# TechTalk99

# DATV – a High-gain "Panel" Antenna for 1.2 GHz

**by Ken Konechy W6HHC**

**(Revised 2012-07-20)**

**[Note – I received good feedback from Kent Britain WA5VJB pointing out the impact of insulation on the velocity factor of wire, caution about "beam tilt", and from Paul Melbourne G8GML elaborating on his early involvement in the "panel" antenna design and other details. These additions are certainly worthy of a revised edition of the article.]**

I am always interested in discovering antenna designs that can be easily built by hams. While scanning the British Amateur Television Club (BATC) web site for digital television forums, I noticed the posting by Keith GØKTD. Keith had posted photos of his "lantern" antenna for 1.2 GHz that was constructed of four "panel" antennas. The panel antenna turns out to have a good gain, low cost, and the design can be made into several variations.

## Basic Panel Antenna

Back in 1997, John G8MNY published a short article in the BATC CQ-TV magazine that introduced the ATV readers to a panel antenna made with loops of heavy wire positioned above a reflector panel. John G8MNY's article described using four loops of wire. A short time later, in 1998,

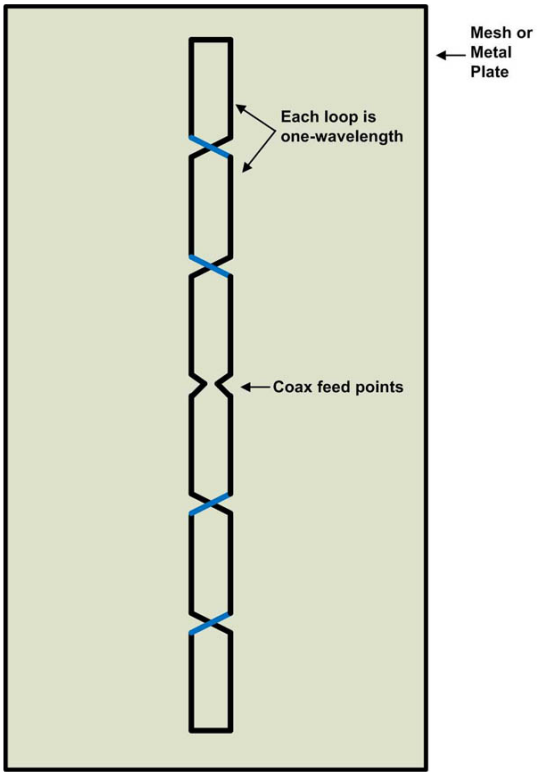


**Figure 1 – Six Loops of wire are positioned over a Mesh Reflector for basic Panel Antenna**

Paul G8GML published his work in BATC CQ-TV magazine where he had over several years evolved the panel design to use six loops of wire for better gain and more convenient impedance. **Fig 1** shows the modern basic construction concept for the panel antenna. The design of **Fig 1** can achieve a theoretical gain of about 14 dBd. Each loop is one-full wavelength (electrically) and can be thought of as two half-wave dipole antennas with 3 dBd of gain. Two loops double the number dipoles to provide 6 dBd of gain. Four loops provide 9 dBd. Six loops of wire can produce a gain of about 11 dBd. Finally, adding a metal reflector spaced behind the loop array will add another 3 dB and provide a total theoretical gain of 14 dBd!! [NOTE G8GML's earlier CQ-TV article stated field measured gain of 6 loops with the reflector at 16 dBd. Paul G8GML explained that performing field tests includes the ground's distortion of the radiation pattern and that the higher value of gain reported is the result of "ground gain"...but is a good method to compare antennas at a specific location. "Your mileage may vary!"]

One of the simplicities of this antenna occurred when Paul G8GML evolved to the six-loop design.....the resulting feed impedance for the coax is 50 ohms for **Fig 1**. How simple can you get? Most articles on this design recommend a 1:1 balun to feed the antenna.

The wire size usually chosen is 2 mm diameter copper. Stranded copper wire can be used if you leave the insulation on. Most construction articles show insulated solid wire being used. However Kent WA5VJB, who is the Antenna Editor for CQ magazine, pointed out that the velocity factor of bare wire is different from insulated wire. So insulated wire needs to be about 1.5% shorter. The dimensions of the loop are 88 mm long by 28 mm wide for each of the loops. The spacing of the loops should be about 30 mm above the mesh (screening) reflector panel. Most hams construct the reflector to be about 8 inches wide by 20 inches long using garden screening with about 0.5 inch squares.

