Australian TV Band 4 / 5 (IV / V) log-periodic yagi
- covering 500 to 850 MHz -
- with VHF add-on elements -
built to use with a USB digital TV tuner stick..

August 2009

We are starting to use our camper trailer more for a few breaks away from home and since I always seem to take the notebook computer with us anyway, there was a thought about buying a USB tuner stick to plug in and be able to watch TV - only as necessary, of course. That means that a single device (i.e the notebook) can take the place of a stand-alone TV, with or without DVD player for those rainy days, card games computer, music source, and internet gateway - a saving on space that is most important when moving around with our camper trailer and trying to fit all our "extra bits" in..

Accordingly I went to one of the local computer retailers and bought what turned out to be an AV Labs AVL680HD high definition digital tuner stick (for Win XP-SP2 / XP-MCE / Vista only) for about $Aud40 - including GST. I dutifully powered up the notebook, installed the software from CD, plugged in the tuner and supplied antenna (connects via thin coax and a PAL plug) and set it scanning for signals. It found some of the standard definition digital channels on VHF and all on UHF as well as the local HD ones on UHF.

Of course, there are many other similar USB TV tuners available cheaply these days and it is simply a matter of what is available to you - and whether you want just digital TV or want to include analogue TV as well (at a higher price). Just remember that analogue TV coverage in Australia is already starting its phase-out, will be gone by around 2012/2013, and all analogue programme is already available on the digital channels anyway..

Moving the supplied small 'modified' whip antenna around made a huge difference as to what channels could be received. It worked fairly well when attached to the side of the fridge (using its internal magnetic base) (thus horizontal polarisation) but standing vertically on the wooden table was hugely ineffective. Obviously if we were going to use it at various locations around the countryside, a better antenna was going to be required. Since most of the places we were likely to visit would have UHF coverage either from prime transmitters or via translators, I decided a single broadband antenna covering 500 to 850 MHz was in order, hopefully not so big that it would be a problem to transport. That would then cover both Band IV and Band V (4 & 5) services. The only style that would provide that sort of bandwith coverage was a log periodic yagi (or LPY).

A bit of Google web searching later producd a LPY calculator (in french) at http://alain.caupene.club.fr/Log_periodic.htm (http://alain.caupene.club.fr/Log_periodic.htm) and by entering my desired upper and lower frequencies came up with some dimensions to build from. Please note that the calculated dimensions are tip-to-tip and the physical construction has to take that into account. I ended up choosing a 13 element design that required a boom length of just over 1 metre (actual 1039mm), longest element at 300mm, shortest at 177mm, as best suiting my needs. Of course, others may want smaller or larger variants and the calculator will allow you to create those. My physical device was going to have to be robust (to survive the transit and packing phases) and having materials left over from the 23cm yagi project made that job easier. The elements were mounted using the same methodology but being a LPY, two spaced parallel booms were used.

This page is not going to be a step-by-step guide to building an identical antenna - simply a set of photographs with comments and basic dimensions about how it can be done. They say a picture is worth a thousand words and there are enough pictures on this web page to nearly write a small book. Certainly the methodology used in the construction should be fairly obvious to most who do a little "handy-work" in their workshops and aren't afraid to cut metal and drill holes.

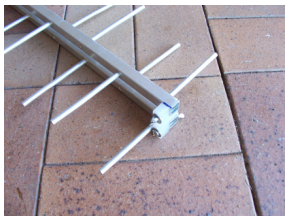
Main materials used : 15mm square aluminium tube, 1/4" / 6.2 mm round aluminium rod.

