RF Explorer®

Signal Generator

Signal Generator Combo

Specifications and Datasheet

Updated to Firmware Version 1.31

Description of main features

The RF Explorer Signal Generator is a powerful, wideband fully programmable RF signal generator. It is the perfect companion for Spectrum Analyzer RF Explorer product line.

As a standalone unit, RFE6Gen can generate CW and Sweep signals by selecting embedded menu options. When connected to a PC, it can be fully programmed with the RF Explorer for Windows software tool and automated with Python, .NET and USB RS232 API. Furthermore, the unit can work as a powerful Tracking Generator when used with RF Explorer Spectrum Analyzer connected to the same PC, offering full Scalar Network Analyzer (SNA) capabilities. The SNA feature allows full characterization of filters, amplifiers and any 2-port RF device.

Feature

- ✓ Pocket size and light weight

- ✓ Solid aluminum metal case

- ✓ Lifetime free firmware upgrades available, open to community requested features

- ✓ High capacity Lithium for 10hs+ of continuous run, rechargeable by USB

- ✓ RF Explorer for Windows free software download

- ✓ Can be extended with internal Expansion Modules for additional future band support and functionality

- ✓ Wide band support for CW signal, Frequency and Amplitude Sweep, and advanced Tracking SNA.

General Specifications

Parameter	Combo Signal Generator	Baseline Signal Generator
Frequency range	100KHz to 6GHz	23.4MHz to 6GHz
Frequency step/resolution	1Khz	1Khz
Frequency stability	100KHz to 250MHz: ±5ppm or 800Hz 250MHz to 6GHz: ±0.5ppm	±0.5ppm
Frequency accuracy (internal reference)	100KHz to 250MHz: ±10ppm or 800Hz 250MHz to 6GHz: ±1ppm	±1ppm
Output power range	Calibrated: -40 to +10dBm Uncalibrated: -60 to +18dBm *More details in section below*	40dBm to -30dBm in 3dB steps -10dBm to 0dBm in 3dB steps *More details in section below*
Output power resolution	0.25dB	3dB
Output power accuracy	Typical ±1.5dB	Typical ±3dB
Output power stability	Typical ±0.5dB	Typical ±0.5dB
Output amplitude settling time	500uS	500uS
Output protection	25VDC	25VDC
Harmonics	Typical -40dBc *More details in section below*	Typical -10dBc
Spurious	Typical less than -52dBc	Typical less than -50dBc
Phase Noise	Typical less than -125dBc/Hz on 1MHz at 1GHz	Typical less than -125dBc/Hz on 1MHz at 1GHz
Frequency Sweep settling	< 5ms	< 5ms
Amplitude Sweep settling	< 500uS	< 500uS
Sweep hops range	unlimited	unlimited
Functional modes	CW Frequency Sweep Amplitude Sweep Tracking SNA	CW Frequency Sweep Amplitude Sweep Tracking SNA
Operating temperature	5-35C	0-45C
Connector type	SMA 50 ohms	SMA 50 ohms
Display	Graphics LCD 128x64 pixels	Graphics LCD 128x64 pixels
Backlight	5 levels	5 levels
Weight	205g	185g

