

Getting Started on 630 metres: Part 2

Steve McDonald, VE7SL

"That's a beautiful looking job you've done", said Jack, as Edgar proudly placed his new homebrewed 630 metre transmitter on Jack's workbench. "Well it's a good start! It seems to produce about 70 watts into the dummy load, but not having an antenna for the new band has been making me antsy. Any good ideas Jack?"

"You bet. I know you have a small backyard and that you already have a dipole for 40 and an inverted L for 80, right? Well, believe it or not, both of these antennas can be made to work on 630 and give you lots of contacts once the activity picks up. Your inverted L is probably the easiest one to get going. I do recall you telling me about the bunch of radials that you buried just under the lawn last spring – about a dozen or so if I remember. Those will be good enough for now but you may want to add some more later. You can never have too many ground radials!", advised Jack.

"Now, your 80 metre inverted L is around 35-feet high and then goes out about 40 feet – perfect for 80 metres but really pretty short for 630 metres.

A good inverted L on 630 metres would need to be around 500 feet and we know that's not gonna fit in your yard!

What you need to do is load the antenna with inductance, with a big loading coil at the bottom to make it behave as if it were longer. This will resonate your antenna to 630 metres and allow it to radiate a lot more efficiently.

You'll also want to be able to tune your antenna carefully and for this you'll want to build a simple variometer.

It will allow you to finely adjust the overall added inductance and

zero right in on your operating frequency. And lastly, you will need to impedance match the antenna so that you have a low SWR."

"Let me show you a diagram", said Jack, reaching for his notebook (see Figure 1).

"I see what you're getting at", said Edgar. "I've got a nice plastic bucket that I could use for the coil and variometer. I even have some 6-inch white PVC tubing that would work. Oh, and I saw a few nice chunks of what looked like big green PVC pipe scraps where they're building down at the corner. That would be ideal!"

"Sure, that or even some fat ABS pipe will do the job. Depending on the actual length of your antenna, you'll probably want to be able to adjust the overall number of turns in your main loading coil by adding a few taps at the top or bottom."

"Theoretically your 80 metre inverted L would need an inductance of about 860 microhenries to resonate it on 475 kHz but this is just a starting point. It might need

In the early morning hours of September 15, 2016, the first 630 metre contact between North America and Australia was completed when Roger, VK4YB and Steve, VE7SL, completed a two-way contact on 475.300 kHz at 1319Z. The contact was made on the JT-9 digital mode, the WSPR QSO mode designed for two-way work on LF/MF and the HF bands. At the time this article was submitted, this 11,800 kilometre path is the furthest two-way work on 630 metres worldwide and indicates the potential for long-distance Amateur Radio work in this part of the spectrum, particularly over the next few years of solar minimum. This article is a continuation of a series of articles about 630 metres.

Here is some terminology used in this article:

Non-Directional Beacons (NDBs) are omnidirectional radiobeacons found in the MF range from ~ 200 – 530 kHz. Most NDBs are associated with airport approach or enroute navigation procedures and transmit a continuous CW identifier every few seconds. Ranging in power from 25 watts to 1000 watts or more, even the low-powered signals can often be heard over several thousands of miles and make excellent propagation indicators for those interested in 630m work. An up-to-date searchable list of all NDBs logged in North America can be found at: http://classaxe.com/dx/ndb/rna/signal_list

Effective Radiated Power (ERP) is the power supplied to an antenna multiplied by the gain of that antenna compared to some "standard" antenna. Unless stated otherwise, it is usually taken to refer to the gain over a half-wave dipole.

Effective Isotropic Radiated Power (EIRP) is effective radiated power referred to a theoretical "isotropic" point-source radiator, which radiates equally in all directions.

Effective radiated power is usually taken to mean power radiated in the direction of maximum radiation for the antenna under consideration.

A dipole antenna which is electrically one half-wave long, in free space, exhibits a gain in its direction of maximum radiation of 2.15 dB over a theoretical isotropic radiator.

All 630 metre backyard antennas will have a negative gain!