Element Number	Total Length (Tip-Tip) mm	Half Length Cut (mm) for 15mm mount tube (2 required each length)	Spacing to next element (mm)
1 (lowest freq)	300	165	109
2	287	159	104
3	275	153	100
4	263	148	96
5	252	141	91
6	241	136	88
7	231	131	84
8	221	126	80
9	211	121	77
10	202	116	73
11	193	112	70
12	185	108	67
13 (highest freq)	177	104	Boom = 1039mm + front +rear mount allowances (Allow 1200mm)

Half Length Cut (mm) for 15mm mount tube column is half the length plus the mounting tube external dimension (i.e. 15mm)
as the rod passes through from side to side & thus still has the desired length exposed on one side and is flush on the other.

Simply mouse over any image to see a higher detail image.

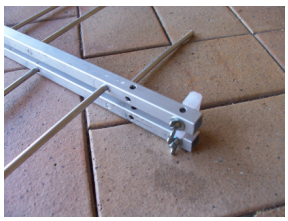
This is the basic LPY assembled - the front is the narrowest end (LHS above) and should be pointed towards the TV transmitter site.



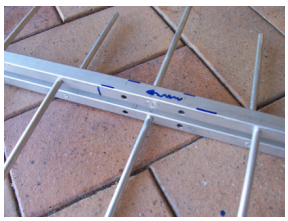
The mounting/spacer blocks are "T" shapes with holes drilled through the tops of the "T". Note that the elements protrude from alternate sides of the two booms once assembled : eg bottom, top, bottom, top... on the LHS of the photo. When you are making it, the two booms with elements are identical and one is simply "flipped over" when being attached to the "T" insulator blocks.

The "T" blocks are used to insulate and separate the two 15mm square boom tubes. The screws and wingnuts are 3/16" whit and because of clearances to the front-most elements are mounted from alternate sides. The boom-boom spacing is about 10 - 12mm but is not super critical.

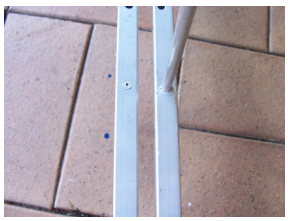
As noted below, the material is cut from 12mm kitchen "chopping board" - very easy to cut with a saw and then drill.



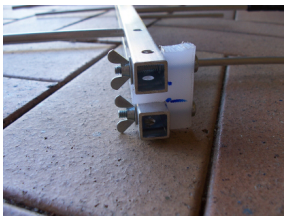
The rear insulator is another "T" section identical to the front one. The set of 2 holes in the sides of both boom tubes allow the assembly to be rear-mounted. The extra holes in the tops are not required but were drilled when the vertical/horizontal mounting arrangements were not yet finalised.



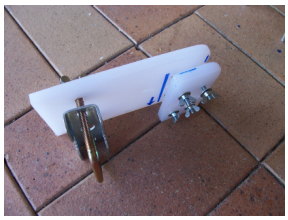
This set of 2 holes per boom is used for centre-mounting the antenna and is the normally used position.
The blue permanent marking pen just makes it easier to assemble by matching up the similar blue marks.



The element holes are drilled right through the boom tubes at the spacings given in the table above and then reamed out slightly so that the element material is a tight fit into the hole on both sides. The elements are then tapped into place such that the end is flush with the sidewall of the boom

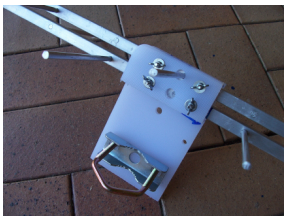


This view shows the rear T insulator a little more clearly - with the two 3/16" wingnuts on the same side - as there is no element clearance issue

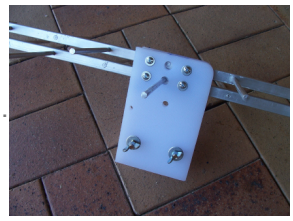


The mounting block/insulators were cut from a 12mm thick kitchen "chopping board" drilled as required to suit the 3/16" screw hole positions in the booms and the 5/16" U-bolt.