Kent WA5VJB also points out that with the loop array positioned vertically (as shown in **Fig 1**) the electrical field radiation is polarized horizontally. Finally, Kent WA5VJB points out that "The main problem is beam tilt...it takes a lot of care to build one so that the main lobe of the beam really is at the horizon".

## How About More Gain?

The beauty of this antenna is that you can double the number of arrays and easily use two sets of six-loops over a lightly larger reflector panel as shown in **Fig 2**.

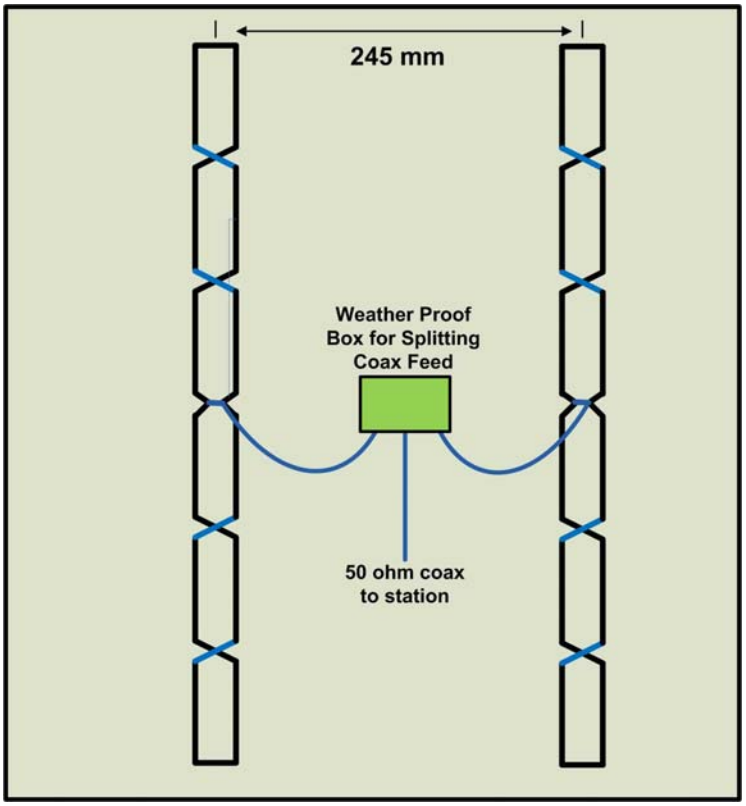


**Figure 2 – Two sets of Six-Loop Arrays provide 3 dB More Gain for a Total of 17 dBd**

The coax splitter feeds the two arrays in phase. Special note – the two pieces of coax from the coax-splitter need to be chosen carefully to "transform" each of the 50 ohm antenna loads to look like 100 ohms at the splitter end. Then two 100 ohm loads when connected in parallel look like 50 ohms again to the feed coax. This "transformation" of impedance in the coax is usually accomplished by carefully choosing the length of the "splitter coax" section of coax. The ARRL Antenna Handbook (Chapter 26) calls these sections of coax "quarter-wave transformers". To get the 50 ohm antenna to look like 100 ohms,

$$Z_{transformer} = (50 \times 100)^{1/2} = 70.7 \text{ ohms}$$

use quarter-wave or 3/4-wave sections of 70 ohm coax.

It is possible to continue to increase the number of the six-loop arrays to obtain even more gain.

| Number of 6-Loop arrays | Antenna Gain |
|---|---|
| 1 | 14 dBd |
| 2 | 17 dBd |
| 4 | 20 dBd |
| 8 | 23 dBd |

Remember that all of the six-loop arrays need to be fed in-phase. The antenna gain will be a very sharp (narrow) beam that is perpendicular from the front of the panel.

## The Omni-Directional Lantern Configuration

Keith GØKTD recently posted about his "Lantern" antenna that is constructed by bolting four panels together, each aimed at 90 degrees from each other (see **Fig 3**).

