The REPEATER

The OFFICIAL newsletter of the Rogue Valley Amateur Radio Club

W7DTA

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Next Club Meeting

Thursday, April 7, 2011, 7:00 PM
Red Cross Building, 60 Hawthorne St., Medford, OR
Across from Hawthorne Park
Program: Restoration of Classic Radios (Van Sias, K7VS)

President's Letter

As I write (early Saturday morning March 12), the world is reeling from the magnitude of the earthquake and tsunami in Japan. Among my first thoughts were the status of my son's in-laws southwest of Tokyo. We have heard now that they are OK. After that my thoughts went to the MANY radio amateurs I have worked in JA over the years. There are three that come to mind specifically by callsign: JA1NUT, JA7SSB, and JA8LN. I have had memorable and lengthy CW chats with all three. It was gratifying to receive news regarding at least one of these friends. The following quotes from the CWops reflector:

I and my family are all OK here in Tokyo. But northern part of Japan had a terrible damage. More than 1400 killed or missing up to now.

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Secretary's Report

The meeting was called to order by President Allan Taylor, K7GT at 1905L in the Red Cross building in Medford, OR.

Guests in attendance where: Karl Sargent, K7KDS, John Dollison, KF7LVJ and Jeff Statchwick, WB7OGP.

The minutes where not read as they are in the newsletter. Lud, KB2EVN reported that the club treasury has $4004.00 in it.

Old Business: After some discussion it was decided that Lud find the best projector and buy it.

Bob Duell, K2GLO made a motion and it passed that we allow $500 for the projector cost.

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President's Letter, Continued

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Leak of Cesium has been detected at the nuclear power plant in Fukushima about 250Km north from Tokyo. That might mean nuclear fuel material is melting down. Very serious situation.

Atsu, JE1TRV

Hi all, We just got out of the power outage right now. No water supply. No foods sold. But this area, 80km north of Tokyo, has spared real serious damages. No one was hurt. Some damages to house items only.

As someone told, in JA7 area, north of here, they have suffered so much especially due to the Tsunami, which they say over 7m high. A whole town is said to be destroyed by Tsunami. So far, more than 1000 people were killed or missing. I am sure much more will be lost.

The melt down of nuclear plant in Fukushima Prefecture is a real terrible event. I am afraid our government has been aware of this possibility before. Our prime minister has mentioned of the nuclear plant problem in his very 1st speech after the quake occurred. I really hope the pollution will be limited to the small area and no one will be injured.

Personally, my old mother and a brother with his wife are in Sendai city, where it caused much damage. No contact with them at all. It makes me worried much.

When I opened the e mail box, I found bunches of mails from friends abroad asking me if I am OK. It touched me a lot. Please keep eyes and ears open to those severely damaged by this disaster. I appreciate your concern toward me, my friends.

Sorry for such a lengthy post. It may take me some time to set up the gears which are all fallen down on the floor from the desk. But I will come back on the air soon.

Shin, JA1NUT

A footnote to Shin's note. He is a pediatrician and will likely be VERY busy in the recovery effort. Please pray or have a good thought or whatever you do in behalf of all the people affected by this natural disaster.

I am sure there are other frequencies in use, but please be aware that 7030 kHz is one of their emergency communications frequencies (7030, LSB).

Allan K7GT

Secretary's Report, Continued

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Scott Cummings, KD7EHB reported that he has been looking around for field day sites and would like some input as to where people would like to go.

New Business: Tom McDermott, N5EG said this years (2011) name tags are on the table and please get yours.

Don Bennett, KG7BP reported that 3 people passed their ham license test last week.

Allan put the meeting on hold for coffee and "eyeball QSOing" at 1945L and called the meeting back into session at 2015.L

Tom presented a very interesting program on his experiences with an almost invisible 70-foot long wire doublet antenna on all HF bands.