$EIRP = ERP + 2.15\text{dB} / 5W$ $EIRP \approx 3W$ ERP

If you know your antenna gain from modelling and total power output, your EIRP can be calculated online at: <http://sss-mag.com/calcdB.html>

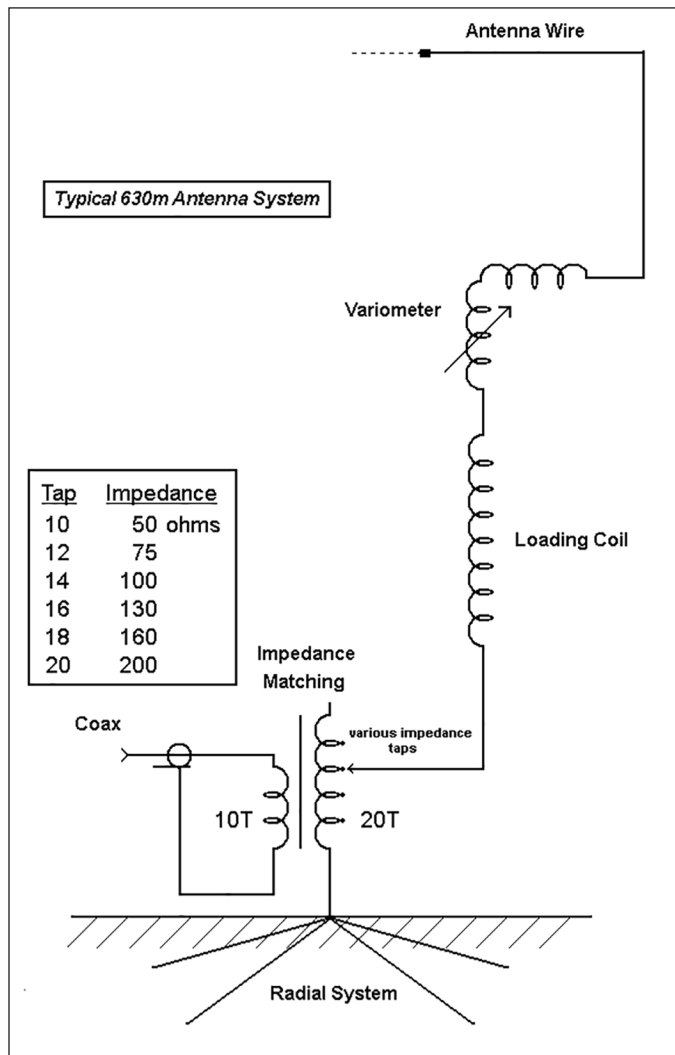


Figure 1: A typical 630m antenna tuning system with impedance matching transformer.



Figure 2: The KOLR antenna meter used to find antenna resonant frequency.

more or it might need less. Everybody's system is unique it seems and will require a bit of experimenting to get things properly tuned. This is where the fun starts Edgar. 630 metres is all new territory and offers some nice learning opportunities for those up to the challenge."

"If you had a 160 metre inverted L, say 70 feet up and 70 feet horizontal, you could get by with a much lower inductance, something around 460 microhenries. If you choose to use your 40 metre dipole, you would tie the coax ends together and feed it as a top-loaded vertical 'T' antenna, similar to the antennas used by many of the NDB stations (see the Sidebar on page ??). This would require an inductance of around 500 microhenries for starters, assuming the overall length of your coaxial feedline is about 60 feet."

"Of course it's probably best to wind a coil a little bigger than you think you might need as it's always easier to remove unwanted turns than to add new ones. And no matter which antenna you end up using, you'll want to have as many ground radials as you can manage. Ground system efficiency is the biggest challenge for us small-yard 630 metre antenna builders", added Jack. "Then again, you could take down your dipole and build a simple 'T' antenna, making the top horizontal wire as high and as long as possible. You would also need to base-load this one, just like the others. If you made the 'T' with a 100-foot flattop and the vertical wire was about 50 feet, you'd need about 440 microhenries for your coil."

"Here's something that will help you get started with your coil", said Jack, going to the computer. "It's an 'inductance calculator' (see Note 1) and will give you an idea of how many turns you'll need once you know the size of your coil form. I like to use PVC-covered solid wire, something around #14 or #16. Remember to make it a bit bigger than you might need as well as adding several taps at one end, every couple of turns."

