efficiency and assessing your abilities as an operator. You don't have to be up there among the high scoring big-guns to have some fun, but if your are a regular contender in a particular annual contest then you will be able to compare current scores with your previous results for the same event. Did my new tri-band beam contribute to the higher score? Did the superior receiver on my replacement TS2000 make the predicted big difference this year? Were the many hours at the PC fine-tuning the EZNEC-designed antenna rewarded in practice?

The answers to such questions, and the honing of one's operating skills are among the benefits of contest operating. In addition, of course, is the personal satisfaction and fun we get out of active participation, rather then being bystanders.

John G3VLH

A Compact Active Wide-Band Receiving Antenna [Part 1]

Report by Derek G3GRO

The "Mini-Whip" active antenna described below and designed by PA0RDT offers a very simple constructional project capable of providing a good performance in the lower frequency bands from 10 kHz to at least 10 MHz

In a typical noisy urban environment, it can if suitably located, often provide a better signal-to-noise ratio than that received via the main transmitting antenna.

The Active Receiving Antenna

The active antenna usually falls into one two types, either a loop antenna sampling the magnetic field component of the signal or a short whip sampling the electric field. Both types normally having an integral low noise amplifier and impedance matching circuit.

There is good evidence to suggest that the magnetic component of interfering domestic sources such as TV line time bases tends not to be significantly confined within a building whereas the electric field tends to be significantly attenuated by the structure.

This can work to the advantage of the short whip if mounted clear of a building and reasonably high - say 20ft or so. The whip can also have a wide bandwidth without tuning but the consequence of this is that it needs to have a very good dynamic range. It needs to cope with the large range of signals emanating from long and medium wave high power broadcast stations through to short wave broadcast as well as things like MSF on 60kHz, the NPL standard frequency transmissions . This is where many active antennas fall down leading to phantom signals and cross-modulation.

I have in the past, tested several commercial designs including an ex-Decca navigator all of which showed signs of cross-mod. I have also tested test the AMRAD design published in QST (Ref.1) and more recently the PA0RDT "Mini Whip" described below. The latter design is simpler than the QST design and although my tests are not yet complete, seems to free of cross-mod and is marginally more sensitive than the AMRAD design.

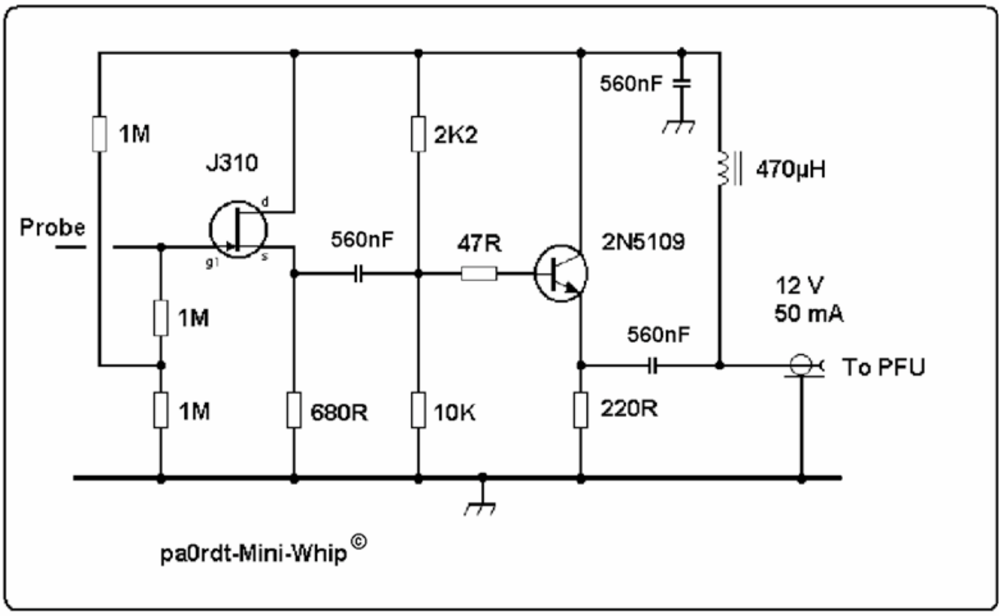
PA0RDT realised that rather than a whip, a very short, but relatively wide strip of copper-clad PCB material, will work just as well as a whip leading to a very compact design with the simple interface circuit mounted at one end of the copper strip.

