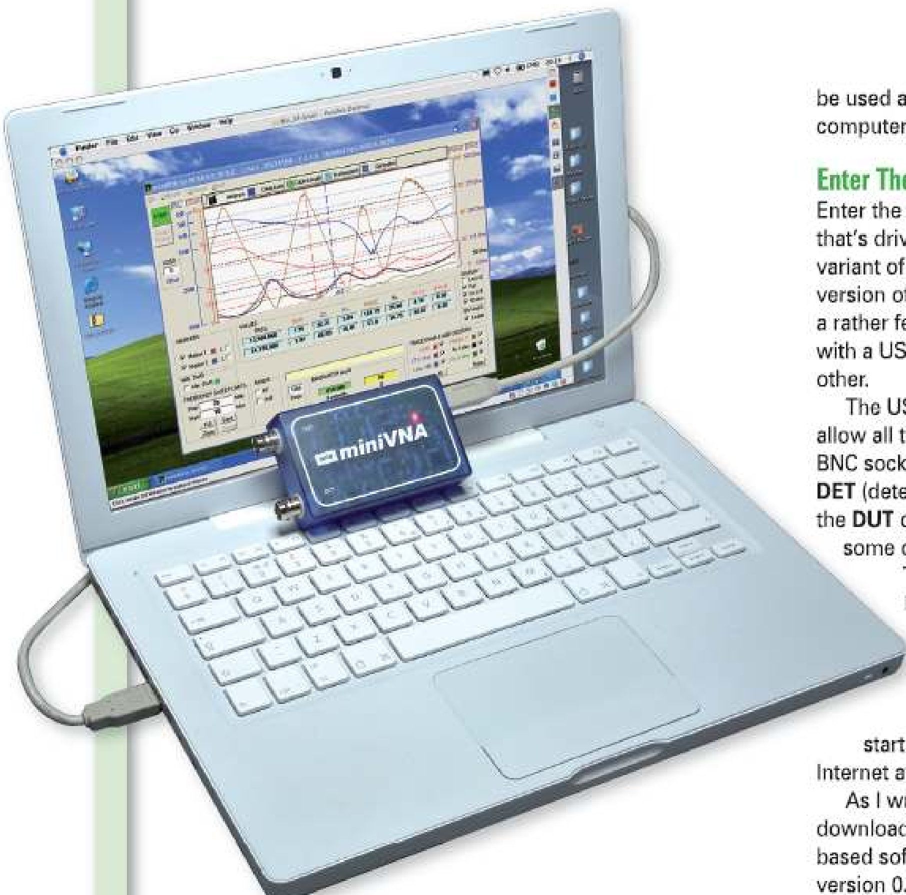
Not just an antenna analyser!

Review

The *miniVNA*
antenna testing – and much more!



I consider that a system or box, capable of easily showing the matching and tuning of an antenna over a band of frequencies, one of the best instruments available to the antenna experimenter. For many years the systems and units available to the Amateur experimenter, have lagged a little way behind those available to the professional.

With the advent of the all-in one 'boxes' available from the likes of MFJ, and AEA the gap started to close. Over the last 10 years or more, I've owned and used various versions of MFJ's Antenna Analysers and I've found them extremely useful, not to mention informative of the state of an antenna's tuning and matching.

The MFJ units operated in the range 1.7-170MHz, with one version offering a range tripler to cover the 420-480MHz band. Some other units, often offering more information, operated only up to 30MHz or so. Bearing in mind that all my previous antenna analysers have been hand-held devices that could be used almost anywhere, could an analyser that's tied to a computer replace any one them?

Enter The miniVNA

Enter the miniVNA antenna analyser, a small piece of hardware that's driven from the USB port of a PC running a modern variant of the *Windows* operating system. There's also a *Linux* version of software to use with the hardware. The hardware is a rather fetching transparent blue box some 93 x 57 x 24mm with a USB socket at one end opposite two BNC sockets at the other.

The USB socket is for connection to a suitable computer to allow all the functions to be controlled from a PC, while the two BNC sockets are the **DUT** (device under test?) output and the **DET** (detector) input connectors. For basic antenna tests, only the **DUT** connection is required, while for transmission and some other tests, both connections are used.

To start using the miniVNA, it's necessary to install both a USB device driver and the actual software that controls the unit and calculates and displays the results. While the driver went on without problems, the *Antenna Network Analyser* software had 'timed-out' and needed updating before I could start using it. An updated version was available from the Internet at **www.miniradiosolutions.com/**

As I write this review, the *Windows* software for downloading has reached version v.2.3.0, while the *Linux*-based software *Gnome-Vector-Network-Analyzer* has reached version 0.1.2. As I run an Apple Macbook (portable Macintosh) computer for almost all my work, I had no alternative but to run *Windows* via virtualisation software, as there's presently no native Macintosh software available. All 'screen-grabs' are taken under these circumstances!

