Brickworks: IVARC Project

Getting started with an HF antenna

by

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It all seems very complicated and difficult!

- This idea arises because of what is done to optimise or specify given special objectives
- If current flows in a wire above say 15kHz the wire will radiate!
- So, it is a transmitting aerial or antenna
- If an electromagnetic field cuts an aerial it will induce a voltage into it!
- So, it is a receiving aerial or antenna
- It is as simple as that!

How does this relate to aspiring Radio Amateurs?

- Given that they will need a TX/RX aerial/antenna the questions are:
- How big is it? (how long is the piece of wire?)
- Where can I put it? Space is often a factor, also layout of property
- Visibility? My spouse is not keen
- How do I make it ?
- Is there a ‘best bet’ type that IVARC recommends and supports?

Some answers, not necessarily in the above order! (apologies to Morecambe&Wise)

- The IVARC supported designs are:
  - The **end fed half wave** on 40m, (66ft long gives 4 bands (40/20/15/10 with no ATU)
  - The **trapped half wave dipole** -overall 66ft long with two 20m traps (gives 40/20 with no ATU)
- Both the centre fed trapped dipole and the end fed are simple and effective multi-band aerials
- They will get you on the air quickly, easily AND CHEAPLY

MYTHBUSTERS
(Apologies to the TV testers)

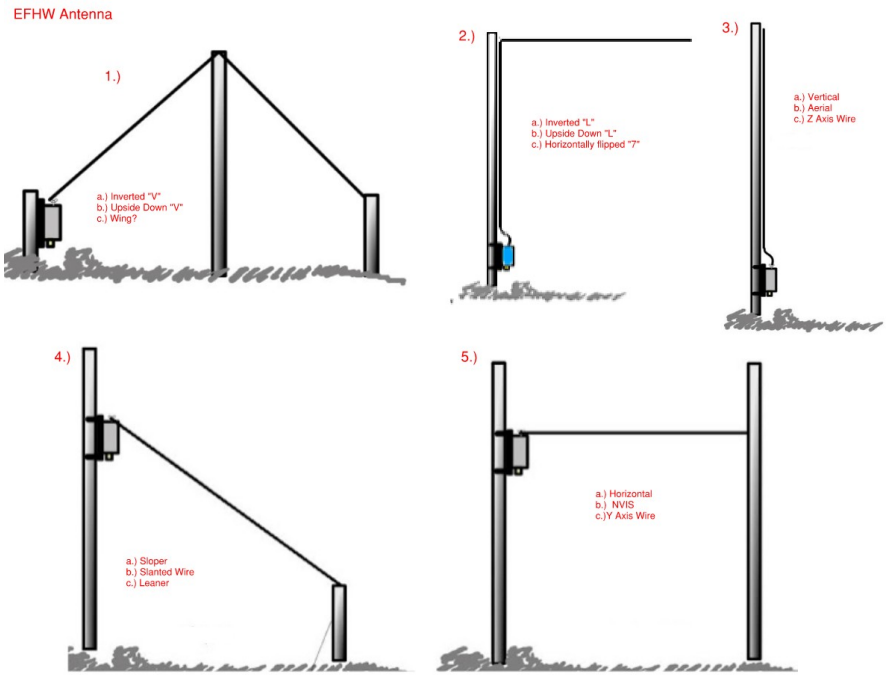
- Antennas have to be resonant – Nonsense, remember page one! Resonant antennas work naturally best on one or harmonically related frequencies and as such do not need an Aerial Tuning Unit (ATU), Since they offer a centre feedpoint impedence close to that of the feeder at those frequencies.
- An ATU tunes the antenna – And a steamroller rolls steam! An ATU is a matching device that matches the antenna impedance to the feeder over a large range and is used when antennas are not resonant (max power is transferred between matched txvr and antenna then) ‘ATU’ is a misnomer!