An extract of PA0RDT's original technical paper is given below. This will be followed in Part 2 of this article by some suggested variations to the design of the power supply feed circuit aimed minimising the risk of noise arising from earth currents.

Part 2 will also include a discussion of test results taken in situ at the G3GRO QTH.

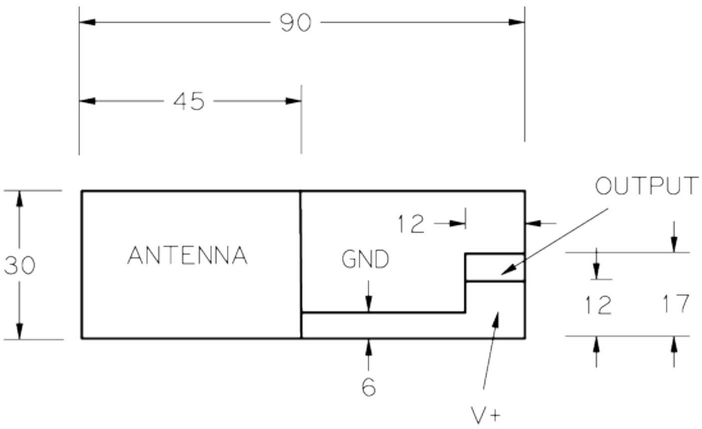
cont.

Circuit diagram of the *pa0rdt-Mini-Whip©*.



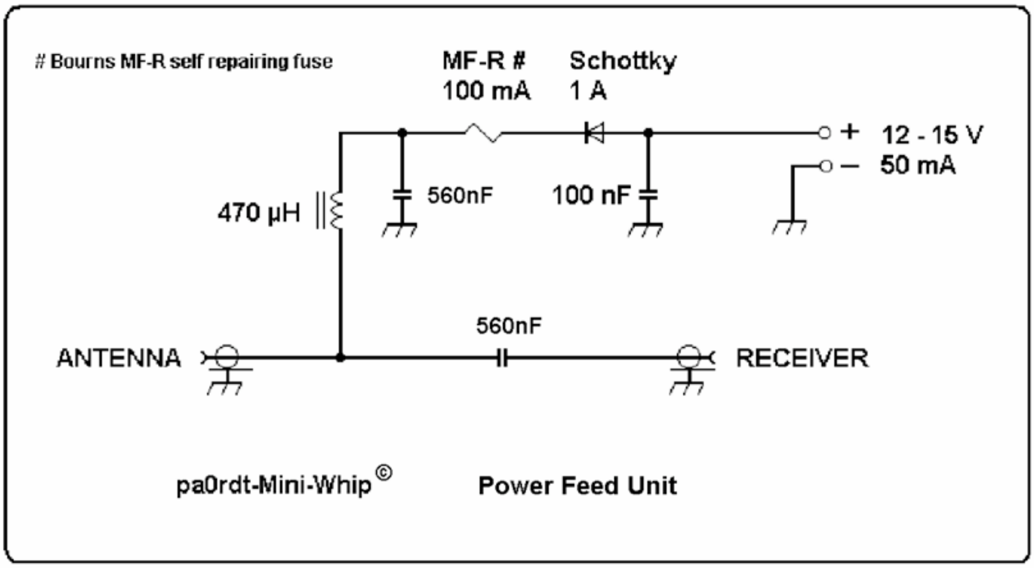
Construction.
The ***pa0rdt-Mini-Whip©*** uses commonly available materials. A single sided printed circuit board is mounted inside a 10 cm long piece of 40 mm drain pipe (white), using end-caps. One of the end-caps carries an insulated BNC connector onto which the PCB is soldered. Half of the PCB is the actual antenna; the other half contains the buffer-amplifier, using "Amateur Surface Mounted Construction".