Figure 3: Salvaged TV flyback ferrite core for making an impedance matching transformer.

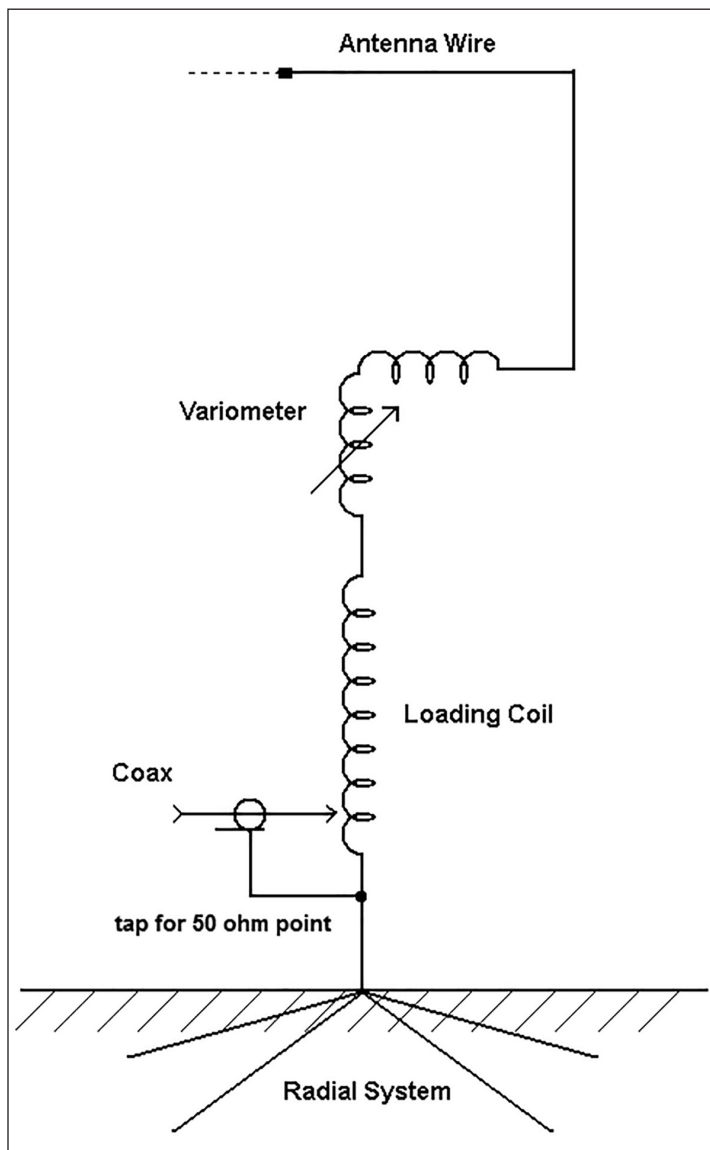


Figure 4: Impedance matching by tapping up the main loading coil.

"There are a few other pieces of gear that will help you get the antenna tuned. One of the handiest that I used, when first getting started, was this. It's a little antenna meter (see Figure 2), designed by KOLR. You just sweep the low-powered oscillator across the MF band while connected to your antenna. When the meter peaks up sharply, that's where your antenna resonates. Once you get the antenna close to resonance, then all that's left is to impedance match it. Here's the schematic info." (see Note 2)

"What about this matching coil then?", asked Edgar, pointing to Jack's original diagram. (see Figure 1)

"If you have any ferrite cores, they'll work just fine. Nothing fancy is needed. In fact, my own matching transformer is wound on an old ferrite TV flyback transformer core (see Figure 3). If I recall, you've got a couple of old video monitors in your stash. Just grab the flyback core from one and you're in business! Wind the secondary, with its taps, on one of the long sides and then wind the smaller primary right on top of it, with a few layers of electrical tape in between the two coils. Also, remove the little thin mica spacer on one side of the core if there is one as you don't need that any longer. If you don't have an old flyback core, just use a large ferrite core."