MYTHBUSTERS (contd)

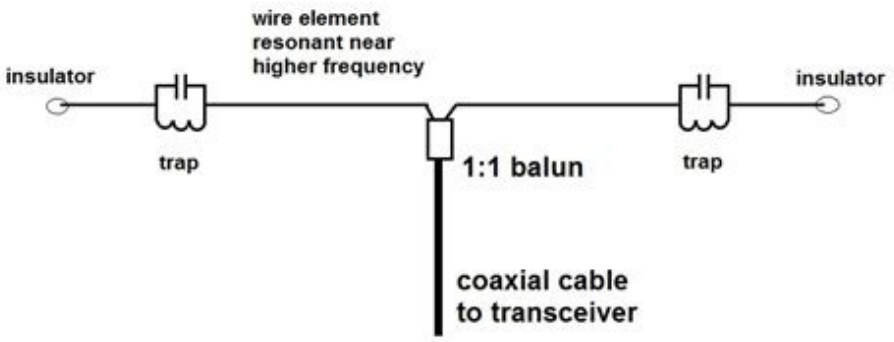
- There are ‘miracle’ antenna designs. I’ll get one!– Nonsense, Physics will not be defied! To start with, just build your own antenna.
- Antennas should never be bent - I disagree. Do what you have to, it is unlikely to stop your antenna working.
  - However make sure people can’t reach high voltage ends -check you comply with EM radiation rules (checking program on RSGB site)
- Antennas have to be half a wavelength high. No.
- Aerials as low as 10 or 12 feet (3-4m) can work OK (you’ll have lots of QSOs)

The IVARC project Antennas:The EFHW

- 66ft/20m long- still too long? Then bend it!
- Works on 40/20/10
- Need not be fed at end of the garden!
- Many mounting options
- Feed end 49:1 transformer



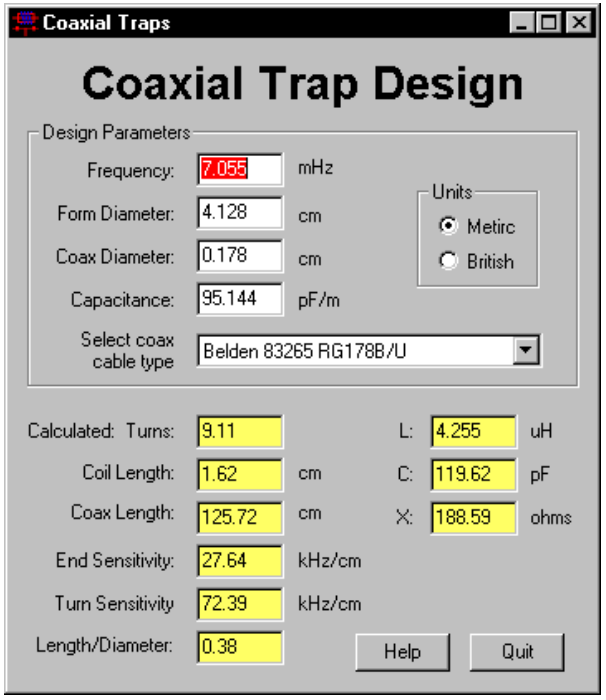
Two band Dipole



- Works on 40/20m (7/14MHz)
- 66ft/20m long – too long? Then bend it!
- Need not be high and could slope down at the ends – double slope (inverted V)
- Traps easy to make
- Centre fed

Components – Make or even Buy

- Dual band dipole
  - Wire!
  - End insulators
  - 2 traps*
  - Balun** (when coax fed)
  - *easiest made using coax and waste pipe!
    - 85mm of 40mm diameter poly waste pipe and 8 turns or so of coax
    - https://www.qsi.net/ve6yp/coaxtrap.html
    - ** and ***more later but the transformer matches the high voltage low current feedpoint to the 50 ohm feeder



Components (contd)

- End Fed Half Wave
  - Wire!
  - End Insulators
  - 49:1 transformer

Antenna choice,deployment or configuration

- This will depend on:
  - Property Size
  - Property Layout
    - Where is the house within the plot
      - In the middle or nearer an end
      - Small front garden, large back garden or vice-versa etc
      - Close neighbours or not?
      - Orientation and shape of plot

Antenna choice and deployment (contd)

- The HF antenna project offers two options:centre fed and end fed. This to help in deploying the antenna efficiently and elegantly to suit the site.
- If bending is needed to fit, consider:
  - A ‘V’ shape* (one bend in the middle), both designs will do this
  - Sloping* (again one bend but nearer the feed end)
  - Two bends each nearer the termination ends
  - Bending can be in any plane (horizontal,vertical,sloping) create what fits in best
  - * require only a single support pole or equivalent

    Just remember: the termination end is a high voltage point for both designs and should be unreachable by anyone or made inaccessible and also comply with EM safety rules

Antenna choices and deployment (contd)

- Antenna wire can be coated, if so colour choice can help with ‘stealth’ - Brown or Green are considered best in the UK!
- What about support poles?
  - Fibreglass; Carbon Fibre; Aluminium
- What about feeder?