PCB-layout.



The traces are cut using a Dremel tool.

Power Feed Unit circuit diagram.



Power is fed to the ***pa0rdt-Mini-Whip©*** via the coaxial feed line. A Power Feed unit couples the power trough the coaxial feed line to the ***pa0rdt-Mini-Whip©***. A second coaxial cable couples the signal to the receiver.

Installation is straightforward:

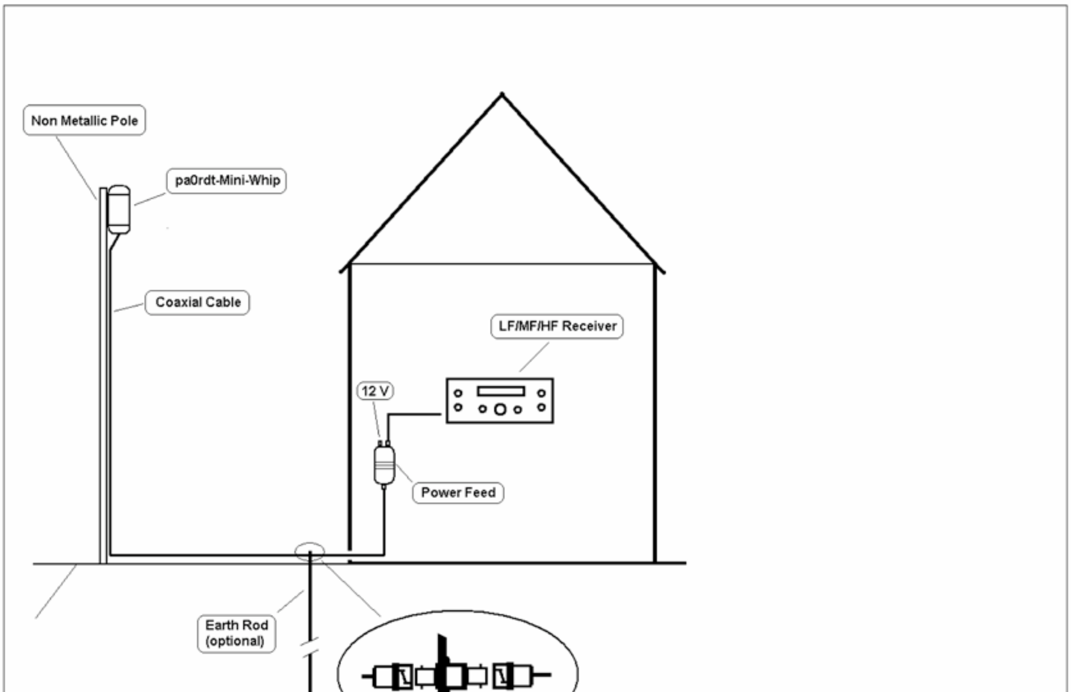


Figure 2

The PA0RDT Active Receiving Antenna (Part2)

Previously in Part1 of this article, the design of a compact wide-band active antenna by PA0RDT, the "Mini-Whip" was described.
In Part2 below, a variation on the original circuit is suggested together with some practical on-air performance data.