Allan adjourned the meeting at 2100L

Submitted by Jacob O. (Jack) Schock, WA7IHU secretary

The Beta, Gamma, and Omega Matches

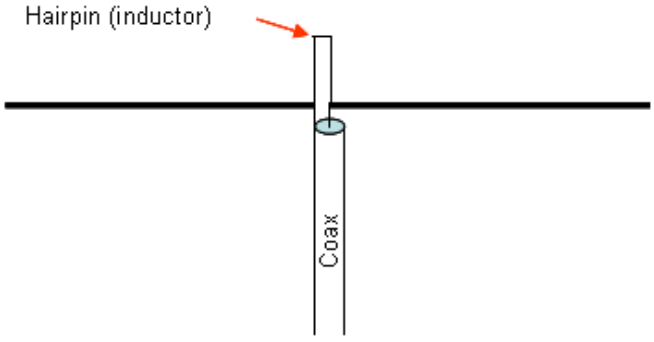
In the January and February issues we discussed broadband antennas and feeding. We'll now turn to narrowband antennas and some common matching methods.

Modern multi-element yagis when optimized for best forward gain or front-to-back ratio have a feedpoint impedance that is not 50 ohms. Generally the maximum gain point occurs when the feedpoint impedance is less than 50 ohms, somewhere between about 10 and 30 ohms. This presents a practical difficulty when trying to match to 50-ohm coaxial cable directly to the antenna.

There are several approaches to matching this feedpoint impedance — one is the gamma match, and the other is the hairpin match. In this article we'll look at the range of matching possible with each type of network.

Beta Match

The simplest match is the Beta match, sometimes also known as the Hairpin match. It consists of a short length of wire across the feedpoint. See the hairpin (beta) figure. While it might seem that this just shorts out



Beta (Hairpin) Match

the driven element, in reality the hairpin has some inductance, and this inductance is in parallel with the feedpoint input. The hairpin requires that the feedpoint impedance be less than 50 ohms, and that it exhibit a capacitive series reactance (driven element is a bit short).

In fact—the beta match only works over a narrow range of input impedance values. Trying to express the range as an impedance turns out to be a bit messy, as the resistive and reactive values are interdependent, and if the resistance is changed, then the reactance also has to be changed, or else the hairpin won't end up converting the impedance to 50 ohms.

However, if we look at the possible range of values that can be matched as admittances, rather than impedances, then it's easy to state the range of feedpoint admittances that can be matched to 50 ohms:

- The input admittance must be
  = 0.02 + j xx siemens
  (we used to call these units ***mhos*** back in the good old days).

The xx value of susceptance (inverse reactance) can be theoretically any positive value (parallel capacitance) and we can achieve a 50-ohm match. As the input susceptance changes, the length of the hairpin section needs to change accordingly. What's happening is that the hairpin inductance is in parallel with the capacitive input susceptance, and those two reactances form an LC parallel resonant circuit across the input. When that LC network is resonant, the L and C cancel each other, and we are left with a pure 50 ohm resistive (0.02 siemens conductive) input and we have achieved a match to our 50 ohm coaxial cable.

While the words are a bit difficult, the range of matches is easy to see on a Smith chart. The dashed green line shows where the input impedance of the antenna must fall in order for a hairpin match to be able to transform it to 50 ohms.

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For example, if the antenna input impedance is 15.4 - j 23.1 ohms, it's input admittance is the inverse of this, or .02 + j.03 siemens.