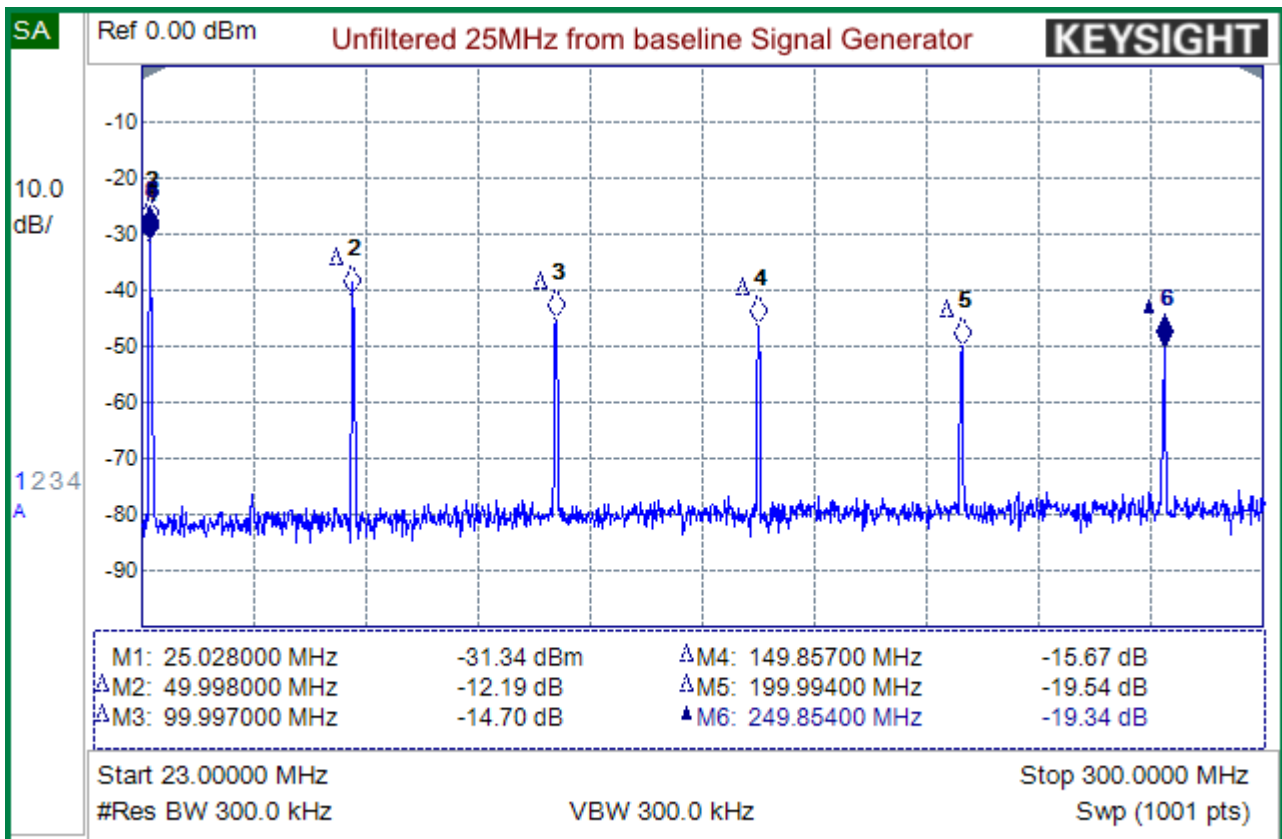| Parameter	Combo Signal Generator	Baseline Signal Generator
Size	113x70x25 mm	113x70x25 mm
Programmable	USB generic API Python API .NET API	USB generic API Python API .NET API
Software	Windows PC	Windows PC
Certification	CE/FCC/RoHS/MSDS	CE/FCC/RoHS/MSDS

Harmonics Filtering (Combo model)

A more detailed section on harmonics and filtering is available in the full user manual.