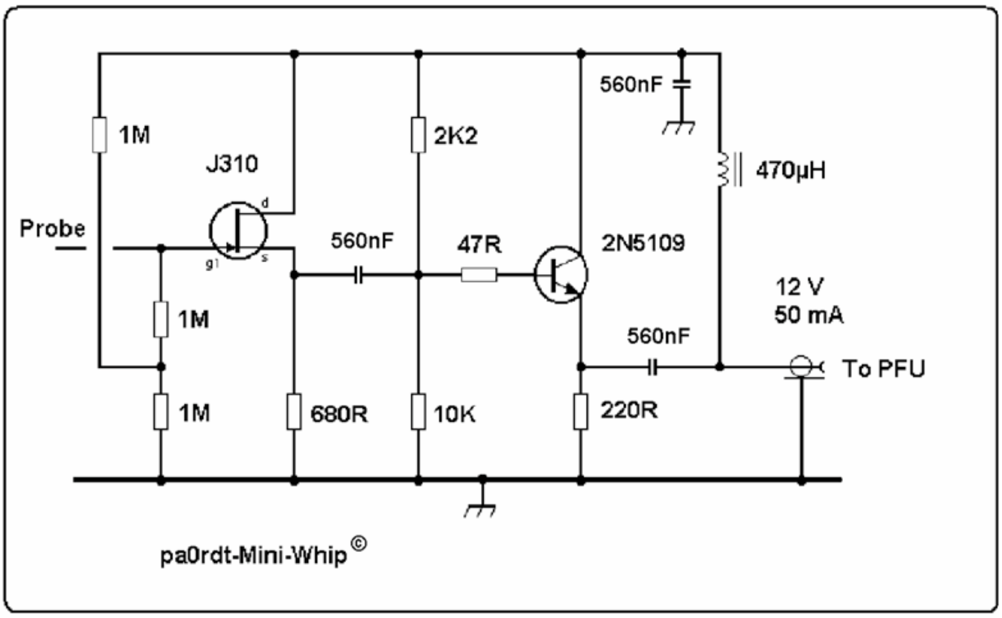
The most common application of the active receiving antenna is in the lower frequency bands from10kHz up to 10Mhz. where if it is well sited, it can often provide a better signal to noise ratio than a longer wire antenna under conditions of local domestic noise.

The circuit diagram of the RF section of the mini-whip which was previously shown in Part1 of this article is repeated again above to save referring back to the original.

The RF input from the printed circuit probe is coupled into the gate of a low-noise J-FET device, the J310 which has high input impedance and is operated with a moderately high drain current, providing a good dynamic range necessary to cope with the large number of signals it will see at the input. The output signal is coupled from the source of the J310 into the base of a 2N5109 emitter-follower output stage. The output of this stage is designed to drive up to 100m of either 50 or 70 ohm coax to the input of DC Power Feed unit which would normally be located in the shack. The output of the latter in turn is connected by a second coax to antenna input of the receiver.

PA0RDT suggests an antenna probe length on the circuit board of 45mm. At the moment however, I have opted for a somewhat longer probe length of 100mm in order to obtain a slightly higher sensitivity. Caution is necessary in extending the probe length so as to avoid overload and resultant spurious phantom signals appearing. The best place to check for this is in the region of 350 to 450kHz. and if weak broadcast stations can be heard in this part of the spectrum which is in the MF beacon band, then that's a sure sign of spurious mixing products due to overload..

Circuit diagram of the *pa0rdt-Mini-Whip©*.



PA0RDT Power Feed Unit

(See Fig2 overleaf)

The function of this simple unit (normally located in the shack) is to couple +12-15V DC via a 470uH RF choke into the coax running up to the Mini-Whip. The incoming DC supply being first decoupled to ground via 100nF and 560nF capacitors. The incoming signal from the active antenna is fed via a 560nF DC blocking capacitor to the receiver via a second coax cable

Modified Power Feed Unit

(See Fig3 overleaf)

Practical experience at the G3GRO QTH has shown that on noisy urban sites, noise pick-up on the outer braid of the coax from the remote mini-whip can be a significant problem.

