

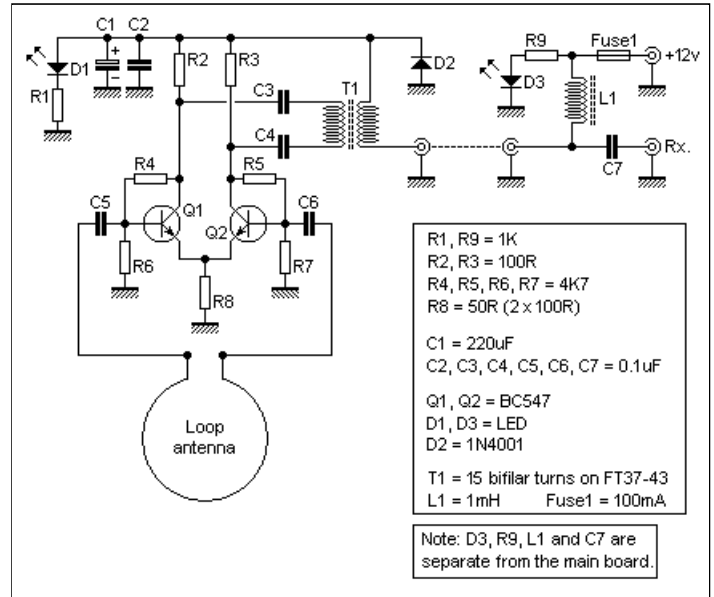
HF Active Loop Antenna

Introduction:

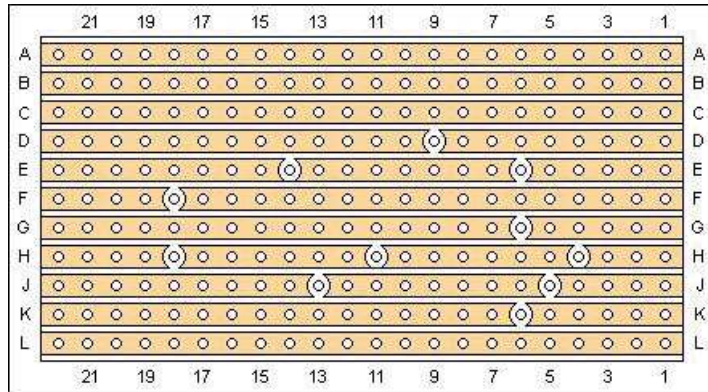
An antenna which requires no resonant tuning over such a wide range and with a performance equal to a high-gain beam antenna is almost a dream come true. And being that its overall size is relatively small means that this antenna can be installed in most any attic or postage-stamp-sized garden.

The shape does not necessarily need to be a loop. In my case the final version was installed in the attic, which follows the pitch of the roof and co-ax fed at the bottom, thus making a diamond shape. Each leg of the diamond is approximately two meters in length, but these dimensions are not written in stone. It could be a triangle shape, or maybe even a square. It all depends on the amount of space you may have available.

A loop antenna is highly directional. The signal is strongest when either node is pointing towards the transmitting station. Conversely, the loop also has two null positions at right angles to the ends. Careful positioning of the antenna can null-out annoying interfering stations while at the same time receiving just the station of interest. In my case I found that the best position was for the loop to be facing in a NE/SW direction. This gave the best signal-to-noise ratio versus nulling-out unwanted interference.



Construction:

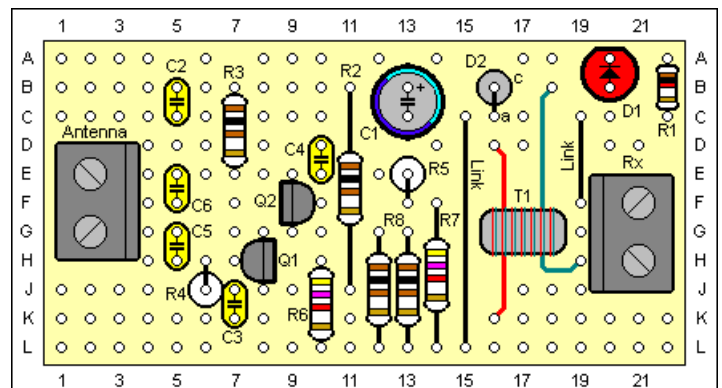


Begin by cutting a piece of Veroboard, 22 holes x 11 tracks (fig.1).

















Flip the board track side up and make 11 breaks at the locations shown. You can use a 3mm or 4mm drill to do this. In order to get the correct orientation, note that location A1 is at the top-right corner.

Before you start you might want to familiarise yourself with the components shown below. Compare them with how they look in figure 3 on the right. There is no order of preference of soldering but you might want to check the polarity of the electrolytic capacitors and all semi-conductors. Check also the primary (red) and secondary (green) windings on transformer T1.