These values are measured at reference output signal at -20dBm, measuring all harmonics order #2 - #10, as this is representative of worst-case scenario.
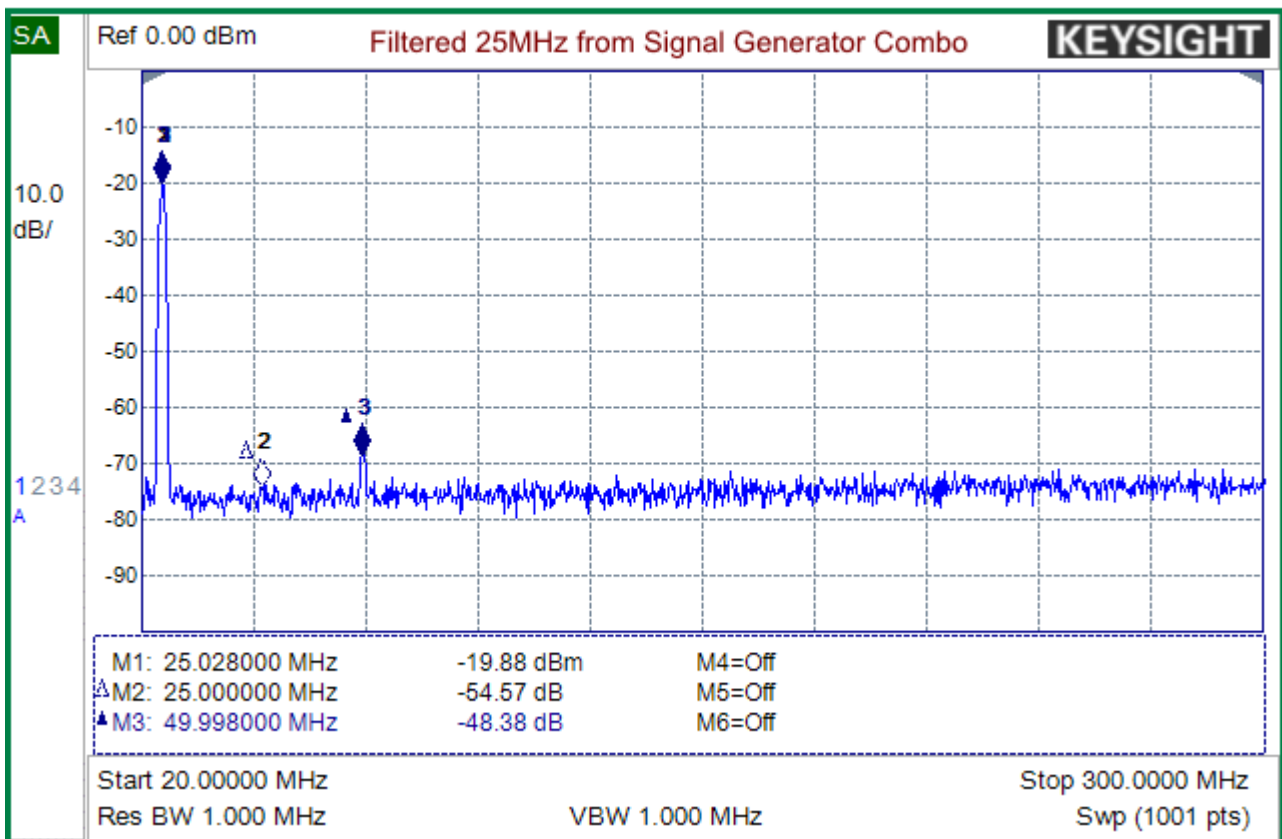
RF Explorer Signal Generator Combo – Harmonics filtering			
Frequency range (MHz)	Best case (dBc)	Typical (dBc)	Worst case (dBc)
0.1 – 0.5	-42	-40	-20
0.5-250	-59	-57	-42
250-430	-53	-40	-22
430-630	-53	-45	-35
630-820	-39	-37	-22
820-1960	-50	-43	-34
1960-2500	-30	-26	-20
2500-4600	-50	-40	-27
4600-5200	-42	-33	-24
5200-6000	-46	-42	-37

Usually harmonics have better filtering at higher power levels up to +10dBm, and about the same response on lower power levels. Higher signal levels beyond +10dBm may increase harmonics due to saturation of internal power amplifiers.

An example of harmonic filtering in action at 25MHz comparing baseline Signal Generator and filtered Combo model below.

Unfiltered 25MHz from baseline Signal Generator

M1: 25.028000 MHz	-31.34 dBm	M4: 149.85700 MHz	-15.67 dB
M2: 49.998000 MHz	-12.19 dB	M5: 199.99400 MHz	-19.54 dB
M3: 99.997000 MHz	-14.70 dB	M6: 249.85400 MHz	-19.34 dB

Start 23.00000 MHz · Stop 300.0000 MHz
#Res BW 300.0 kHz · VBW 300.0 kHz · Swp (1001 pts)

Comparison between original output signal from baseline RF Explorer Signal Generator (above)
and the new RF Explorer Signal Generator Combo (below)

Filtered 25MHz from Signal Generator Combo

M1: 25.028000 MHz	-19.88 dBm	M4=Off	
M2: 25.000000 MHz	-54.57 dB	M5=Off	
M3: 49.998000 MHz	-48.38 dB	M6=Off	

Start 20.00000 MHz · Stop 300.0000 MHz
Res BW 1.000 MHz · VBW 1.000 MHz · Swp (1001 pts)