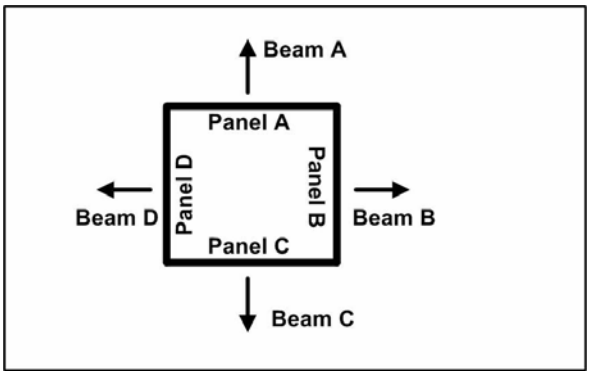


**Figure 3 – Looking down onto the top of the four panels used for the Lantern Antenna**

By sending the beams out in four different directions, the test results by GØKTD, GB3NQ and G3MCD indicate an almost circular gain pattern is radiated. The gain in any direction is the gain of the facing panel.

## Tricks of the Trade

One way to adjust the resonance and SWR on the panel antenna is to prepare a "trombone" adjuster for the feed line connection to the 6-loop array. The tubes used for the trombone feed sections are made from 2.5mm ID M83 brass tubes as shown in **Fig 4**. The solid wires of the loop-arrays can be flattened slightly to create a snug fit into or out of the hollow tubes.

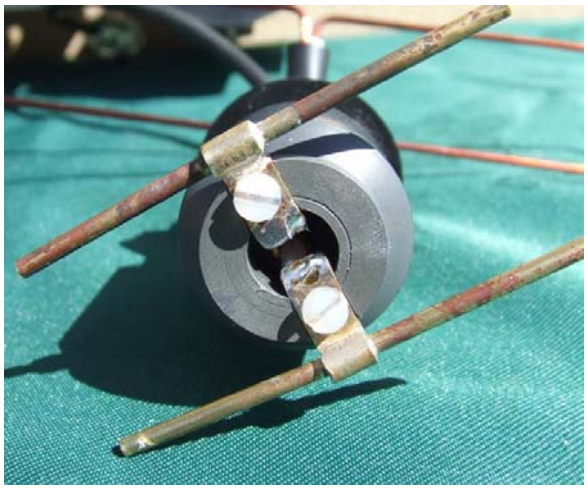

**Figure 4 – A Trombone coax feed section that allows the wire in loops to slide in or out for adjustment**
**(Courtesy of Maurice Richards, G3WKF and BATC)**

## Conclusion

This looks like a neat 1.2 GHz antenna that can be built as a beam or as an omni!! This appears to be a straight-forward construction project. The referenced articles below provide additional construction details for interested hams. The reader can make the array as small or as large as desired.

Paul G8GML sent along these photos in **Figure 5** and **Fig 6** of the Panel Antenna construction by Simon Laszlo HA5IW. The gain is "in the region of 30 dBd".

**Fig 5 – Large 6-loop panel array construction by HA5IW**
**(Courtesy of Paul G8GML)**

**Figure 6 – The Large 6-loop panel array by HA5IW mounted up on the Tower.**
**(Courtesy of Paul G8GML)**

I have added the hi-gain Panel Antenna to my list for DATV projects.

## Interesting Links

- British ATV Club – Digital-ATV and DigiLite Forums – see **www.BATC.org.UK/forum/**
- British ATV Club – select from about 25 streaming repeaters – see **www.BATC.TV/**
- BATC CQ-TV Magazine Archive – see **www.BATC.org.uk/cq-tv/archive/index.html**
- John G8MNY article "Flat Plate Aerial" in BATC CQ-TV magazine, 1997 issue 180
- Paul G8GML and Ian G3KKD article "23 cm Panel Antennas" in CQ-TV-182 magazine, 1998
- Ian G3KKD and Paul G8GML "Correction to Drawing 3" in CQ-TV-197 magazine, 2002
- Paul G8GML article "UHF Panel Antenna", 2004
  – see **http://G8GML.zxq.net/page20.html**
- Maurice G3WKF article on "Update on Panel Antennas" CQ-TV-234 magazine, 2011
- Orange County ARC newsletter entire series of DATV articles – see **www.W6ZE.org/DATV/**
- Yahoo Group for Digital ATV - see **groups.yahoo.com/group/DigitalATV/**