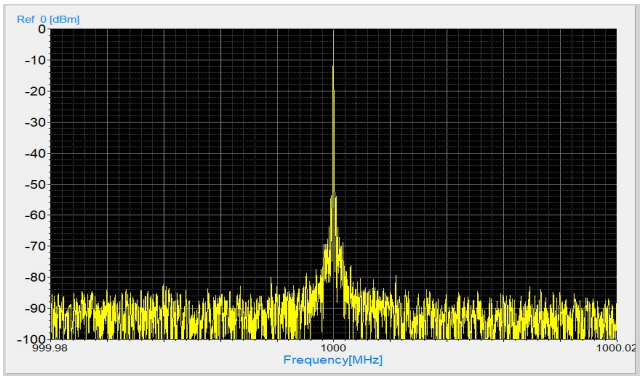
HB logarithmic sweep



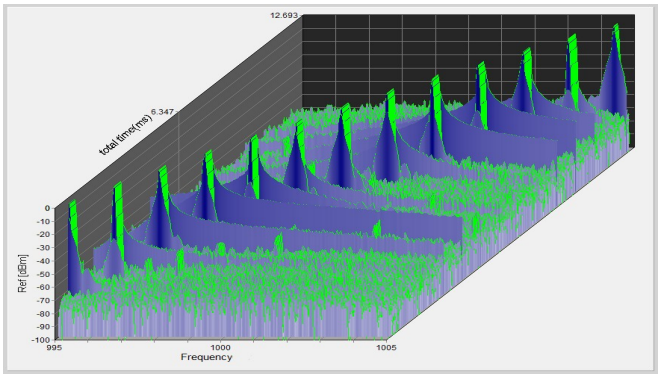
LB logarithmic sweep



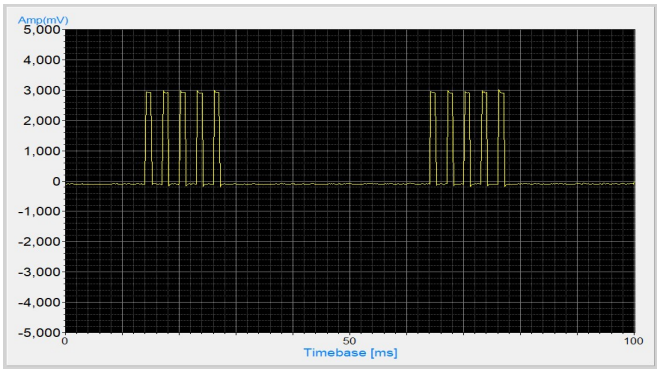
Hopping Sweep Mode



Smaller RBW



Linear frequency sweep (RF signal generator)



Multiple pulse signal (Pulse signal generator)

Specifications

Frequency

Frequency range	5 KHz – 6400 MHz
High Band (HB)	36 MHz – 6400 MHz
Low Band (LB)	5 kHz – 36 MHz
FFT sweep range (HB & LB)	5 kHz – 6400 MHz
Linear sweep range (HB)	36 MHz – 6400 MHz
Minimum frequency step	0.1 Hz
Reference clock output	Default 24 MHz (AUX1, rear); selected 12 ~ 100 MHz
Reference clock input	24 MHz only (AUX2, rear)
Reference clock accuracy	Stability over temperature ±0.5 ppm (–10 °C to +50 °C) Aging rate ±1 ppm/year max
Span range	1 KHz – 6380 MHz, min span 1KHz (HB)
Span – FFT sweep (HB & LB)	1 kHz – 70 MHz
Span – Linear sweep (HB)	100 kHz – 6380 MHz
Full span range	20 MHz – 6380 MHz
RBW range	25Hz – 10 MHz
RBW default	SPAN / 100
Phase noise @ 1 GHz	1 kHz: –87 dBc/Hz · 10 kHz: –98 dBc/Hz 100 kHz: –100 dBc/Hz · 1 MHz: –116 dBc/Hz

