Print

A Turnstile VHF/UHF Field Day Antenna

14 January 2011

So what's new about a turnstile antenna ? Nothing's new, but you may be interested in how I set up a series of turnstile antennas for operation on 3 bands for field day outings. If you don't want a tri-band version, simply make a one or two-band model.

I guess the first thing I should do is explain why I decided to use the turnstile-style antenna for this purpose. Firstly, it is a horizontally-polarised antenna - a "must" for SSB operation down the bottom ends of the VHF & UHF bands. Secondly it has an approximate omnidirectional radiation pattern - that means it doesn't need to be rotated - another bonus when you have wet weather. It's main disagreeable property is that it has no actual gain - and many say that it has a "loss".

A basic turnstile antenna consists of two half-wave dipoles perpendicular to each other (i.e at 90 degrees). The two dipoles are fed by an electrical 90 degree coaxial phasing harness (or 1/4 wavelength in coax at the operating frequency) as well so it actually produces a circularly polarised pattern in the horizontal plane. The feed impedance of each dipole should be around 70 ohms, the two in parallel reducing that to around 36 ohms. That represents about 1.6:1 SWR which can be reduced by using an impedance transformation section in the feeder coax.

By rights you should at least run some type of balun-effect device on the incoming coax to the first dipole but I wanted something quick and simple so my coax goes directly to the dipole and then via the phasing section to the other. The result in my case is an SWR around 2:1, or slightly under, on each band.

I used sandwich-style TV antenna element mounts - the large black plastic things in my photos below - plus thin-wall light-weight 12mm OD aluminium tube. If you have access to a quantity of similar TV antenna bits, you can utilise them. I know that the two half-wave dipoles should be in the same plane rather than slightly offset as mine turned out - but it still works ok.

Enough chatter, now some photos..... then I will describe some material lengths etc...

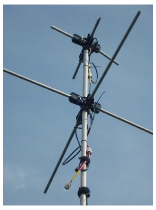
{ mouse-over for larger views }

Well it doesn't look like much.. and it isn't very big or very heavy either. This is a tri-band turnstile (for 50 / 144 and 432 MHz) all packed down. Total length around 1.5 metres and weight around 900 grams.

Unfolding the 70cm (432 MHz) turnstile starts to show how it goes together. Note that the elements just unfold and "click" into position. You can also clearly see the 2m one with it's elements folded down - just click them out and it's done.

The collapsed 6m turnstile is in the background to the right.

Unfolding the 2m (144 MHz) turnstile makes it look like this.... The spacing between the two turnstiles was chosen at 500mm - or around a 1/4 wavelength at 144 MHz.



This is how those 2 sections look when erected.. In this photo, there are a number of coax cables being fed up the mounting pipe, with one connected to each turnstile. Note that the coax connectors visible are N-male plugs on the incoming cables in the form and N-female sockets on the flyleads to each turnstile.

And, before you comment, the RHS element on the 70cm turnstile was knocked on a tree branch as the array was being erected vertical. I just didn't notice it before I took the photos.

Then the third turnstile is mounted below - this one for 6m / 50 MHz. It is a little over 1.2m below the 2m one, but the tubing in between is sleeve-joined with a different diameter tube - with the option of varying this spacing - as well as making the entire assembly shorter thus easier to pack into a car.

I must add that the coaxial "form" has 6 cables all zip-tied together and is normally used on my field day VHF/UHF yagi and verticals arrays. I won't be using both antenna options at the same time so it makes sense to use it for this antenna implementation. After all, it lives in the FD box and isn't used for anything else anyway....

The dimensions of each dipole vary depending on how you create the "feeder" cables. The "exposed" feed cable becomes part of the active length of the dipole so if your dimension varies from the 40mm that I used, your half-wave dipole lengths will vary. This "40mm" I used is from where the inner of the coax is separated from the shield of the coax, and I was careful to make all of the feeder coax pieces the same length, regardless of which band it was for.. I used a foam-style RG58 coax with a velocity factor (Vf) of 0.7.

That meant that the following dimensions were used :

BAND	Each 1/4 wave section of aluminium tube (i.e. each half of the 1/2 wave dipole.)	Coax Phasing Cable (Vf = 0.7) + 40mm tails (after cutting) Note that the length given is for the actual shielded cable used for the 1/4 wave stub and not including any flylead length.
50 MHz	1360 mm	1047 mm
144 MHz	492 mm	364 mm
432 MHz	165 mm	121 mm

From the above list, you will need about 5.5 metres of tube for the 6m one alone, 1.8 metres for the 2m one and 900 mm to make the 70cm one. To make all 3, over 8 metres of aluminium tube is required. You need to get as thin a wall as you can to keep the weight down and prevent the 1/4 wave elements pivoting/dropping down out of the sandwich insulators under their own weight.

