VHF AM receiver

for tracing overhead line noise

For several months I had been experiencing random variable level wideband impulsive noise across the whole 2m band. This manifested itself at times as a strength seven continuous crackling noise. It reached a point where medium and weak FM signals were becoming unreadable. With a vertically polarised aerial there was no way of telling where it originated but with a horizontal Yagi it appeared to be coming from beyond the road at the front of the house. My QTH is within the Forest of Dean and in that direction there is a wide valley with only two houses, the nearest being three hundred metres away. Half a mile (1km) away, across the valley, is a small village and an industrial estate. As the noise was present outside of normal working hours, I guessed that the noise must be coming from one of the overhead 11kV or 240V lines that run in the valley.

I have several portable 2m receivers but all operate either on FM or SSB. With FM it was not easy to detect small changes in signal level; with SSB the noise was significantly less due to the narrow bandwidth filtering. So neither mode was suitable. Why not try AM? But who has a portable AM VHF receiver these days?

The 108-136MHz band is close enough to 2m (in wide band interference terms) so I thought I'd try an air band receiver. Trawling the internet for suitable devices, I came across several cheap air band AM receiver kits for around £10 to £20 – some of the more expensive versions come with a small aluminium case. Of these, some have a printed filter that does not need alignment. One site **[1]** included a schematic, after which **Figure 1** is drawn. Studying the original diagram, I could see an AGC line around the IF stage (LM358-2 in Figure 1).

PHOTO 1: **The modified kit with an edge meter. Left to right: Tune, Squelch, Volume and headphone socket.**

S-meter

The front panel has just enough room for a small meter to be mounted to show signal strength. I obtained an edge-reading 100µA meter from CPC **[2]** (order code PM11086) but any physically similar small meter would do.

The meter location is tight. For the meter I used, a slot 34x14mm is needed 3-4mm from the top edge of the panel and 13-14mm from the right hand side. Any greater distance from the top edge will cause the meter to foul the board components and the volume control knob. Too far right and it will foul the case; too far left will foul the LED.

The case in my kit was pre-drilled but needed fettling to properly align with the power connector. In my kit, there was no provision on the PCB to wire in a power switch or an LED indicator. Others may have this now.

Scribe the back of the panel to avoid spoiling the front and cut the slot for the meter before fitting the controls. The brackets that come with

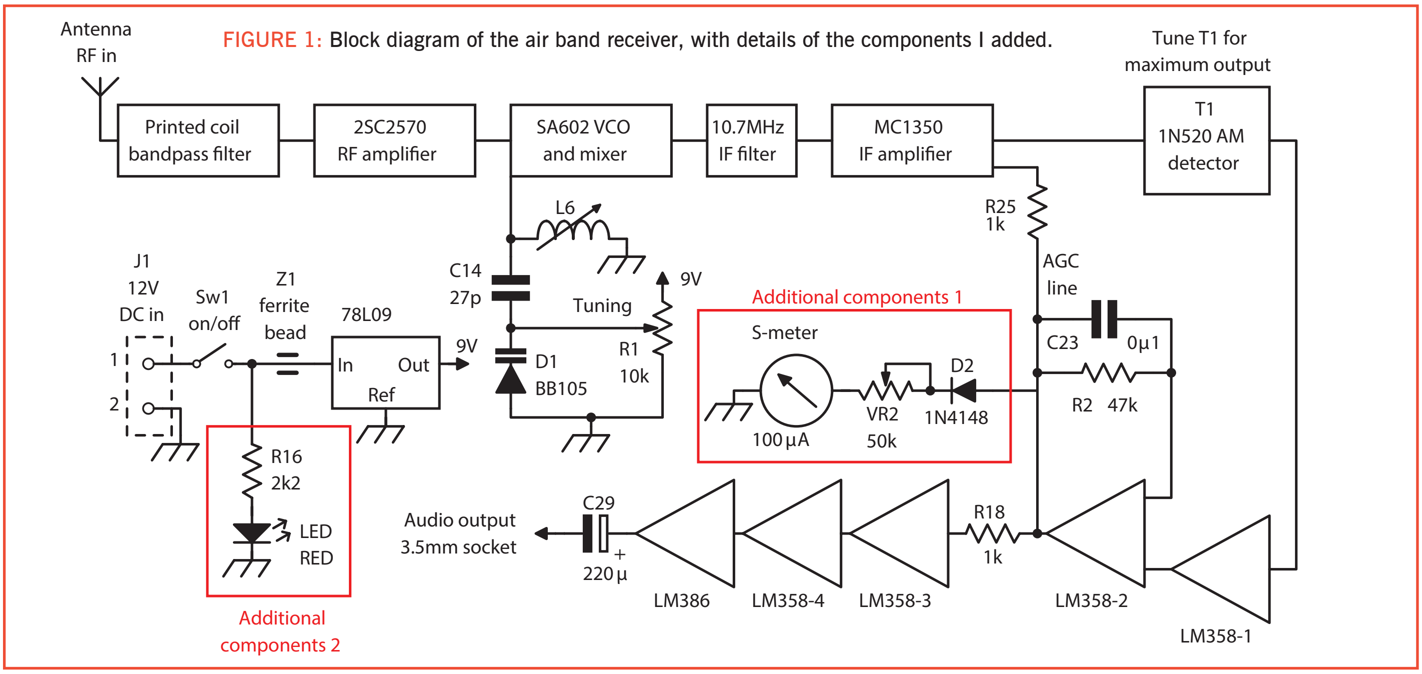

FIGURE 1: **Block diagram of the air band receiver, with details of the components I added.**