The other side of the mounting block shows the flat washers under the screw heads and the wingnuts on the U-bolt threads



The mounting block/insulator as screwed onto the boom at the centre mounting position. You will probably note that there is an element protruding through a hole between the two uppermost screws and that the very end of the lower element is visible in the hole between the lower screws. These hole sets allow the same mounting block to be used at the rear or the centre position.



Opposite side view showing the lower element protruding through the hole

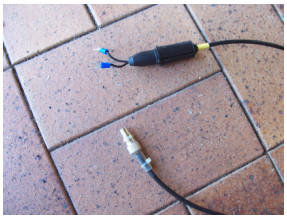
The extra hole visible below the protruding element actually lines up with the U-bolt when set up as vertically polarised - the metal top prong of a tent pole fits into the hole to help stabilise the assembly.

Why use wingnuts ???

The antenna has to be able to be assembled and then pulled apart - at the beginning and end of any camping stay - just to save storage space. Wingnuts make it quick and easy and it is usually easier to see where a wingnut is when you drop it in the grass (and 'Murphy' says that it will happen !) .

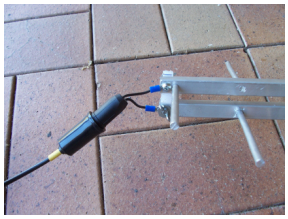
If your antenna was for more-or-less permanent mounting, wingnuts are not required but spring washers and nuts are...

You still need to use the flat washers as the white chopping board material is soft-ish.

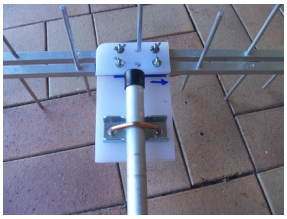


The connection to the tuner card is via the PAL plug (bottom) and the other end is terminated with an "F" connector that screws onto the end of the TV balun (top, inside the weather sleeve), which is fitted with spade lugs to go under the screws at the front of the LPY.

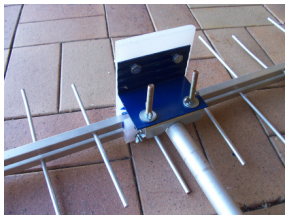
This is the entire connection cable - 10 metres of 75 ohm low loss foam dielectric coaxial cable, PAL-male plug on one end to the balun with spade lugs on the other



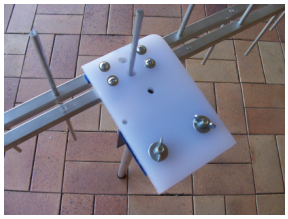
The spade lugs on the balun are simply placed under the 3/16" whit screws at the front of the antenna - note that the balun must be fitted at the front of the LPY(the narrow end) - NOT the rear.



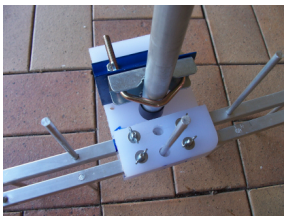
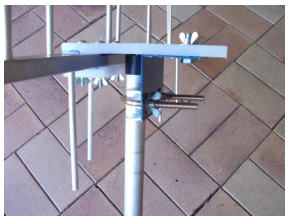
The mounting pipe is fitted into the U-bolt and the wingnuts tightened. As shown, the antenna is set up for horizontal polarisation.



With the 90 degree mount bracket in place, the antenna is now set up for vertically polarised TV signals.