Support Pole, Coax and Proximity considerations

- Poles

  Metal poles are conductors and thus if close to the antenna wire or running parallel will have currents induced and contribute ohmic losses. Not therefore the best option.

  Fibreglass and Carbon are non-conductive. Fibreglass is cheapest and Carbon is strongest but relatively expensive.

- Proximity

  Try to avoid the antenna wire being close to properties,foliage; or trees. All absorb RF energy. Buildings may absorb energy (depending on materials) but radiation polar diagrams and VSWR are affected.

  Note: Proximity causes greater or lesser losses and characteristic to change but the antenna will still work!

Coax feeder options

- Project recommendations:
- RG58, around 45p/m, loss around 2.4 dB/m* at 28MHz

  OR for lower loss
- Mini 8, around £1/m, loss around 1dB/m* at 28MHz
- RG213 around £1.50/m, loss around 1dB/m* at 28MHz

  RG213 is much thicker/stiffer and has a large minimum tuning radius

  *per 100 feet (30.48m)

Coax Loss Chart dB per 100 Feet

	RG-316	RG-58	RG-8X	LMR-240	RG-213	9913	LMR-400	Bury-Flex
3.5 MHz	1.5	.8	.65	.45	.3	.23	.2	.26
7 MHz	2.1	1.2	.85	.64	.5	.32	.3	.37
14 MHz	3.0	1.7	1.21	.91	.7	.46	.5	.53
28 MHz	4.2	2.4	1.74	1.29	1.00	.65	.7	.75
50 MHz	5.6	3.2	2.36	1.73	1.40	.88	.9	1.00
144 MHz	9.6	5.5	4.20	2.95	2.40	1.54	1.44	1.73
440 MHz	17	9.9	7.92	5.23	4.40	2.818	2.7	3.08
2400	41.4	24.8	22.80	12.65	12	7.48	6.6	7.63

www.qsradio.com

Commissioning

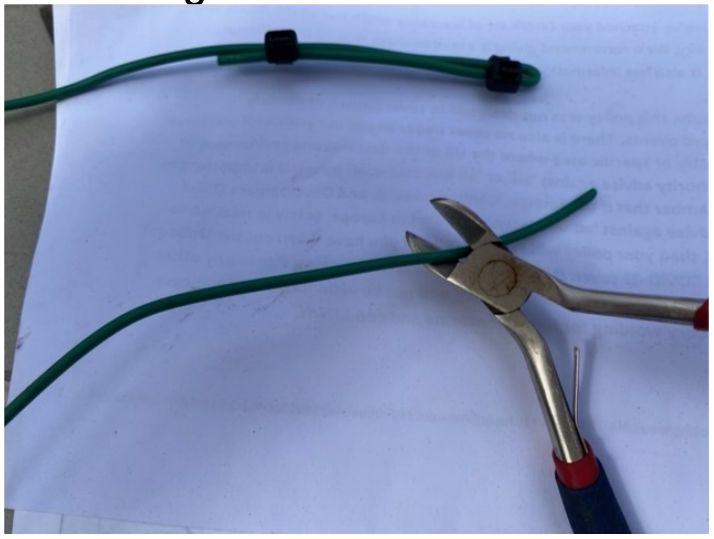
- OK, it’s built and installed
  - You want it to be efficient and effective. This means you need to ensure a good match between the feeder and the input impedance of the antenna
  - Antenna impedance depends on the ratio of Voltage and Current standing waves at the feedpoint
  - This depends on frequency and on antenna length
- How can I understand what I need to do? Relative to the half wave dipole:
  - Short antennas are capacitive
  - Long antennas are inductive
  - Matched antennas are resistive
- Matched antennas exhibit low VSWR
- Short or Long = high VSWR
- You can add capacitance or inductance to get a low VSWR or you can achieve this by trimming the length – electrical or physical adjustment

Electrical adjustment?

- Given that you might initially be well off a match:
- You would need an effective ATU
  - Depending on the power you are hoping to use:
  - This could be an expensive device like the Palstar model opposite
  - Or cheaper, like the MFJ one on top!

Physical adjustment (trimming)

- At the wire end either:
- Shorten by cutting (small amounts at a time) or by foldback
- Lengthen by adding wire – a ‘tail’ and then trimming that



- Many rigs include a built in ATU with a limited range of ability to match. Mostly these are auto-matching
- The VSWR range covered is typically

  3:1
- This gives the opportunity for a little electrical AND a little physical adjustment
- Also, knowing you can automatically match over the frequency range between the 3:1 VSWR points is handy

How can I measure VSWR and the frequency at which it occurs?