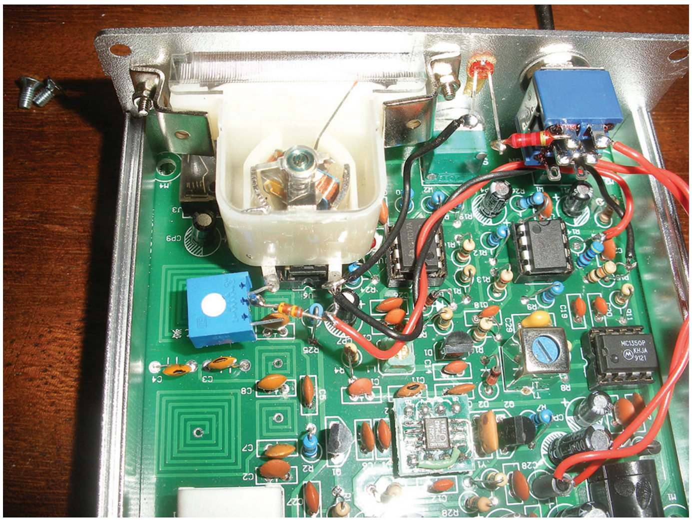

PHOTO 2: Behind the front panel. The meter, switch, LED, blue trimpot and associated parts are additions to the original. Note the meter fixings.

PHOTO 3: Using the receiver to trace the source of interference.

the meter need to be reversed, re-drilled (2mm) and fettled to fit. They are fixed with the two M2 screws supplied.

Depending upon the supplier some components may be labelled differently. There were small differences between my kit and the schematic. The ferrite bead was mounted between the supply connector and the voltage regulator rather than after the regulator as shown on the schematic.

Before the PCB was assembled, provision was made for the switch to be connected in the power line and for the LED indicator (with a 2k2 series resistor for 12V supply) to be fitted between the switch and ground. The ferrite bead (Z1) was used as the live take off point for the switch. I fitted some components (R16, R17 in Figure 1 – may be marked R14 & R16 in some kits) the wrong way around to the board legend to allow for the S-meter connection. On test after assembly I found that a silicon diode and a 50k trim-pot were required in series with the meter to reduce the AGC offset on no-signal and to limit full scale deflection on maximum signal. The S-meter, in series with a 1N4148 diode and a 50k trim pot, is connected between R16/18 and ground.

The kit is straightforward and can be put together within an evening. **Photo 1** shows the completed modified front panel.

In **Photo 2**, the 50k pot and diode are seen soldered onto the meter terminals. The AGC take off point is below the power switch. The LED and series resistor is wired from the switch and the supply comes from the ferrite bead at the lower right, close to the DC input jack. The printed input band pass filter inductors can be seen on the left side of Photo 2.

Adjustments

As designed, the receiver is intended to receive the VHF civil air band, 108-136MHz, though in reality the coverage extends to something like 162MHz. If you want to reduce the tuning range to be closer to (just) the 2m band you can replace C14 with a smaller value and tweak the VCO tuning coil (light green, centre of board, partly obscured by the red & black wires) to set the new range.

You will also need to adjust T1 (blue core, metal case, centre right of Photo 2) for maximum noise.

In use

I used a small 2m HB9CV-type beam with a short coax terminated in a BNC cable. This gave me the advantage of portability and directivity without too much encumbrance. I would have preferred to see a screened (metal) BNC socket on the receiver board but a plastic one was supplied, presumably for cheapness. You could replace it if you felt so motivated.

A small (4Ah) lead-acid battery provided the power; the current draw was about 40mA so battery lifetime is unlikely to be a problem. Audio output – which was more than sufficient – was fed to a pair of headphones via the 3.5mm socket. Any headphones will do, although if you're going to be out and about in an acoustically noisy place it may be a good idea to use an over-the-ear type to reduce the background level (but do watch out for traffic, which will also be quieter than normal).

I found that the receiver's RF sensitivity was quite good, with about a 3μV threshold. I could easily hear aircraft reasonably nearby, even with the antenna tuned for 2m. However, the image rejection is poor and the overall performance reflects the price. As the interference I was tracing was wideband, it was only necessary to tune for noise maximum rather than worry about what precise frequency I was listening to.

Using a tradesman's tool belt to carry the radio and battery (see **Photo 3**) made searching much easier allowing the use of both arms to hold the antenna and tune the receiver for maximum interference. **YOU MUST avoid <u>any</u> possibility of your antenna getting anywhere near overhead lines – the result could be fatal.**

I confirmed immediately that the noise was truly coming from the direction suspected. Setting off on foot I found that the 240V overhead line and nearby houses were not to blame; the interference was coming from further afield. After repeated taking of bearings and much tramping around the valley I found that the principal source was a set of two 11kV poles connecting to an underground cable, some 700m from my house. Under the poles the signal level was so strong that I could remove the antenna lead completely and just rely on signal leakage via the power and headphone cables. This allowed adjacent poles to be checked, where the noise was much lower – confirming them as not being at fault.

The noise was erratic and staccato in sound and varied from just detectable to strong almost independent of day and hour. In fact after long term logging of the S-meter readings at home I found that the noise generally vanished when it rained. After advising the electricity distribution company of the problem and supplying them with the pole number, the problem subsequently vanished.

Websearch

[1] www.Banggood.com/DIY-Aviation-Band-Receiver-Kit-High-Sensitivity (similar items are also available on eBay, Aliexpress etc)

[2] https://cpc.farnell.com/

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