Same signal compared in the time domain with an oscilloscope

25MHz signal from harmonic filtered
new RF Explorer Signal Generator Combo

25MHz signal from unfiltered
standard RF Explorer Signal Generator
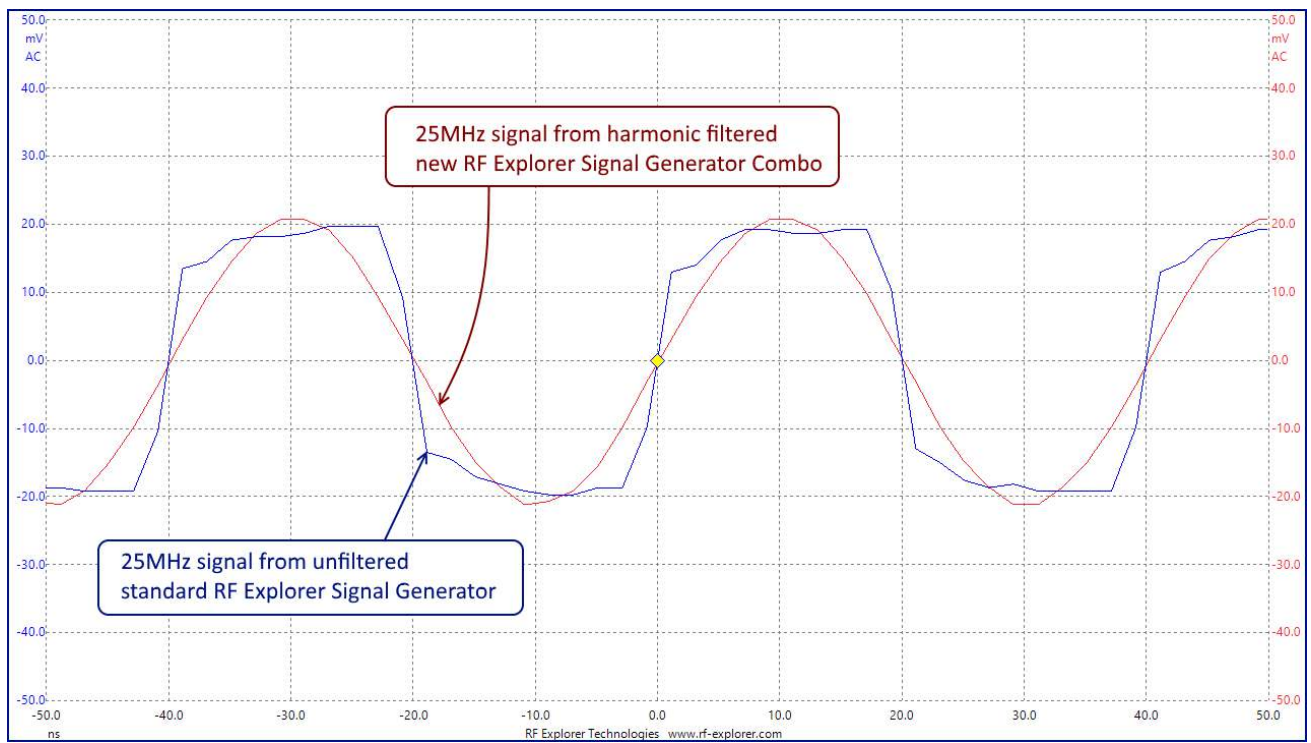
Output Power Levels (Combo model)

The RF Explorer Signal Generator Combo model delivers output power signal in the nominal range -60 to +15dBm. The range is calibrated by bench laboratory grade instruments, sampling 600 measurement points, and is suitable in the range -40 to +10dBm. Output signals outside this range will not perform with the same linearity and accuracy as within the calibrated range.

The calibrated range accuracy is described in next table. Uncalibrated or out-of-range power levels are described as "n/a". In these ranges the device can be used but output power level may not be accurate.