Amplitude

Measurement range – HB CW	DANL to +24 dBm (above 36 MHz)
Measurement range – HB pulse	DANL to +28 dBm (above 36 MHz)
Measurement range – LB CW & pulse	DANL to +10 dBm
Reference level range	HB: –40 to +30 dBm · LB: –20 to +20 dBm · resolution 0.25 dB
Maximum input level	CW RF 30 dBm (<1 min, Ref = +30 dBm) · DC input ±25 V max
DANL	–144 dBm
Absolute level uncertainty @ 1 GHz	1.5 dB
Frequency response (36 MHz – 6.4 GHz)	2 dB
Level display range	Log scale, 100 dB (manually movable)
Scale units	dBm, dBmV, dBµV, dBµV/m, dBW/m²
Markers	5
Trace functions	Current, Average, Max Hold, Density, Waterfall
Marker readout resolution	0.1dB

Sweep Time & Trigger

Sweep time (FFT mode)	4ms – 20 s
Sweep time (Linear mode)	8ms – 40 s
Full scan time	8 s
Trigger source	External from rear AUX1 SMA connector, internal from input signal
Trigger level	3.3 V TTL (external), full pulse level (internal)

Logarithmic Sweep Mode

Span range – HB	30 MHz – 6400 MHz
Reference range – HB	–40 to +30 dBm
Span range – LB	8 kHz – 36 MHz
Reference range – LB	–20 to +20 dBm

Hopping Frequency Sweep Mode

Operation	Defined by hopping file
Hopping points	100 (each defined in the hopping file)
Frequency range (HB)	36 MHz – 6400 MHz
Span value	30 MHz (single span value per hopping file)

STFT Sweep Mode

Frequency range	36 MHz – 6400 MHz
FFT points	64 – 8192 (2^n step, n = 6–13)
Max time step number	63 – 8191 (depends on FFT points)
Time scanning range	21 µs – 70 ms
Span range	1.8 MHz – 70 MHz
RBW	Default SPAN / 100
STFT modes	FFT_Amp and FFT_Phase
Display	3D (amplitude / frequency / time), 3D (I phase/Q phase/time)

Analog Demodulation

Frequency range	36.1 MHz – 6400 MHz (HB) · 8 kHz – 36 MHz (LB)
Timebase/div (AM, Zero span)	0.033 µs – 199 ms (HB) · 0.0833 µs – 3.367 ms (LB)
Timebase/div (PM)	0.033 µs – 7 ms (HB) · 0.0833 µs – 3.367 ms (LB)
AM demodulation index	5 – 95 %
PM demodulation phase range	–180° to +180°
Zero-span amplitude ref	+24 to –40 dBm (HB) +10 to -20dBm (LB)
Timebase/div (FM)	0.0833 µs – 6.4 ms (HB) 0.0833 µs – 3.367 ms (LB)
FM deviation full scale	2 kHz – 18 MHz

Frequency Digital Demodulation

Modulation types	Any frequency digital modulation (e.g. MSK, GMSK, GFSK, FSK, 4FSK)
Display types	Frequency table, FM, phase tree, constellation, eye diagram, I&Q data
Symbol rate	15 Kbps – 18 Mbps

Phase Digital Demodulation

Modulation types	Any phase modulation defined by I&Q file (e.g. 4PSK, 8PSK, 16QAM, 64QAM, 256QAM)
Display types	Constellation, EVM, eye diagram, I&Q phase data
Symbol rate	15 Kbps – 20 Mbps

RF Signal Generator

Single frequency range	1 MHz – 6400 MHz
Linear / Log sweep range	1 MHz – 6400 MHz (min 1 ms time step)
Hopping sweep range	1 MHz – 6400 MHz (min 1 ms time step)
Single frequency with pulse mod	1 MHz – 6400 MHz
Pulse period range	1 ms – 10 s
Pulse width range	100 µs – 5 s
Amplitude range	–70 to +10 dBm (0.25 dB step) below 3.5 GHz –70 to 0 dBm (0.25 dB step) above 3.5 GHz
Amplitude ramp range	–50 to +10 dBm

General Pulse Signal Generator

Pulse period range	100 µs – 10 s
Pulse width range	50 µs – 5 s
Multiple pulse number	1 – 255
Pulse delay	100 µs – 1 ms

General

Operating temperature	–10 °C to +50 °C
Storage temperature	–50 °C to +70 °C
Power source	5 V via USB port
Dimensions (L × W × H)	115 × 65 × 20 mm
Weight	350 g