Firstly it is strongly recommended that the outer braid of this coax should be connected to an earth rod reasonably close to the base of support pole of the mini-whip as indicated by PA0DRT in Part1 of the

Fig 2 Power Feed Unit circuit diagram.
PA0DRT Version

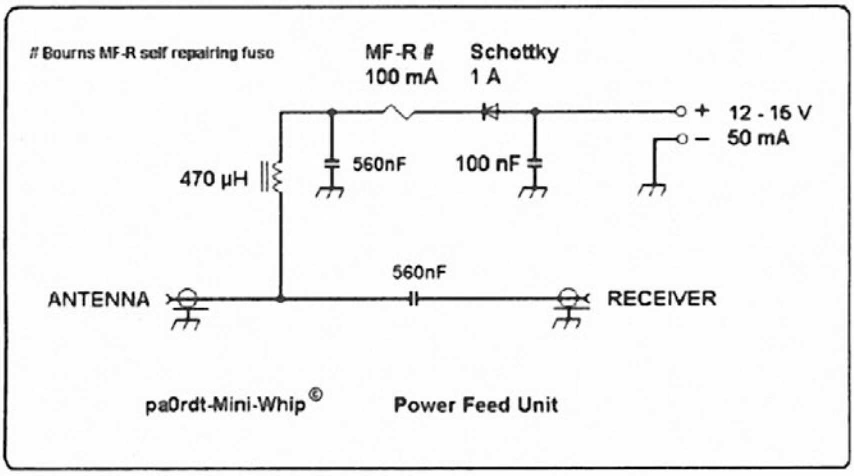
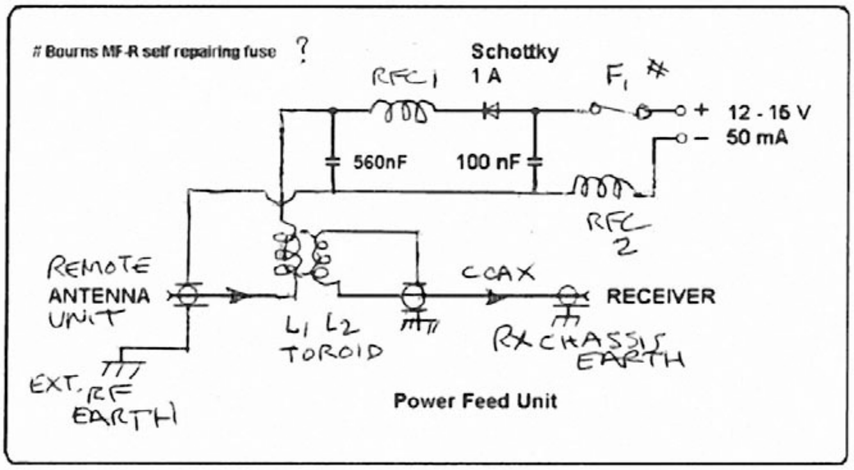


Fig 3 Power Feed Unit circuit diagram.
Modified G3GRO Version



article in which he suggests making an earth connection via a back-back panel-mount BNC in series with the coax.

Secondly, a modified version of the Power Feed Unit is suggested which incorporates a "braid-breaker" in the form of a bi-filar wound toroidal transformer with a 1:1 coupling ratio inserted in the coax down lead from the Min-Whip. This helps to suppress noise currents flowing in the outer of the coax induced by pick up of local "hash" and "bleeps and bloops" etc from TV and switched mode PSUs etc on the 80 and 160m bands in particular,.

. I have also found that it is also a good idea to insert RF chokes in both the +ve and -ve leads of the DC PSU input to suppress noise which may get into the RX by that route. .

The modified version of the Power Feed unit is shown in Fig.3. The toroid L1-L2 is wound on a FT82-43 ferrite core or similar with 8 turns of #26swg enamel wire or similar on both primary and secondary.