After setting up the USB port to use, it's a good idea to calibrate, frequency, reflection and transmission 'zero' settings. I've shown the frequency calibration screen in **Fig. 1**. This may be the most difficult to set for most readers unless you have access to an accurate frequency counter.

If you're unsure of the quality of your available counter, you can ignore this setting as the direct digital synthesiser (DDS) is fairly accurate – it's well within ±0.01%, which is more than accurate enough for most tests. The DDS generator outputs 500mV p-p into 50Ω, with up to 1000 frequency steps, between the variable lower and upper frequencies limits of 100kHz to 180MHz.

The number of frequency steps defines how often the display updates. When using 500 steps, the screen updates

Our Technical Editor Tex G1TEX was eager to get his hands on the latest piece of antenna test equipment. He found that it does an awful lot more – read on to find out what!

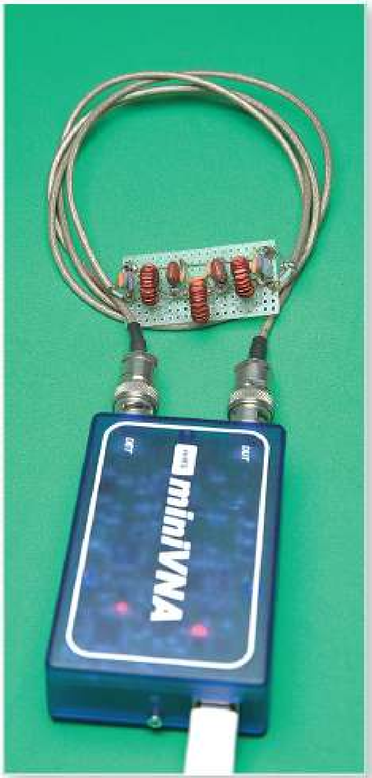


Fig. 8 (left): And here's how the set-up looked when measuring the filters.

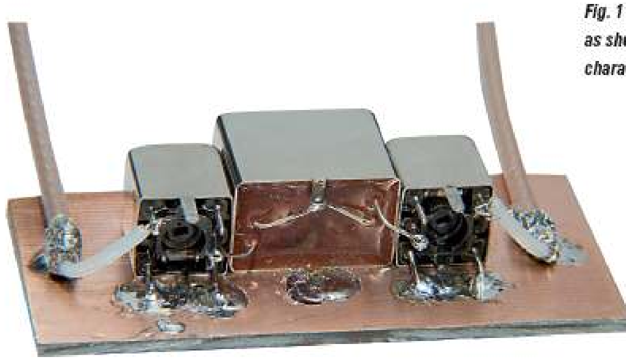


Fig. 11: Fitting two 10.7MHz i.f. transformers, as shown helped improve the crystal filter's characteristics. See Fig. 12.

every second or so, while the maximum number of steps, 1000, causes screen updates every two seconds. I suppose that most users would set the **Start** frequency as the lower one and the **Stop** frequency as the higher one. But I noted that it also worked with the **Start** and **Stop** frequencies reversed. In this case the lower – **Stop** frequency is at the right-hand of the display, rather than the more normal left-hand side!

The first test I tried was to attach my station's h.f. antenna, based on an end-fed G5IJ antenna (as featured in Antenna Workshop), onto the DUT socket and the s.w.r. plot of **Fig. 2** was what I saw on the computer's screen. There are two 'cursors' on screen the red left-hand vertical line show that the system matches reasonably well on 1.8MHz, though to be honest this is due more to the length of the coaxial feeder rather than the antenna's length and matching.

Turning on all display options for my antenna, **Fig. 3**, shows a rather more initially confusing number of coloured plots, which includes s.w.r., Zin(Ω), Loss i(dB), Phase angle(°) and Rs and Xs, both in ohms. They're all parameter that can be very useful in optimising antenna! But if you're unsure how to apply them, then just using the s.w.r. plot is ideal for starters.

For my next test, I tried a simple end-fed (λ/2) 144MHz v.h.f. antenna as shown in the display of **Fig. 4**, that shows that the antenna is substantially 'flat' over the whole of the band. The display updates around once per second when the DDS covered the band in 500 steps. This allowed me to see the changes and adjust the matching capacitor quickly and easily.

Quick & Easy

Having found that the miniVNA makes plotting s.w.r. and matching parameters both quick and easy, I tried two low-pass filters as described by **Ed Wetherhold W3NQN** in his article *Filters – Cutting The Edge* (PW July 1998). The two filters I tried are shown in **Fig. 5**, the 3.5MHz band low-pass and **Fig. 6**, the 7MHz version.