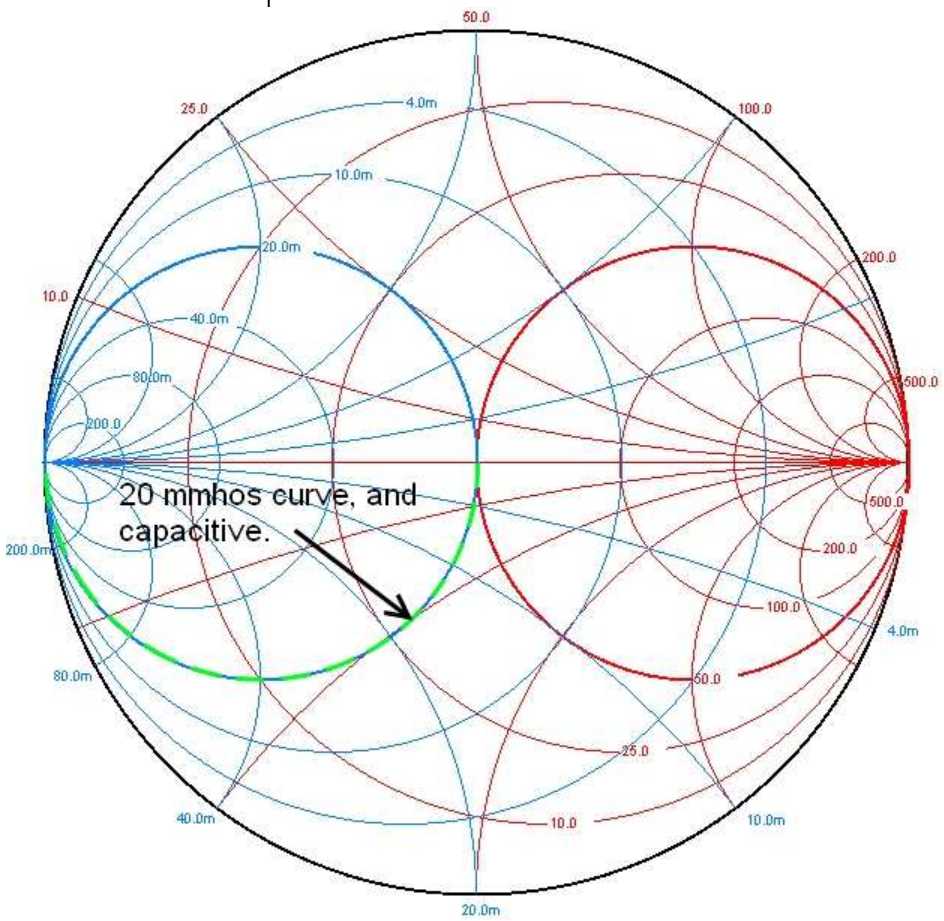
Placing a hairpin of –j0.03 siemens across the antenna will cancel out the +j.03 siemens of parallel capacitance leaving just the resistive (conductive) portion of 0.02 siemens, or 50 ohms. At a frequency of 14.2 MHz, the hairpin would need to have an inductance of 374 nanoHenries.

In practice, the length of the driven element is shortened to introduce the capacitive reactance needed, but the feedpoint conductance may also change a little bit as the element length is adjusted — the two are interlocked. Additionally the yagi antenna reflector and director interact a bit with the input impedance as the driven element length is changed. The net result might sometimes be a tedious iterative process required to achieve a proper match, but it usually can be done. Normally we can tolerate a bit of SWR, which eases the adjustments a little.

The hairpin when formed into a u-shaped piece of wire or tubing actually looks like a short length of transmission line, so it's equivalent inductive reactance can be modeled as a shorted transmission line.

Gamma Match

Another type of match is the gamma match. This is a pretty well-known match, and consists of a series capacitor along with the adjustable gamma rod. The driven element is shorted at the center, and the gamma rod is tapped out along the element to provide the proper resistive portion (50 ohms) and the series capacitor cancels out the series inductance of the gamma rod.



The range of input impedances that can be matched to 50 ohms with a hairpin (beta) match is the half-arc shown by the dashed green line.

Thus, with some freedom as to where to set the tap point, and the ability to counteract the stray inductance of that tap, there is a range of feed conditions that can be matched to the element. The gamma figure