This is a top view of the mount when set for vertical polarisation

 This is actually an "underneath view" of the mounting arrangement for vertical polarisation. The U-bolt is used this way around specifically so that the centre of gravity of the antenna is closest to the mounting pipe.	 This is the view from the front of the antenna showing the positions of the mounting tube, the 90 degree bracket and the various wingnuts	 This right angle piece is used to change the antenna from horizontal to vertical polarisation. The bolts are also 5/16" whit with wingnuts and flat washers, to match the threads on the U-bolt.. The spacing of the 2 sets of 2 holes is also set to exactly match the U-bolt thread spacing
 To extend the frequency coverage where VHF digital TV is available, 4 extra extensions were made from additional 6mm rod pieces plus the compressible sleeve part of 1/4" Dynabolts tapped on and then covered with heat-shrink plastic tubing.	 **These VHF extension pieces are fitted onto the end of the two rear-most elements** and provide additional frequency response down in the 150 to 220 MHz range when fitted.	**VHF extension pieces :** 2 at 280mm 2 at 200mm About 20mm of each length is inside the fixed long section of the 'ex-Dynabolt' joining collar. The 3-expansion fingers "collar" pushes-on over the basic element for 15mm. This gives a total approximate element length for #13 as 600mm (~150MHz) and #12 as 750mm (~200MHz) providing basic support for VHF TV channels 5A to 11.

Using the antenna above made a gigantic difference to the received signal level as indicated by the little bar meter/indicator near the top of the "TV" display on the notebook. The TV signal would no longer drop out when someone walked nearby - as it did with the small antenna supplied with the tuner. All in all, it looks like the results were worth the couple of hours spent working out how to mount/insulate the booms and creating the "T" end spacers, cutting the tubing and rod.

Total materials cost - about $25 - $30.

NOTE : I tried the USB tuner in the side of my IBM notebook and it worked fine - BUT plugging it into a USB port on the back made it seem like it was faulty. Windows XP found it but there were no TV channels found on scan etc... Back in the side was ok. Obviously some ports on the notebook are capable of supplying sufficient power to the tuner and some aren't. If your tuner doesn't work, try another true USB 2.0 port or via an external 2.0 hub with an external power supply before thinking it is faulty..

A web advert for the USB tuner I purchased :

AVLabs AVL680HD - USB High Definition Digital TV Tuner

With the AVLabs USB High Definition Digital TV Tuner, you can enjoy watching or recording digital TV on your computer or laptop anywhere, anytime! You can watch and record digital TV with the time-shifting function, you can even pause live TV! With schedule recording you won't miss any of your favourite shows.

Supports HDTV
Watch and record digital high definition TV in any country with digital reception.

Bundled with HyperMedia Center
The AVL680HD with HyperMediaCenter, a powerful multimedia player for all purpose. In addition to the basic functions for a multimedia player, when it is paired with DVB-T Stick Pro it also scans and recognizes channels automatically, and enables users to preview 9 channels at once. You can also adjust setting such as brightness, contrast, hue and saturation.

Supports Electronic Program Guide(EPG), Subtitle
Watch additional information, such as subtitlesand program guides.

3 Easy Steps to Plug and Play
Just plug the DVB-T Stick Pro into any computer system, follow the on-screen instructions to install the software application within minutes you will be watching HDTV.

Features
- Watch free-to-air digital TV and listen to digital radio on your PC or laptop
- Comes complete with HyperMedia Center, a powerful user friendly application that allows you to:
- Watch or record digital TV
- Auto channel scan and name recognition
- Multiple channel preview
- Brightness/contrast/saturation/hue adjustment
- Supports HDTV
- Supports EPG and subtitle function (DVB standard)
- Supports time-shifting and scheduled recording function
- Supports still image capture in JPEG or BMP format
- AVL680HD is compatible with Windows XP, Windows Media Center & Vista

System Requirements
- Pentium-IV 1.6 GHz or higher recommended (recommended 2.8GHz for HDTV)
- 256MB RAM of system memory or above (recommended 1GB for HDTV)
- One available USB2.0 port
- Graphics card (Must support Microsoft DirectX 9.0C or above)
- Sound card (AC97 compatible sound card)
- 1GB Free HD space
- CD-ROM Drive (For software installation)
- Microsoft DirectX 9.0c• Microsoft Windows XP SP2 / XP MCE / Vista

Package Contents
- USB Digital TV Tuner
- Antenna
- Installation quick guide
- Installation CD
- Remote