Compare low-cost spectrum analyzers

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The one piece of gear that’s essential for EMC troubleshooting is a spectrum analyzer. You can buy a decent portable for about $10k or used ones go for $1k to $5k if you don’t mind the 30 to 80 pounds of weight or the initial investment. This article reviews several models that cost under $2,000.

Models less than $600

RF Explorer - The RF Explorer was designed by Ariel Rocholl (an engineer from Spain) and manufactured by www.seeedstudio.com, a Chinese electronics supplier for the hobbyist crowd. The original RF Explorer (Model WSUB1G) is limited to a frequency range of 240 to 960 MHz, which covers quite a bit of the most desired radiated emissions band. However, it sells for just $129, which will at least give you some idea of the emissions profile of a product under test.

I’ve used this with the Beehive probes and it works well for general troubleshooting. They also sell the WSUB1G with added Wi-Fi receiver module, called the RF Explorer - ISM Combo, for $175. In 2012, Rochell released a brand-new design - the RF Explorer 3G Combo - that is available for $269 and will tune from 15 MHz to 2.7 GHz. With DIY probes, and scavenging through your local hardware store, you should be able to put together a “starting out” kit for under $300 ($500, for the upgraded RF Explorer 3G Combo. I reviewed the original RF Explorer - WSUB1G here. As you can see in Figure 1, the user interface is quite limited, so you may find it a little slower to use than the full-sized analyzers. But if price is an issue, it works well enough.
To test the RF Explorer, I attached an H-field loop probe from Beehive Electronics and started probing a crystal oscillator demo board used in my EMC seminars (Figures 2 and 3). The sensitivity was sufficient to display usable harmonics.

While the keyboard is limited, the analyzer is relatively easy to configure for frequency and span (or high and low limits) and reference level. Once the span is set, pressing the left and right keys causes the frequency to change in half-span steps. Pressing the up/down keys changes the vertical range in steps according to the defined vertical scale. The resolution bandwidth (RBW) is automatically set and displayed at the bottom by pressing ‘Return’ during a measurement. This displays the center frequency, span, and RBW. Pressing Return once again displays the start, center, and stop frequencies.

I like the fact the unit includes modes for normal, max, averaging, and max hold. Normal mode displays the signals with no calculations. Max takes the last 1 through 28 (user-defined) sweeps and displays the peak amplitudes. Averaging takes the last 1 through 28 (user-defined) sweeps and calculates the average. Max Hold changes to a persistent display, recording the highest-level amplitudes detected.

The instrument firmware is open source, so Rocholl and an active worldwide user group are always
improving the performance and adding additional features. Units may be easily upgraded with the latest code. Another nice touch is that free client software is available for both the PC and Mac platforms for remote programming, display, and waveform capture through the USB port. The built-in Li-Ion battery is charged through the USB connector.

![RF Explorer display showing a few 16 MHz harmonics from the demo oscillator board. Either dBm or dBuV may be displayed.](image)

The RF Explorer WSUB1G has an input-power limit of +5 dBm and the upgraded 3G Combo is protected up to +30 dBm. Resolution bandwidth is automatically set for 2.6 to 600 kHz (depending on the span) and the average noise level is -115 dBm. ([Product review](https://www.tmworld.com) from TMWorld.com and more information and specs from company [website](https))

**Triarchy TSA5G35** - Always on the lookout for useful, but inexpensive test equipment, I recently ran across the Triarchy Technologies USB spectrum analyzer, model TSA5G35. The one thing that really struck me was the whole thing was built into a USB dongle, just a little larger than a memory stick. What's more, the advertised frequency range was an exceptional 1 MHz to 5.35 GHz.

So, is a spectrum analyzer no larger than a pack of chewing gum that you can carry in your pocket good enough for EMC analysis and troubleshooting? For a total cost of $599 (through their store on eBay), I decided to take a chance and run this remarkable PC-based analyzer through the ringer. See the [complete review](https://www.themicrowaveblog.com) on The EMC Blog.

![Triarchy USB spectrum analyzer can tune from 1 MHz to 5.35 GHz.](image)

While there are some obvious drawbacks, considering the small size, this is a useful gadget for casual EMC troubleshooting, as well as for general engineering and hobbyist use. The unit comes with a 1m long USB extension cable and a fixed 30 dB attenuator (for higher power measurements). The input port is a standard SMA connector (Figure 4).

Basic specifications include frequency coverage of 1 MHz to 5.35 GHz, resolution bandwidths of 50 through 500 kHz (not selectable and depending on the RBW), frequency spans from 1 MHz to 1 GHz, input level range of -110 to +30 dBm (using the supplied 30 dB attenuator for the higher power levels), and typical noise levels of -80 to -100 dBm (depending on the span and RBW). The maximum power level is +20 dBm (without the external attenuator) and +/- 25 VDC, which is excellent protection for this little instrument.
Further processing is performed with the free and downloadable PC-based software (currently in version 1.04). After loading the software and entering the license key (available only via email request to Triarchy), there were no glitches and I could immediately see a frequency sweep once I pressed "Start". Here is where you control the center frequency and span, as well as functions like applying the marker (peak, minimum or arbitrary), max hold, amplitude (reference level), sweep time and screen captures. The resolution bandwidth is not user-selectable, but is automatically selected based upon the span. The frequency is auto-scaled nicely and the vertical scale is primarily set with the Amplitude (or reference level) setting, but large signal excursions can auto-scale that, as well, to a degree. The vertical scale seems to be set to 10 dB per division. See Figure 5 for a sample screen capture of the "front panel".

Figure 5 - The user interface from the free PC client software.

Attaching the USB extension cable and a small near-field probe allows you to probe for harmonics quickly as shown. Alternatively, you can simply plug the analyzer directly into a USB port and use an SMA coax cable and near-field probe. I’m not sure I’d recommend using the larger and thicker RG-58/U type coax, because it may apply side pressures to the USB connector and potentially cause some damage. So, I recommend sticking with the supplied USB extension cable or the thinner coax. I found the analyzer to have plenty of sensitivity and never really required an external preamplifier to see harmonics clearly. (Product review on twmworld.com and more information from the product website)

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