The screen-grab of Fig. 5 shows that the roll-off of the filter is very steep, as the -3dB point is around 4.5MHz and the -40dB point is at only 6.2MHz. The flattening out of the curve at -50dB is due to the limitation of the sensing methods used in the miniVNA rather than of the filter itself. The response curve of Fig. 6 is for the 7MHz low-pass filter.

I discovered an unusual 'sting-in-the-tail' for the 3.5MHz filter, **Fig. 7**, when the oscillator went up to 180MHz. It turned out that the curve showed that there was a reduction of rejection towards the top end of the swept frequency. This could lead to interference from a 144MHz v.h.f. rig affecting a simple h.f. receiver, when none would be expected.

The photograph, **Fig. 8**, shows one of the filters being tested. I noted that the two h.f. low-pass filters offered very low in-band attenuation. This was a situation that wasn't mirrored when I tried a 144MHz band-pass filter, **Fig. 9**, that showed almost 2dB of in-band loss as opposed to less than 0.5dB of loss of the h.f. filters.

Next, I tried a crystal filter from a 'bagful' that I'd bought very cheaply as the seller said he was unable to provide information for them. A quick scan, **Fig. 10**, showed that the band-centre was at 10.7MHz. This screen shows only a limited range of 10.69–10.71MHz, arrived at after a series of more wider-band scans. The in-band ripple is due to the gross mis-match between the 50Ω of the miniVNA and the higher impedance (2kΩ approximated guess) of the crystal filter.

Adding two 10.7MHz i.f transformers, Fig. 11, to the crystal filter improved things. Calculations indicated that they'd match with an impedance of around 2kΩ into the filter. The in-band ripple then became much smoother and the losses became less too, **Fig. 12.**

Thinking a little more obliquely and I decided to treat a 7MHz amplifier as a band-pass filter, Albeit one that would need an attenuator at least 20dB, in between the **DUT** output of the miniVNA and the input of the amplifier.

The output of the amplifier was taken back to the **DET** input of the miniVNA. and the 'band-pass' characteristics are shown in **Fig. 13**. The actual gain of the amplifier at band-centre was the same as the setting of the attenuator, which was some 20dB.

One other use of my MFJ units has been finding best settings for notch filters, either LC or coaxial cable ones. So, a final test, was of a variable v.h.f. notch filter that I attached to the miniVNA, although the depth of the notch, **Fig. 14**, was rather poorer than I would have liked (-30dB at 86MHz and only -18dB at 172MHz).

Stable & Accurate

Because the DDS inside the miniVNA is both very stable and accurate in frequency, with the addition of a good attenuator, it will perform as an excellent signal generator. Such a shack signal generator combination, will have a maximum output of around half a volt peak-peak into 50Ω.

In conclusion, not only is the miniVNA a useful tool to check out filters (discrete L/C or crystal), or to act as a main station r.f. oscillator, the software has an option for some coaxial cable-based tests, such as determining cable length and losses to be made. The miniVNA also allows tuning and gain adjustments to be made on amplifiers, (**although caution is needed to keep the input to the DET socket within limits**).

In my enthusiasm for all the 'other' things that the miniVNA does, I mustn't forget that it's also an excellent tool for playing with antennas. All-in-all, this unit gets my unequivocal vote of approval as a decidedly good addition to any shack that already has a PC. So much so, that I'm going to be rather loath to give the review item back!

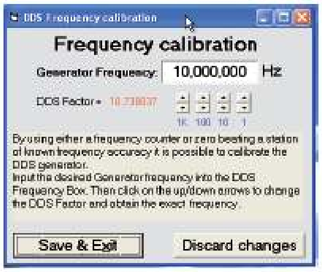


Fig. 1: Calibration of the direct digital synthesiser needs a known accurate counter for ease.

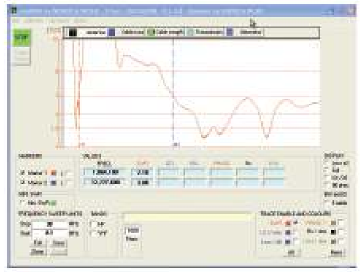


Fig. 2: The s.w.r. plot of my end-fed G5IJ antenna with its 20m long element.

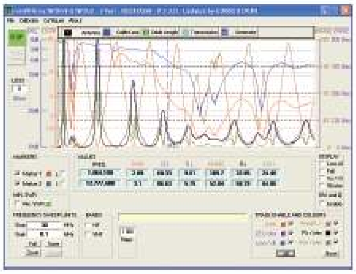


Fig.. 3: Looking far more complex, with all other parameters plotted for my antenna.