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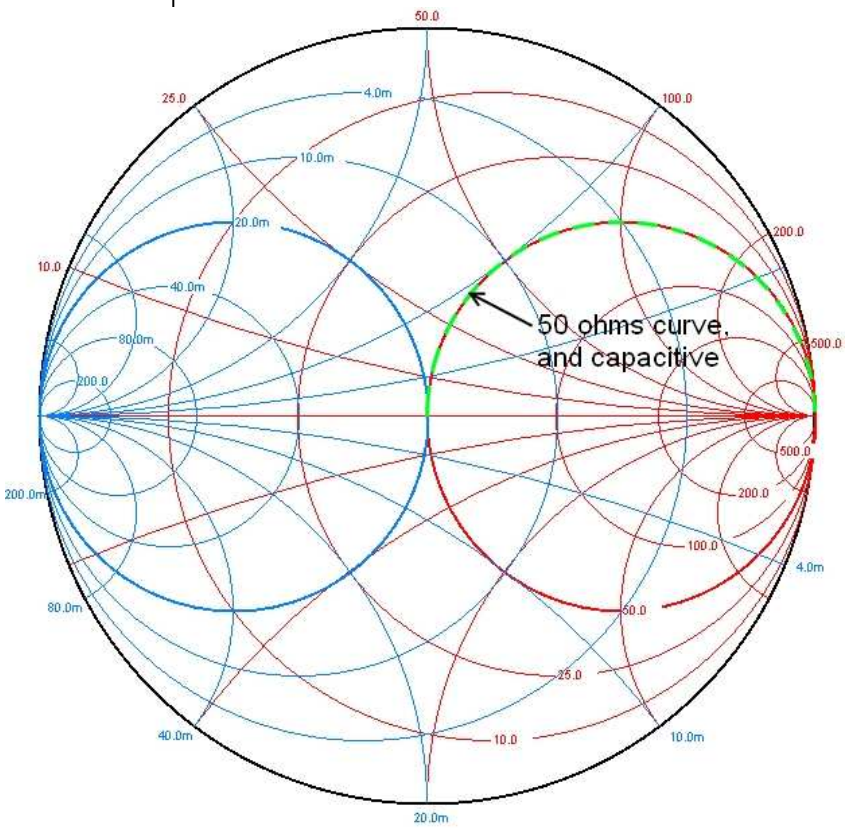
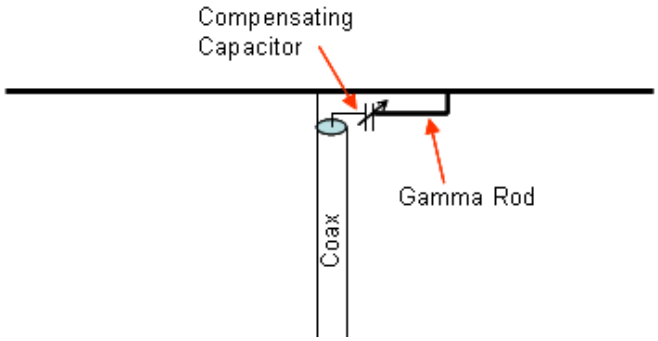
shows the gamma match, compensating capacitor and gamma rod. The gamma rod tap point on the element determines the resistive portion of the impedance presented to the feedline, and the gamma rod introduces both series inductance as well as impedance transformation due to the transformer action of the rod fed against the element. The ratio of the two diameters and the rod spacing will impact the impedance transformation that occurs.

Typically, both the tap point and the capacitor must be varied to achieve a good impedance match.

The gamma match is common not only for yagi antennas, but also on shunt-fed tower vertical antennas. In this case the left-hand dipole element becomes the ground plane, and the right-hand element



The range of input impedances that can be matched to 50 ohms with a gamma match is the half-arc shown by the dashed green line.

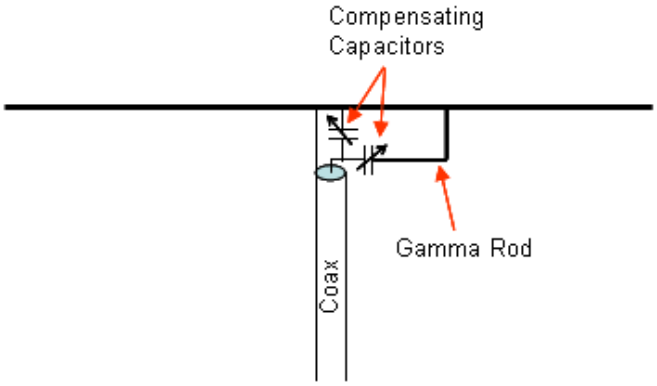


Gamma Match

is the vertical portion of the antenna.