The RF chokes L1& L2 which I used in the supply lines were 470mH (not critical in value -.there are still some of these in the CARC component drawers!). Other bits and pieces such as J310 etc. can be obtained from Sycom Ltd.

Siting

In order to get the best performance from the active antenna, one should aim to mount it at least 25 to 30ft above the ground if possible and some distance away from the house to avoid it being shadowed by the building as shown in the diagram in Part1 of this article.

PA0RDT suggests mounting the Mini-Whip on a light weight non-metallic pole but since the coax braid running down the support pole already forms a vertical conductor to ground, I do not think however that this is important - providing that the last foot or so of the support is non-conducting. Alternatively, ensure that any metallic support does not overlap the probe section of the antenna thereby effectively screening it . As indicated in Part1, the coax braid should be earthed to a ground rod close to the base of the support pole.

An alternative also worth considering is to mount the antenna on a short piece of plastic pipe at one end of the apex of the roof but away from any TV antenna.

The height above ground of the antenna

makes a considerable difference to the antenna effectiveness as can be seen in the graph shown below of the relative signal strength received from the German utilities transmitter DCF39 on 138.8kHz. This provides a stable reference over the measurement period. It will be seen from the graphs that over a height range of 20ft the signal increases by around 20dB (100 times in power). The graph also shows that at low heights, the received signal is about 6dB weaker when the antenna support is moved closer to the house. In this position, the antenna is also more likely to pick up electrical noise thus making the signal to noise even worse. As the antenna height is increased, so it starts to move out of the "shadow" of the house structure and the screening effect disappears and the slope of the increase in signal strength with height graph gradually flattens off.

The signal strength versus height graph was plotted on VLF at 138.8kHz on the signal from DCF39 because that was a region of particular interest but it is considered likely that a similar variation of received signal versus antenna height would also apply over the HF bands.

Antenna Bandwidth

The frequency coverage of the Mini-Whip was checked by coupling in signals from a signal generator via a 5pF series capacitor directly into the antenna strip on the circuit board. These measurements showed that the transfer characteristics from the high impedance input of the antenna through to the low impedance coax output connector was essentially flat to within around +/-3 or 4dB from 100kHz to 30Mhz

The frequency of 100kHz was the lower limit of the signal generator and FT1000MP receiver being used to carry out the measurements but on-air tests showed that the sensitivity of the active antenna extended all the way down to below 20kHz,

On-Air Results.

Comparative tests were carried out at various times between the signals received from the active Min-Whip antenna mounted at around 25ft AGL at one side of the garden and the same signal received from a multi-band windom antenna up at around 40ft AGL running down the other side of the garden some 40ft away to minimise possible cross-coupling .

Signal comparisons were made on a number of bands from VLF through to14Mhz. The tests showed that the Mini-Whip antenna has a very respectable performance up to at least 10Mhz.

The signal strengths received on the active

antenna were typically one or two S- points below that received from the Windom but with a signal to noise ratio generally at least as good and often better than that from the windom antenna. Unfortunately the HF band conditions were very disturbed during the period of the signal comparison tests with signals being received on 14Mhz and above being very weak even on the Windom which made comparison difficult. Further test are planned.

On VLF, one indicator of the good Mini-Whip antenna performance at LF was that I could detect during daytime, the pulse sideband interference spreading from the 100kHz Loran stations up to the136kHz band which normally determines the minimum detectable amateur signal on this band but which is often masked by local electrical noise.

In summary, a well sited Mini-Whip active antenna can I think offer a very useful general purpose receive facility especially on 80 and 160m and could probably out-perform a typical multiband vertical antenna on those bands.

One final suggestion of a possible application of the Mini-Whip would be as the second receive antenna in a QRM canceller system such as the MFJ1025 to null out a persistent noise QRM source which is located outside the boundary of the home QTH. [I have a MFJ269 if anyone wants to try it]

Have a go - Put Stanley knife to circuit board and carve out a mini whip!!
73, de Derek Atter, G3GRO