Figure 5: Homebrew variometer inside main loading coil.
(courtesy VA7BBG)

“You can also impedance match by tapping up on the bottom of the loading coil a few turns to find the 50 ohm point (see Figure 4). Although this method doesn’t require you to wind a transformer, it can be a bit tedious finding the proper spot. It actually sounds harder than it really is, but 630 metres RF behaves just like any RF and you’ve done enough antenna work before to be able to handle it. Getting it properly tuned is all part of the 630 metre challenge. And if you think you may want to run higher power in the future, don’t forget to beef up your end insulators. Make them as big and as long as you can or add a few in series since the ends of your ‘short’ antenna will have some pretty high voltages. Keep the ends away from tree branches as well, to prevent any possible arcing to dry foliage in the summer.”

“Now most fellas like to combine their variometer with the main loading coil, all on one form, while others like to keep them separate (see Figure 5). One interesting design I’ve seen uses a sliding tube arrangement, with one coil sliding in or out to fine-tune the inductance. Either way works the same. Both coils connect in series with one another and the variometer provides a bit of plus and minus tuning to the main coil. You’ll be able to see what frequency the antenna is tuned to with your antenna meter. Depending on where it resonates, you may have to add or remove a few turns from the main coil – no plug and play appliances on this band! I’ll lend you my little meter, but you might want to build one yourself as they’re pretty simple. We’ll also print out some variometer info for you before you head home.” (see Note 3)

“Now, back to this matching business. How will I know when I’m on the right impedance tap Jack? Can I use my HF SWR bridge?”

“Yes, sort of... some fellas have good results while others find that their bridge does not give an accurate reflected reading. It’ll probably tell you when you’ve reached the lowest reflected power at the 50 ohm point, but the actual SWR reading might not be bang on. I’d put it inline as a tuning tool anyway.”

“There’s a couple of other methods you can use as well, once you’ve got your antenna close to resonance. These will work for both the transformer matching or for the 50 ohm tap-up method.

One way is to measure the DC current in your transmitter when running it into a 50 ohm dummy load, then set the tap for that exact same value when running into the antenna. If your antenna is resonant and the impedance is properly matched, the DC current in the amplifier should be identical to what you measured with the dummy load.”

“If you can, try and do this with a short feedline of 50 feet or less. Better yet, right at the antenna if possible. Once everything is properly tuned, the length of your feedline can be increased.”

“You can also tune and match by using your oscilloscope out at the base of the antenna, along with a low power signal from your transmitter, by following the method shown here”, said Jack, pointing to computer once again. (see Note 4)

“You can tune the antenna for resonance as well as find its impedance, which can then be matched to your 50 ohm feedline through the matching transformer. You might even want to use this method to confirm your previous tuning methods are spot on.”

“Most of the 630 guys have built a ‘scope match’ (see Figure 6) before trying to tune their antenna. They’re very simple and if you have a dual-trace scope, you’re all set. Personally I think it’s the most valuable piece of equipment in my shack! It allows you to see the antenna’s voltage and current levels visually and will tell you instantly if your antenna is resonant and how the impedance match looks. You can read all about it here”, said Jack, retrieving several sheets of paper just emerging from the printer. (see Notes 5 & 6)

“I think I might be able to handle this after all Jack. You’ll be there to give me hand, right?”

“That all depends on what your serving for lunch that day”, grinned Jack. “Naw, you know I’d never miss the chance to play with antennas.”

“Now what about power limits Jack? How much power can we run on 630 metres?”

“Thought you’d never ask. Unlike the HF bands, our power limits have been set in terms of radiated power. We’re allowed 5 watts EIRP (see Sidebar 2). Since most backyard antenna systems are pretty inefficient on 630, you need to run a lot more power than just 5 watts to reach that level. A bigger and more efficient antenna would mean running less power than the average station so it all depends on your antenna – every situation is unique.”

