PRODUCT REVIEW

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AIM4170 Antenna Analyser

Chris Lorek falls in love with this versatile PC-based instrument

Photo 1:The AIM4120 is a compact size

Photo 2: Rear panel connections for DC power and RS-232

BACKGROUND. When I first started the hobby many years ago, I realised that an essential accessory to my shack was most certainly an SWR meter. This allowed me to keep an eye open for antenna problems as well as making sure my transmitter was given a good match to my antenna system. I still have that same meter now, tens of years later, and I still wouldn't be without one. When I started a new job around 18 years ago I was introduced to using a Hewlett Packard RF Network Analyser, costing over £30,000, to perform antenna systems tests with. How I wish I'd have been able to use one earlier, especially during the time I worked hard to invent an electronic automatic antenna tuning unit. What had taken me a significant time for a simple impedance measurement would have taken less than a minute, so that I could really see what my antenna system was doing. But haven't times moved on since then! As soon as I saw the AIM4120, I was immediately interested and I was pleased to be able to test one.

FEATURES. The AIM4170 antenna analyzer uses a small box containing the actual hardware, together with your shack or laptop PC for the 'user interface'. The system is designed to measure complex impedance (ie both magnitude and phase) across any selected range between 100 kHz and 170 MHz. The accompanying PC control program calculates the actual displayed parameters such as an SWR graph, Smith Chart etc, and plots the results onto screen in 'real time' either as a single sweep or as a continuous measurement. Results of each sweep can of course be saved for subsequent analysis and to compare results. Although most amateurs will use a nominal 50 ohms antenna and coax impedance, the analyser can make measurements up to 10 kilohms with 'true' measurements of inductive and capacitive reactance. You could thus use it to measure the resistance and reactance of discrete components such as capacitors and coils for homebrew projects.

As well as measuring these parameters at the physical point of the coax connector on the unit, a quick 'calibration' procedure can be performed with an open, short, and known resistive load, each at the end of any length of coax cable you're using; these terminations are usefully provided with the analyser. With this, the coax is 'normalised' out and your measurements are that of the actual antenna system itself which is connected to the end of your coax. It can also detect whether you have a cable fault, such as an open or short some way along the length, as well as the actual cable loss etc. If you can't get to the end of your coax easily, for example if it's up a fixed mast or tower, you can use the analyser to detect the electrical length of the coax from a phase measurement and use this instead, or indeed you can enter the coax length plus the velocity factor from manufacturer's figures.

In a nutshell, the analyser can measure and display in a linear/log graph or Smith Chart format:

- SWR referenced to any impedance
- Resistance and reactance at the cable input
- Resistance and reactance at the antenna terminals
- Resistance and reactance of discrete components
- Return loss
- Reflection coefficient
- Cable length
- Cable impedance
- Cable loss
- Distance to coax fault (open or short)
- Component and quartz crystal parameters

CIRCUITRY. Inside the unit, two digital synthesisers are used to generate the required test frequencies, along with bandpass filters to reduce the effects of external signals such as strong local RF signals from other transmitters which could corrupt your readings. A 12 bit analogue to digital converter is used rather than a simple diode detector, which gives far better linearity for more accurate measurements. Most SWR meters just use diodes. The internal RF generator can also be used as a local signal source, for example to check your receiver.

SIZE. The unit itself is compact, measuring 127 W x 40 H x 108mm D. A handy 'quick start' guide is provided along with a CD containing the complete user manual in pdf format, the operating program, and other files such as configuration data and a help file, Also supplied is a ready-made RS-232 lead and a set of small calibration loads terminated in suitable BNC connectors. A BNC to SO-239 coax adapter is also provided so that you can connect a coax terminated in a PL-259 plug to the unit.

POWER. The AIM4170 is powered from a 6-15V DC supply. A rear panel socket is provided for an external supply. There's

also enough room inside the unit if you want to fit a 9V PP3 sized battery. A diode circuit is fitted within the circuitry so that an external supply and any internal battery won't interfere with each other. The unit consumes around 50mA when switched on and around 250mA when a measurement is in progress. With the unit switched off, the current drawn is less than a microamp, and an 'auto power off' mode is available which can switch the unit off after 10 minutes of no commands being received from a PC.