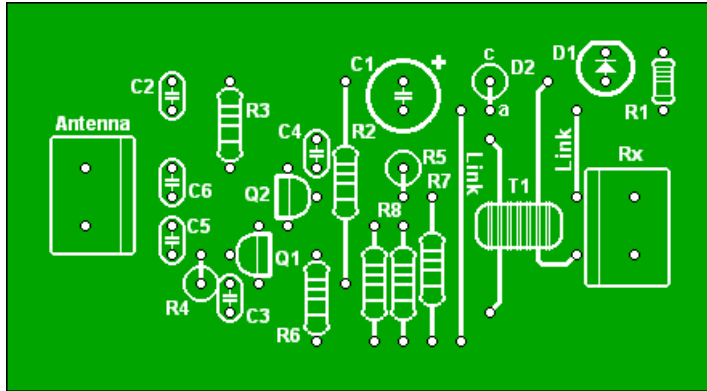
(Note that location A1 is now at the top-left corner).



- Q1 Emitter is at location G8.

	Horizontal resistors 		Vertical resistor 
	0.1uF capacitor 		220uF capacitor 
	Vertical 1N4001 diode 		LED (Cathode denoted by flat) 
	BC547 NPN transistor 		FT37-43 toroid 

- Q2 Emitter is at location G9
- The positive leg of C1 is at location B13.
- The LED cathode (denoted by a 'flat' on the body) at location A20.
- D3 cathode is at location B16; anode at C16.
- Solder the toroid primary and secondary windings where shown.



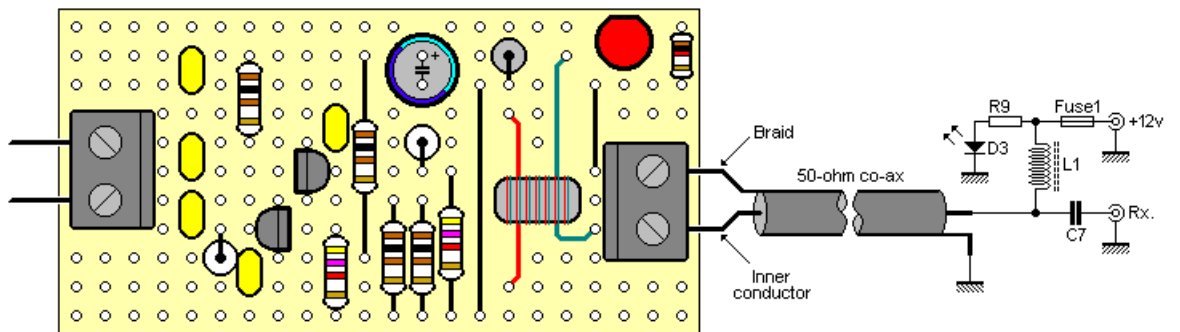
Probably a neater way of doing it would be to paste a parts-placement overlay to the board first. It's just a matter of then stuffing all the components where they are shown. Although aligning the overlay to the board can be a bit tricky, there are perhaps two advantages:

1. Reduces the chance of soldering a component in wrong location.
2. Gives the board a neat PCB-type appearance.

A detailed 'how-to' can be found further down the page. See "Doing it the easy way".

Off-board connections:

Connect the inner conductor and braid as shown in the sketch. Since 12v dc is present on the inner conductor, diode D2 is there to protect the amp if you should get the connections wrong. You will know if this is the case because the LED will not glow, indicating that the fuse has blown.





More about transformer T1:

Nothing critical to worry about here. The toroid doesn't necessarily need be the one specified. You can use just about any ferrite toroid you might have available (even a small length of ferrite rod). Neither too is the amount of turns. What is important is that the primary and secondary winding are both in phase. To do that you simply wind two lengths of enamelled wire through the toroid, in the same direction, at the same time. You will need to know the start and ends of each wire, and you can do that by checking for continuity with a multimeter. An even easier way would be to use two different wire colours.

I used 20-gauge wire, which allowed for roughly 18 or 19 turns on a FT37-43 toroid. You might want to use a thinner gauge and dial on a few more windings for a slight improvement to sensitivity on the lower frequencies.

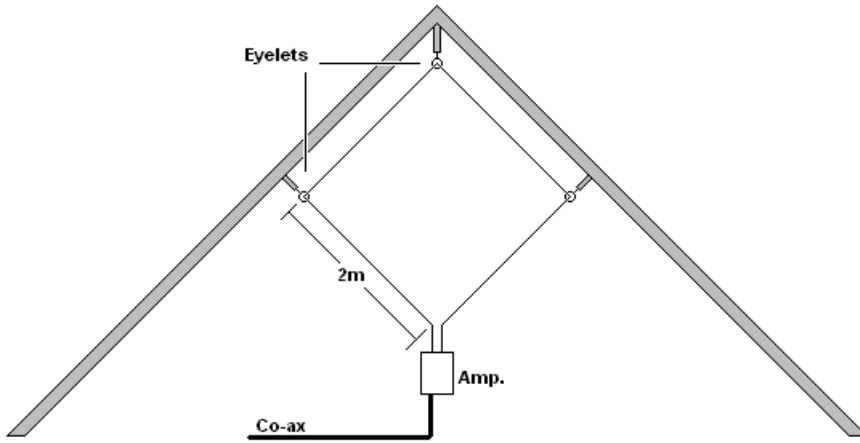
The 12v supply:

The amplifier will work from around 6.5 volts. It can be powered from its own local battery, or even a separate 2-wire supply from a source back at the receive end. An easier alternative is to send the dc source up the co-ax feeder: 12 volts at the receive end is sent into the inner conductor of the co-ax via the 1 millhenry choke, L1, then onwards to the remote amplifier. Capacitor C7 allows only ac signals from the amp, while at the same time blocking 12v dc getting into the receiver's antenna socket. The 1mH choke blocks any ac, allowing just the dc content to reach the amplifier.