RF Explorer Signal Generator Combo – output power accuracy			
Frequency range (MHz)	Power range (dBm)	Typical Accuracy (dB)	Worst case Accuracy (dB)
0.1 to 1	-40 to 0	±2	±5
	0 to +10	n/a	n/a
1 to 10	-40 to 0	±1	±2.5
	0 to +10	n/a	n/a
10 to 1950	-40 to -10	±1	±2.5
	-10 to +10	±1.5	±3.5
1950 to 3600	-30 to +10	±1	±2.5
3600 to 5200	-30 to +10	±1.5	±3
5200 to 6000	-30 to 0	±2	±4
	0 to +10	n/a	n/a

Future firmware upgrade will increase accuracy in some frequency and power ranges using internal calibration table adjusted in factory.

An optional software process will be available to manually calibrate the device and adjust for amplitude deviation. Contact us for additional details.

Absolute maximum and minimum power levels available are described in next table. Note these levels are not guaranteed and not calibrated.

RF Explorer Signal Generator Combo – Absolute output power range		
Frequency range (MHz)	Minimum output power (dBm)	Maximum output power (dBm)
0.1 to 1	-60	0
1 to 10	-60	+5
10 to 3200	-60	+15
3200 to 3650	-60	+10
3600 to 5200	-60	+15
5200 to 6000	-60	0

Output Power Levels (baseline model)

The RF Explorer Signal Generator baseline model delivers 8 different power levels, nominally specified as per table below:

RF output power (nominal)	High Power	Power Switch
0dBm (1mW)	ON	4
-3dBm (0.5mW)	ON	3
-6dBm (0.25mW)	ON	2
-9dBm (0.125mW)	ON	1
-30dBm (1uW)	OFF	4
-33dBm (0.5uW)	OFF	3
-36dBm (0.25uW)	OFF	2
-39dBm (0.125uW)	OFF	1

These are ideal power levels that are not actually constant with frequency. Actual power levels are a function of frequency, as depicted in graph below. This graph is generic but every RF Explorer Signal Generator includes an internal calibration table, produced in the factory at calibration time, with actual values for accurate reading on screen.

RF Explorer Signal Generator RFE6GEN output power typical response
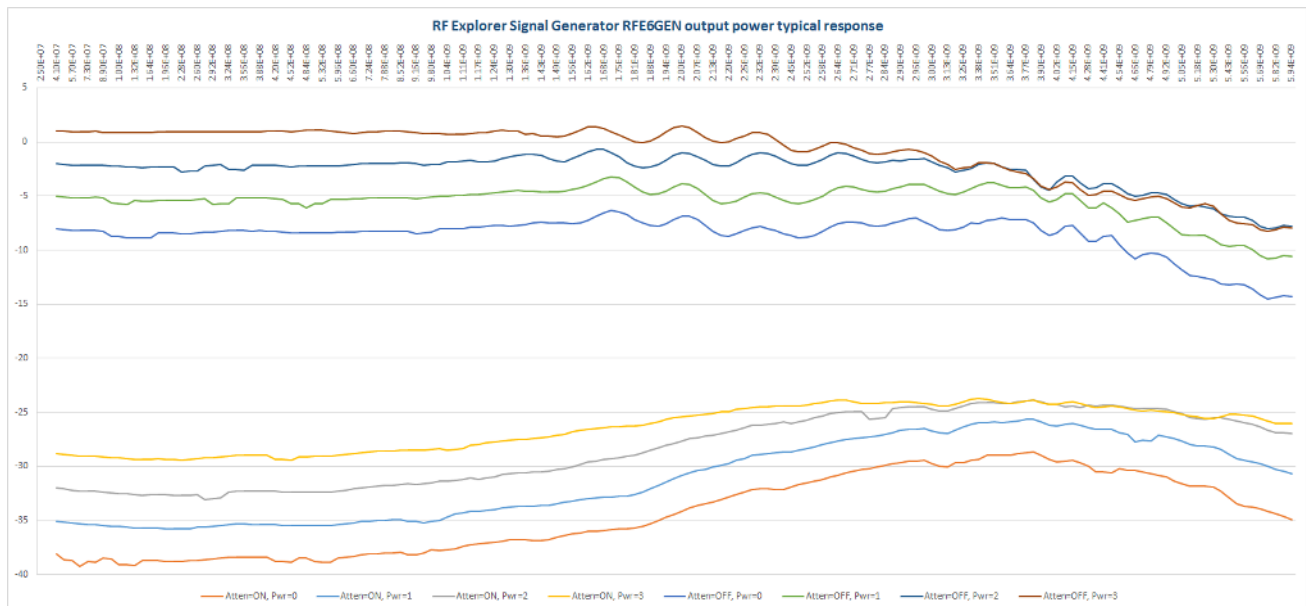
The delivered power levels have a linear response up to about 2GHz, for higher frequencies there are some roll off and power becomes predictable but not constant. The unit is fully calibrated and includes an internal amplitude calibration table to allow accurate power normalization and measurement done in Tracking mode.