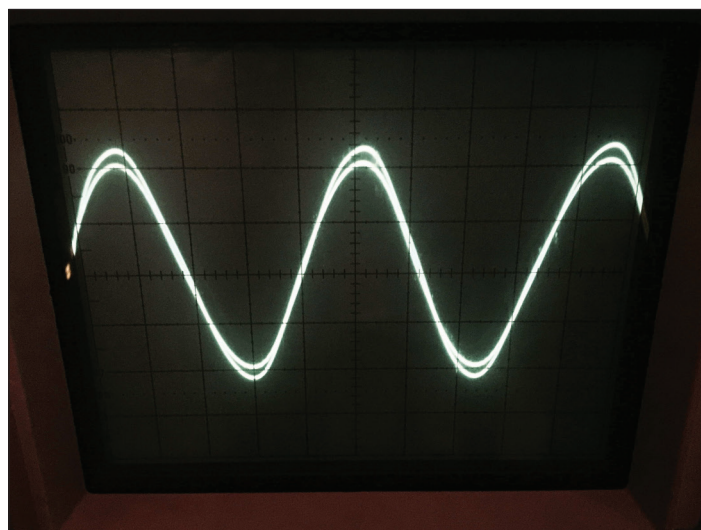


Figure 6: The scopematch screen showing resonance and impedance match condition.

“Okay, I get that. So how do I know how efficient my antenna is? Is there an easy way to figure that out?”, asked Edgar.

“You can try modelling your antenna to get an approximation of its efficiency and then, using the calculated antenna gain value, figure out what power would be needed to reach the allowed limit. Most of the time, though, actual efficiencies will be even lower than the software predicts.”

“Another way is to measure your antenna current once everything is tuned and matched properly then work from there. This will allow you to calculate your antenna’s radiation resistance and then your overall EIRP. One of the American experimental operators has a really good step-by-step explanation of how to do this on his website so that would be a great place to start”, added Jack, moving back to the computer (see Note 7). “There’s also this website Edgar, which will give you a ballpark idea of your EIRP situation.” (see Note 8)

“As usual Jack, you’ve given me a lot to think about. Let me grab those sheets you’ve printed for me and I’m on my way. I’ll stop by the building site on the corner and see if they’ll donate a scrap of that nice fat plastic pipe to a worthy cause!”

“Hey, you’ll never look at construction sites the same way from now on”, added Jack.

“By the way, did you hear the news? It looks like the Americans will finally be getting 630 metres so we’ll soon see a lot of new activity on the band! (see Note 9). There’s a few other boys in town really keen on getting on 630. Maybe we should all get together next week for coffee and talk about it. Give me a call if you need some help – and don’t forget to have fun!”

Notes and Links

Note 1: Coil Inductance Calculator, 66pacific.com – http://www.66pacific.com/calculators/coil_calc.aspx

Note 2: “Using The K0LR ‘Antenna Meter’ on 630m” – <http://ve7sl.blogspot.ca/2014/06/using-k-antenna-meter-on-630m.html>

Note 3: “250 – 400 μ H Variometer”, G0MRF Projects Website – <http://g0mrf.com/variometer.htm>

Note 4: VE7CNF – “630m Antenna Matching Using Just a Resistor” – http://phasordesign.com/VE7CNFamateurradio/AntMatch630m/VE7CNF_AntMatch630m.htm

Note 5: “Your LF Station’s Best Friend. The Scopematch. Part 1” <http://ve7sl.blogspot.ca/2014/08/your-lf-stations-best-friend-scopematch.html>

Note 6: “Your LF Station’s Best Friend. The Scopematch. Part 2” http://ve7sl.blogspot.ca/2014/08/your-lf-stations-best-friend-scopematch_5.html

Note 7: “My First 630 metre Transmitter”, W0YSE’s Ham Radio Site – <http://w0yse.webs.com/wg2xsvpage.htm>

Note 8: Rik, ON7YD/OR7T, 472kHz.org – <http://www.472khz.org/pages/technical-topics/eirp.php>

Note 9: “New Bands! FCC Issues Amateur Radio Service Rules for 630m and 2,200m” – <http://www.arrl.org/news/new-bands-fcc-issues-amateur-radio-service-rules-for-630-meters-and-2-200-meters>

First licensed at age 15, Steve McDonald, VE7SL, is a retired high-school Tech-Ed teacher, now living on Mayne Island in British Columbia. His main interests are homebrewing and CW, particularly on 50 MHz, 160m and on the new 630 metres band.