IN USE. Units sold in the US come with a plug-in 110V AC to 12V DC wall supply, but many amateurs will already have a suitable 12V DC source in their shack. Having plugged in a suitable lead and connected up, I then just copied the files from the CD onto a sub-directory on my PC and clicked on the AIM_562.exe program, which set the system running. Then, with the RS-232 lead connected between the analyser and my PC, I just selected the correct comm port for my PC and I was in business. What could be simpler? If your PC doesn't have any RS-232 ports then you'll need to use an in-line RS-232 to USB adapter. I'm told that current releases of the program, version 564 onwards, have a "Find comm port" function to automatically scan for the correct port which makes things even easier. The system can itself be run from just the CD if you wish, eg for use round at a friend's shack. It's only when in 'calibrate' mode that files need to be written to the program directory (or even just a floppy disk if your PC accepts one). The latest software version (including user manual), which can be used in demo mode without the

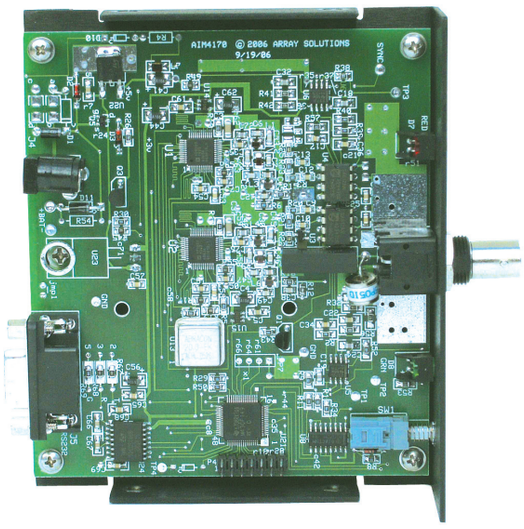
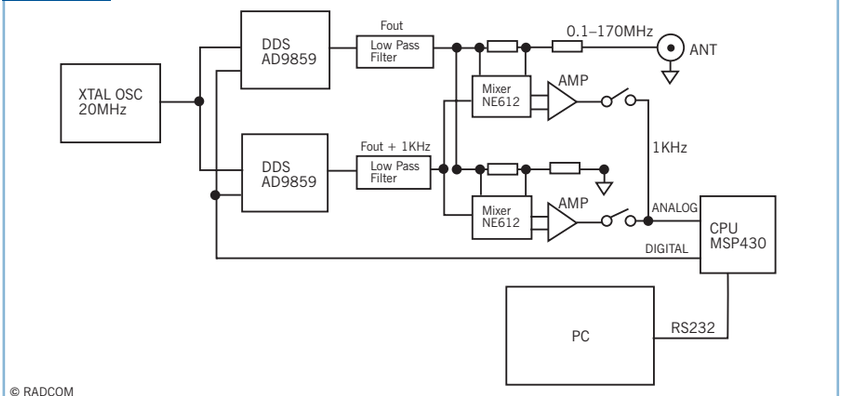


Photo 3: Inside the unit, a well-built layout with room for an internal battery

Figure 1: 2m antenna array VSWR plot

FIGURE 1



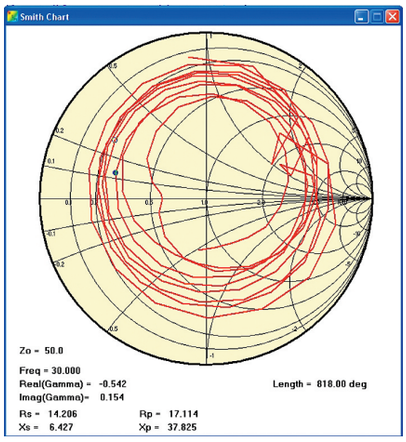


Figure 2: 80m / 40m trapped dipole Smith Chart Plot

hardware, can be downloaded from the manufacturer's web site at www.w5big.com/prog_update.htm.