The exact power level available on each frequency point is available on screen, as well as in the RF Explorer for Windows application. If you need better accuracy please upgrade the unit to a RF Explorer Signal Generator Combo model.

Spurious and Phase Noise

RF Explorer Signal Generator Combo uses a low noise signal source and low noise independent voltage regulators to provide a reduced phase noise output signal.

Below table shows typical values measured at -20dBm output power. These values can slightly increase or decrease at different power levels.

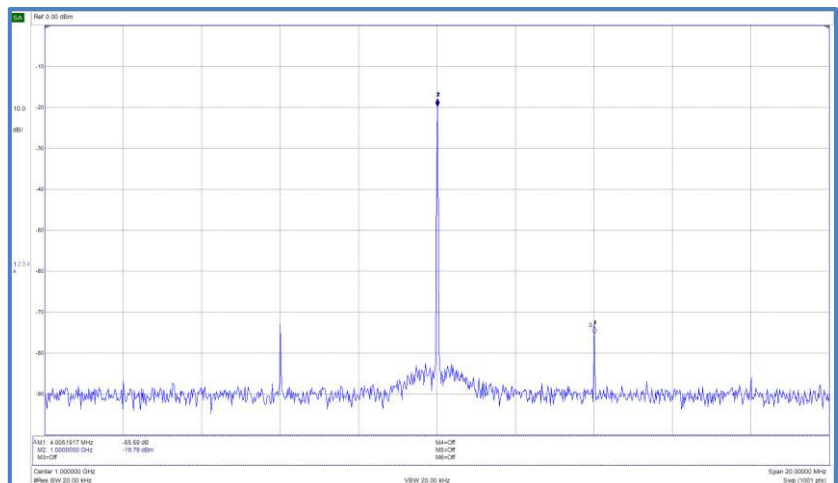| CW Frequency	Phase Noise @ 1KHz	Phase Noise @ 100KHz	Phase Noise @ 1MHz
2MHz	-93 dBc/Hz	-105 dBc/Hz	-122 dBc/Hz
1GHz	-96 dBc/Hz	-108 dBc/Hz	-128 dBc/Hz
5.8GHz	-74 dBc/Hz	-90 dBc/Hz	-115 dBc/Hz

Spurious signals are created by the internal signal source at multiples of the frequency divider and, even though they are filtered, some residues signals may display at 1GHz CW output signal.