- The modern way is with a VNA, Vector Network Analyser. It is a very capable device and can do many types of measurements that demonstrate some interesting things you might not expect.
- E.g. The point of minimum VSWR is not the same exactly as the Resonance point for most antennas. Normally they are very close. Inconsequentially close for our purposes. This can be seen on the Smith Chart Display of the VNA

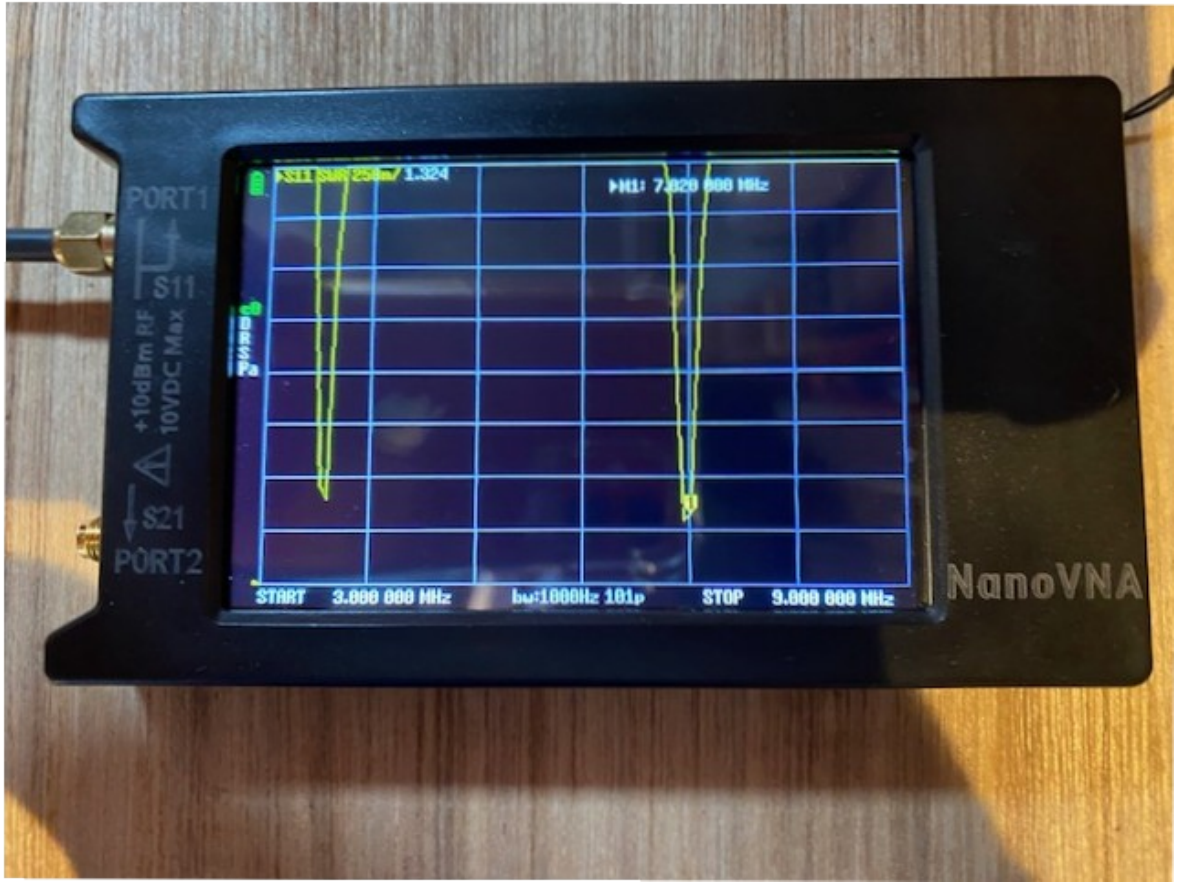
VNA Measurement of my 80/40m trap dipole

My W3DZZ -VSWR plot

- 3.580 MHz
- 7.020 MHz

minima

- Moving the marker can show the VSWR range over the band of interest
- 7.000-7.080 and 3.500-3.580 MHz in my case



What are you waiting for?

- Act now!
- Survey your property and plan how best to implement and deploy your HF aerial
- Get building and installing!