I started with a simple check of my existing antenna systems for VSWR, although the analyser also showed me where the actual resonance occurred, which was often different to the lowest SWR! Using this, I managed to 'fine tune' some of my antennas, including my multi-band three element HF yagi of which I had originally tuned the traps, several years ago, simply for lowest SWR on each band. Resonating this correctly should of course have improved the front to back ratio as well as the forward gain and side lobe performance, a worthwhile time spent! Likewise on 2m and 6m, where I found my antennas were each a little 'out'. For longer term use, I stored the antenna coax parameters for each system to disc so that I could 'keep an eye' on what the ravages of weather could bring; the software could usefully superimpose either repeated scans, or a scan and a stored scan file, for me to compare.

For each scan, various graph colours are used for traces, which correspond to those along the vertical axis:

- Red – SWR
- Green – Magnitude of the Impedance
- Orange – Resistive Part of the Impedance
- Yellow – Reactive Part of the Impedance
- Violet – Phase Angle of the Impedance
- Blue – Return Loss

As I moved my PC mouse along the graph scale, the actual parameter values of each of these were shown on the display, eg the exact SWR figure etc, rather than having to try to visually read this from the graph display. The data can even be sounded out in Morse for visually-impaired amateurs. I could select either an entire spectrum such as 1.8-30MHz, any start and stop frequency, or individual pre-stored amateur bands, to measure across. Following a measurement I could store scan files as well as simply print out the scan onto a connected printer.

Beside using my mouse to select operational modes, several one-touch 'hot key' functions were available, for example to scan, rescan, enter new limits and so on. One handy function I used the analyser for during the review period was to make up a number of quarter-wave coax 'stubs'. These I'd use in line with my VHF system to notch out pager breakthrough on receive as well as reducing the level of 6m transmitter 2nd harmonics. Living in a rather RF congested area as well as a planned 'housing estate' village with over 100 amateurs within a mile radius, I quickly found myself popular with several neighbouring radio colleagues in offering a measurement service for their needs as well as general measurements!

I was impressed with the AIM4170, and checking the performance against a hardware-based laboratory calibrated RF network analyser showed no discernible difference in measurements across the operational range. The only difference was that the AIM4170 was rather more portable, especially when operated from an internal battery and linked to a self-powered laptop. Also, the other (rather more expensive) analyser when coupled to an external HF antenna system showed plenty of 'blips' from off-air signals, usually above around 6MHz, whereas the filtering in the AIM4170 in the same measurement situation completely got rid of these and thus gave a more accurate measurement. I was very happy indeed in using the AIM4170, so much so that I purchased it at full price following the review for the use of myself and my colleagues at my place of work for portable and off-site use.

The AIM427 is currently priced at £279 inc VAT and is distributed in the UK and Eire by Vine Antennas Ltd., Tel 01691 831111, who our thanks go to for the loan of the analyzer for review.

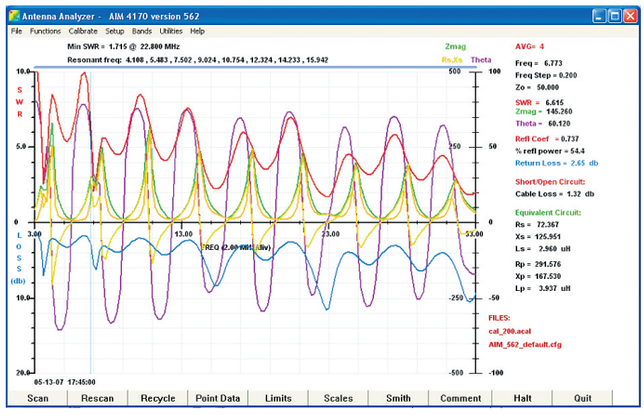


Figure 3: 80m / 40m trapped dipole VSWR plot, the coax length effects can easily be seen