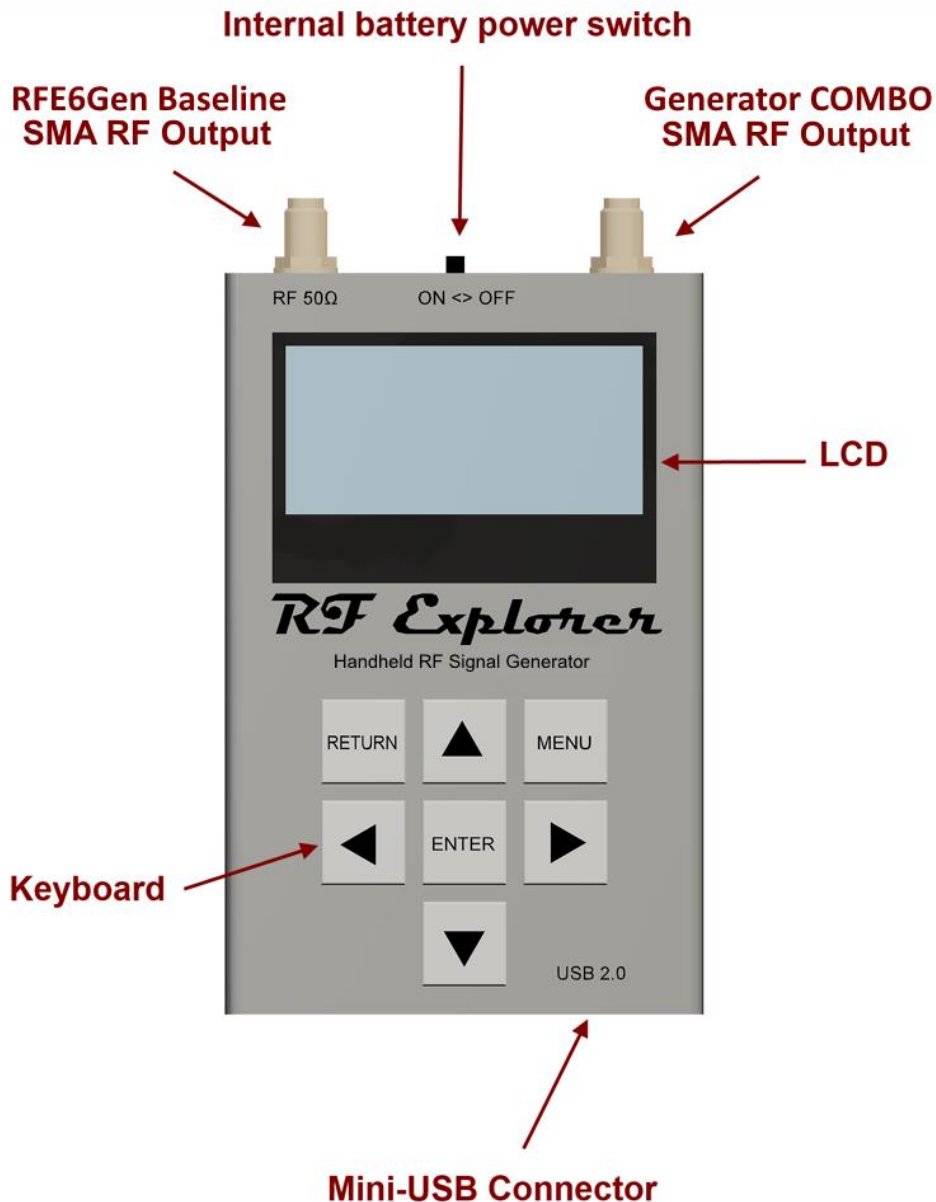| Spur @ 16KHz	Spur @ 32KHz	Spur @ 4MHz	Spur @ 8MHz
-52 dBc	-72 dBc	-55 dBc	-68 dBc
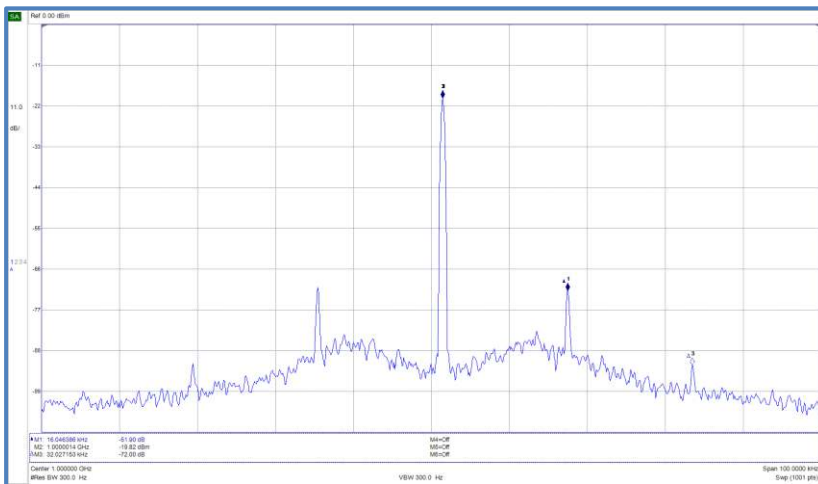
Signal measured at 1GHz narrow band displaying spurs at 16KHz and 32KHz.