The aluminium elements stop about 15mm short of the centre mounting pipe (within the sandwich bracket) and have a retaining/connection screw set back another 15mm and it is to this screw that the coax inner or outer connection is attached via a solder lug. The screws used were 3/16" Whit as the holes in the insulators were sized to that value. Alternatively, 5mm screws could have been used if available. The elements simply pivot on this screw when folded for transit.

Note that the coax lengths are for a Vf of 0.7 and if you use a poly-inner cable like RG58 then you need to make these cables slightly shorter (eg 988mm for 50 MHz, 344mm for 144 MHz and 114mm for 432 MHz). These lengths quoted are after trimming to correct length - always initially cut the basic coax pieces longer so that you can make these lengths accurately.

I actually made an extra coax with the 40 mm tail lengths so that I could assess where the basic dipole resonated before I added the phasing harness. For 6m, my initial lengths were such that the antenna actually resonated around 46 MHz... and were trimmed down to provide the above dimension for 50 MHz. Again, it is easier to trim some length off the aluminium tubes than it is to join it back on......

The important detail not yet disclosed is how the coax pieces are terminated - and this photo shows more or less how I did it :

The incoming coax comes to two solder lugs - one for the inner and the other for the braid connection - and it is double-terminated with the phasing coax going out to the other dipole. The other end of the phasing harness cable goes to another two solder lugs - again one for the inner and one for the braid connection. I used heatshrink to provide some mechanical stability as well as some "weather insulation". Where the N female connectors (not visible in the above photo - below the bottom edge) are attached to the incoming fly cable, I used different colour heatshinks to indicate which band it was for - and that simply makes it easier to determine which cable is which when setting up for a field day because the coaxes in the form are similarly colour-coded.

The erection time of the whole antenna is literally just a few minutes. Connect the coax feeds to the N connectors, add a few velcro straps to keep the cables neat to the mounting pipe, pop the turnstile mounting pipe into the erection pipe (a larger diameter / longer one), unfold each set of elements starting with the smallest (70cm), stand vertical & firm the mounting by tying or clamping off to something solid. No screws or bolts to be tightened so no tools required.

Here's a quick tip. If you are going to be putting temporary antennas up in the air - and it doesn't matter which way they face - eg turnstiles, verticals - the joining sleeves (be they inside or outside sleeves) can just have a single screw through somewhere around the centre of the length. When the other two tubes meet the screw (plus retaining nut of course), that is as far as they go. It means that you can quickly join the upper and lower pieces of this antenna (e.g. the 6m section to the top piece (i.e. the 2m/70cm section)). The same goes for vertical whips. A quick sleeve joiner makes the whole erection and disassembly process so much quicker.

That's it. It is simple, very low cost, doesn't need to be rotated, is small and light-weight, and fairly sturdy so makes an ideal field day antenna for the main 3 bands we use at VHF & UHF. If an element moves, you simply pop it back into place.... Construction time is just a few hours.

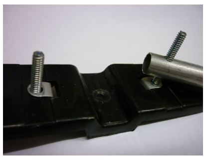
It may not suit many FD operations BUT if the weather is lousy and you don't want to spend a lot of time putting together VHF & UHF yagis in the wind and rain, it makes for a quick-to-put-in-place alternative.

Additional photos are on my 2011 Summer VHF/UHF Field Day page (/~vk4adc/web/index.php/field-day-activities/31-2011-field-days/74-2011-summer-fd.html).

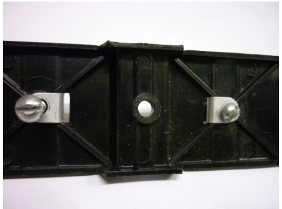
Addendum 12 April 2011 :

It is important that you do not just relay on the screw-in-a-hole to make contact with the aluminium element tubes when assembling a turnstile or other antenna type (eg a yagi) and a pair of plastic/insulating element clamps.

The following photos show how it should be done....



There is a piece of aluminium strip that actually makes the contact with the surface of the aluminium element...



The main connection from the screw is made by the screw head and by the washer and nut on the outside of the "far side" of the element "sandwich".

This image clearly shows the two sections of the sandwich, both with the metallic contact insert, plus the element in between on the RHS.