Omega Match

Sometimes it is difficult to achieve a good match with a shunt fed tower. The vertical element may be short compared to a quarter



Omega Match

wavelength and thus it could prove difficult to find a 50-ohm tap point that allows the gamma match to achieve a 50-ohm match. In this case, an additional variable capacitor can be added to substantially increase the range over which the match can be

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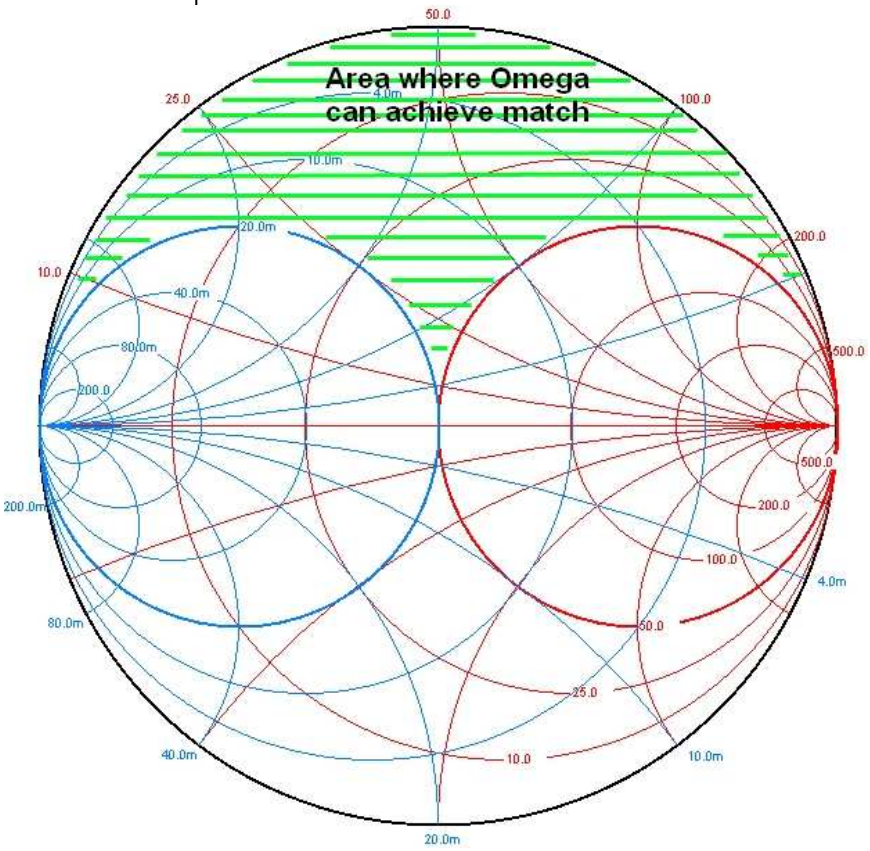
achieved. The omega figure shows where the additional capacitor is located to improve the matching capability. The Omega match requires that the resistive portion of the impedance is less than 50 ohms in order to be able to match to 50 ohms. However, this is usually the case when the shunt-fed tower is short, or the tap point is not high enough to get to the 50 ohms point.

In many cases, a 50-ohm tap point for one band, say 80 meters, would present about 12.5 ohms for 160 meters. The omega match would allow operation of that shunt feeding arrangement on the lower band.

The following figure shows the range of impedances over which the two capacitors in an omega match can transform the load presented by the gamma rod to 50 ohms. Because there are two independent adjustments, the omega match can transform an area (a wide range of possible load impedances) to 50 ohms.

Extreme points in the green area however may require impractical values of capacitance, or create excessive voltage across the series capacitor.

One especially useful trick is to match a shunt-fed vertical on 80 meters with a gamma match, usually the shunt-feed wire does not need to be changed between the two frequencies. Thus just a simple electrical switch, and some variable capacitors would allow a pretty wide range of operation for the vertical. The series (gamma) capacitor would most likely have the higher voltage rating requirement, while the shunt capacitor need only have a voltage rating to support the power level on a 50 ohm transmission line.



The range of input impedances presented by the gamma rod that can be matched to 50 ohms with an omega match is the green shaded area in the upper portion of the chart.

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