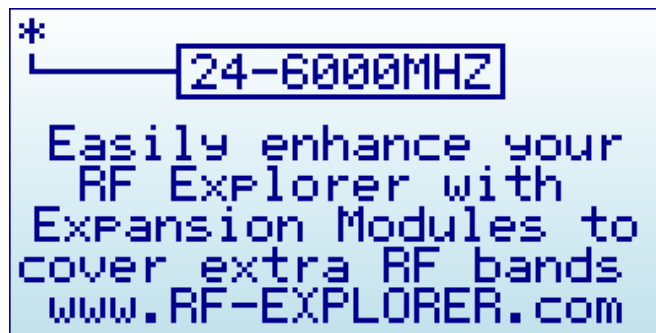Signal measured at 1GHz wideband displaying spurs at 4MHz and 8MHz.

Connecting RF Explorer Signal Generator

Internal battery power switch

RFE6Gen Baseline SMA RF Output

Generator COMBO SMA RF Output

RF 50Ω

ON <> OFF

LCD

RF Explorer

Handheld RF Signal Generator

RETURN ▲ MENU

◄ ENTER ►

Keyboard

▼

USB 2.0

Mini-USB Connector

The unit includes 50 ohm impedance RF connector standard SMA format.

- The RFE6Gen **baseline model** includes only one connector, the RF SMA on the left in the above image. This model will display this information in the RF Connections screen:

```
✱
└──┤24-6000MHZ├
Easily enhance your
   RF Explorer with
Expansion Modules to
cover extra RF bands
  www.RF-EXPLORER.com
```

- The RF Explorer Signal Generator **Combo model** includes two SMA connectors, but only the enhanced functionality of the SMA connector on the right side is enabled. A future firmware may enable both connectors to allow double signal source but with different capabilities. It is recommended covering the left SMA connector with a dummy load 50ohm for better protection. This model will display this information in the RF Connections screen:

Expansion Module

RF Explorer Signal Generator includes an internal expansion port to enhance the RF power capabilities and frequency coverage of the main unit with RF Explorer Signal Generator compatible Expansion Modules. Note: Spectrum Analyzer modules cannot be connected to the Signal Generator, they are incompatibles and have a changed gender connector to avoid any change of connecting incompatible modules.

RF Explorer Signal Generator Expansion is an advanced expansion board. It can be used to easily extend RF Explorer RFE6GEN Signal Generator baseline model into a Combo model.

For more details and assembly information please visit link below.

www.rf-explorer.com/expansion

*Important: After assembling of the RF Explorer Signal Generator Expansion board into a RF Explorer Signal Generator RFE6GEN baseline mainboard, the device becomes fully compatible with a RF Explorer Signal Generator Combo (*specifications*). Same specifications will apply for harmonics filtering, frequency accuracy and RF capabilities as a Combo unit assembled and calibrated at factory. However, due to differences between mainboard electronics, the <u>RF power level accuracy cannot be guaranteed</u> and may not comply with RF Explorer Signal Generator Combo specifications. We offer calibration services to fully adjust to specifications, please use <u>contact form</u> to request more information.*

Connecting RF Explorer to a computer

RF Explorer device can be connected to a computer (Windows, Linux, Mac and Android) for additional capabilities, including higher resolution screen, additional features and programmability.

For free, open source RF Explorer for Windows tool, please check this link: www.rf-explorer.com/windows

For additional software options developed by a growing list of 3rd party companies, please check this link: www.rf-explorer.com/software

API programming specification for RF Explorer

RF Explorer offers a compact, easy to use, USB / RS232 programming interface. It can be used to automate external solutions when connected to an external computer or device.

For full specification of the current API, check www.rf-explorer.com/API .

There are .NET and Python libraries available in GITHUB repository, ideal for custom work required by your application.

RF Explorer for Windows open source code

RF Explorer is a hacker friendly device. Full open source under LPGL license is offered to the community.

As hackers ourselves, we do like customizing, tinkering and expanding gadgets. We certainly designed and built RF Explorer with these factors in mind.

We love and make good use all community contributions, contact us or send us a PULL request if you have source code contributions you want integrated in the final product.

Check our [hacker corner link](#) for more details.

FCC and CE regulations

RF Explorer is a Test and Measurement device, and therefore compatible with US FCC regulation 47 CFR Part 15.103(c).

RF Explorer is certified for CE compliance under regulations EN/IEC61236 and EN/IEC61000.

License

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