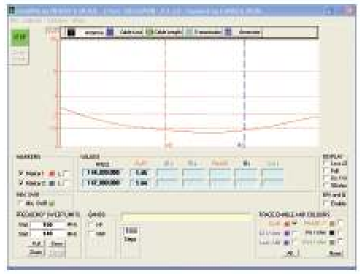


Fig. 4: The flat s.w.r. curve for an end-fed 144MHz antenna, when the tuning capacitor is set correctly.

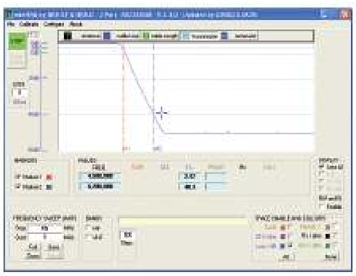


Fig. 5: The pass-band and stop-band characteristics of a low-pass filter suitable for use after a 3.5MHz transmitter.,

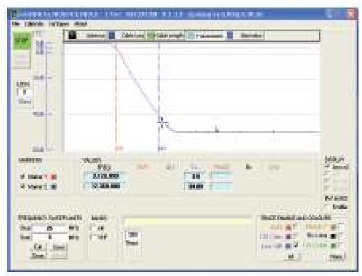


Fig. 6: The pass-band and stop-band characteristics of a low-pass filter suitable for use after a 7MHz transmitter.

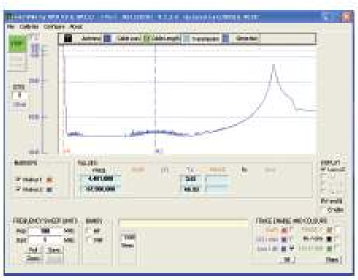


Fig. 7: a reduction in the stop-band performance at v.h.f. for the filter of Fig. 5.

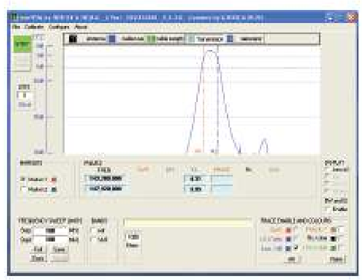


Fig. 9: A 144MHz bandpass filter for a v.h.f. receiver. There's rather too much loss for this to be useful at anything other than low power.

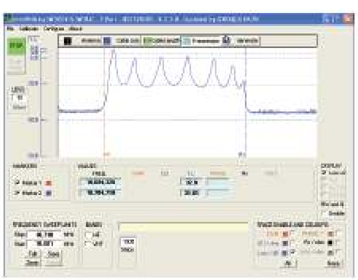


Fig. 10: Measurement of the bandpass characteristics of a 10.7MHz crystal filter, when feed from and into mismatched 50Ω terminations.

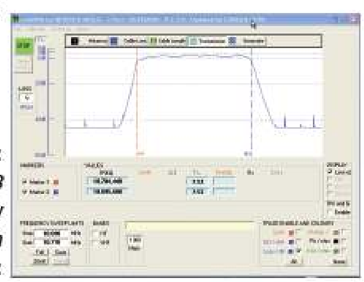


Fig. 12: Now looking much smoother. The spurious peaks and the -50dB signal limiting are due to the way that the miniVNA works rather than the filter.

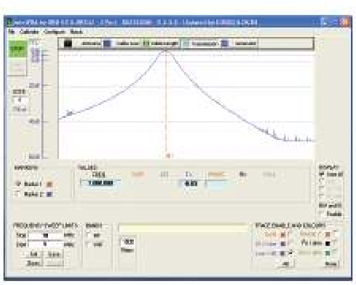


Fig. 13: Treating a 7MHz pre-amplifier as if it were a bandpass filter, after feeding its input via a 20dB attenenuator give this sort of curve.

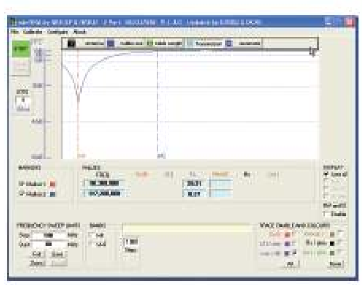


Fig. 14: A commercial v.h.f. notch filter gives a dip (tunable) of around -28dB at 87MHz and a poorer -18dB at 170+MHz.

Product: miniVNA Antenna Analyser

Pros & Cons

Pros: A superbly versatile unit that not only gives great information about antenna, but can be adapted to do many other functions and tests around the shack.

Cons: Portable only as far as you can carry a computer, but it should work well with almost any laptop.

Price: £219.95 incl. VAT

Supplier:
My thanks for the loan of the miniVNA go to the sole distributors
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