I was lucky in that the power plug on my receiver made it easy to tap a 12v supply from. Otherwise, any standard wall-wart adaptor, 12v @ 70mA, would be a handy power source.



Attic installation:



No rocket science here, I simply screwed three eyelets in the rafters to give an approximate diamond shape. Since my house is facing due N/S, the eyelets were placed that the direction of the loop is pointing NE/SW.

Being that the loop is directional meant that a compromise had to be found between the best signal-to-noise ratio of the stations I want to hear versus the minimum local receive noise. Pointing the loop in a NW/SW was found to give the best overall balance.

Local receive noise is usually defined as anything man made. Most all electrical appliances generate unwanted RF noise - including electrical wiring. So to counter the chance of receiving unwanted noise I made sure to keep the co-ax feeder and the main loop away from all mains cables.





Performance:

I initially started with a small hand-held 3-foot diameter loop. Even with a loop that size, the performance was far better than that of the 21-foot vertical antenna. Spurred on by such amazing results, I then tried the attic loop. And that was when the receiver really came to life. The MSF signal on 60kHz is usually too weak to move the S meter, but with the larger loop it's now registering S2 and a much improved S/N ratio. Even a low power AM station transmitting just one watt from over 11 miles away is coming in 5 / 9+10dB.

The only downside to such a sensitive antenna is that I get a couple of image signals where they shouldn't be. For instance, a strong AM station on 909kHz is a massive 30dB over S9. Its image is on the low end of the 160m amateur band at 1818kHz - S6. Also another weak AM image on the lower end of the 20m amateur band. Fortunately, both images are mostly inaudible with the 20dB attenuator switched in.

Acknowledgments:

Special thanks to [M0AYF](#) for the initial idea.

Even though it suffers a couple image signals, the loop antenna has so far out-performed all other indoor antennas. I thought that the roof itself might have attenuated any signals, but that doesn't seem to be the case. M0AYF has planted his loop at the bottom of his garden, away from any household electrical noise... which would be the ideal location. But for those unable to have that luxury, the attic is the next best alternative.

Note also that M0AYF has tacked a heatsink to each transistor. In reality the transistors run nowhere near as hot as I was expecting. In fact, I omitted the heatsink altogether and the transistors have been running constantly without anything ugly happening so far. However, the circuit board has been designed that it's possible to wedge a small aluminium plate between Q1 and Q2. Squirt a blob of hot-melt to keep each transistor firmly against the plate.

Finally...

Doing it the easy way:

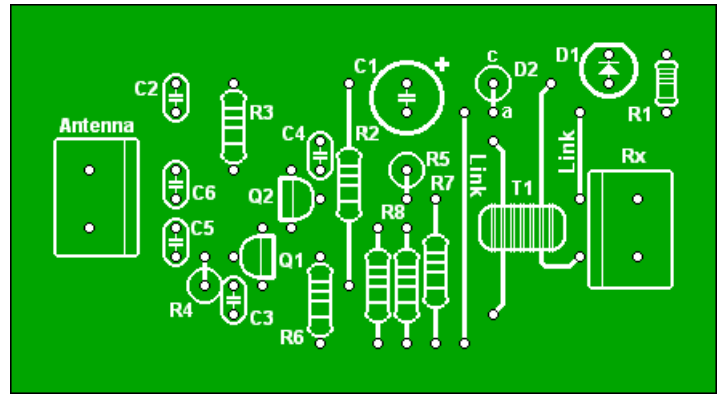
The image shown on the right is obviously too large in the real world. It has to be reduced in size first. So once you've copied it to your drive, and in order to have the printout match the actual board dimensions, you need to set your printer reduction to 54%.

When you get your first printout, hold it, and the board, against the light, then align the holes nearest the corners. If you're lucky they should be pretty much spot on. If not, try adjusting your printer setting just one per-cent plus/minus either side. It's a case of trial-and-error for each individual printer. But starting with 54% will put you in the right

numbers.

Once you're armed with the correct setting, make a final printout on gloss photo paper. Roughly trim it to size, but leave approx 5mm around the perimeter. Paste the board and the printout with Pritt-Stick, then align / stick them together. Try not to get glue on the printed side, because it sticks like you-know-what and looks pug-ugly. Trim off the excess overhang.

Pushing them skinny legs of resistors, etc, through plain-paper overlay is easy. Pushing them through gloss paper isn't. Jab a needle through there first.



Right-click the image, then 'Save Picture As...'

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