THE NEWSLETTER OF
THE KINGS COUNTY RADIO CLUB

KCRC

April 2017 *The Semi-Ridiculously Abridged Edition* Volume 4, Issue 4[A]

Minutes of the April 2017 KCRC Meeting,
April 5th, 2017

Our April "Pre-Meeting Question and Answer Session" was varied, with a lot of the discussion regarding how we all got into this hobby of ours.

The monthly meeting was called to order at 8 PM, by our President, Mitch N2RGA. Also present at tonight's meeting were Vice President Howard N2GOT, Treasurer Richard KA2KDQ, General Secretary Roy AC2GS, Executive Board Members at Large Howard K2IGJ and Milen N2NYU, John WB2LFU, and our new members Gustavo KD2MOJ, Alain K1FM, and Lloyd K2JVX.

Treasurer Report—Richard KA2KDQ, reported that our Treasury currently has $912.71 in assets in our bank account, and $514.20 in our Club PayPal account, for a total of $1,426.91.

2 Meter Report—Richard KA2KDQ reported that the 2 Meter Net was doing well, with an average of a dozen check-ins each week. Cross promotion for all the other Club related ventures was urged. All Club ventures should promote the other Services we supply as a Club. Mitch N2RGA offered to substitute for Richard KA2KDQ for April 11th 2 Meter Net, when Richard will be celebrating Passover. John WB2LFU volunteered to replace Richard's old UHF/VHF antenna, so that our Net Control Operator's signal will be loud and clear throughout the 2 Meter Net!

10 Meter Report—Our Net Control operator, Milen N2NYU reported that the 10 Meter Net is thriving, but limited to local check-ins, due to our present poor propagation conditions. If you can put out a 10 Meter signal, please consider checking into our weekly Sunday 10 Meter Net and participating in it with us!

KCRC TechNet —Our Net Control Operator and Host Roy AC2GS reported that the TechNet has consistently attracted great questions, and responses to our TechNet Puzzles. From the beginning, an archive of the TechNet has been made available on the Club website. It is now being streamed via Roy AC2GS' radio to those that cannot receive our Repeater's signal (http://bit.do/KC2RC). We are being promoted on the NYS ARES Nets, on the Big Apple NTS Net, as well as in the LIMARC eLog Newsletter!

Old News: Our last VE Session was on March 19th, where one new Ham qualified for a Technician's license and our own Simon KD2LQE attained his Extra license privileges! There have been some scheduling issues lately. Howard N2GOT volunteered to discuss our concerns with VE Liaison officer John WK2J. The Club is always looking for new VE's to join our VE Sessions, as well as assistant and/or co-Liaison VE Officers. For ANY interested individuals, please contact any Executive Member of the Club, or the return email address for these emails of our Club Meeting's minutes. People took time out of their busy lives to help get you licensed – pass on the favor!

We presently have 40 Club Members, who have paid their 2017 dues! Those previous members that have decided not to continue in the Club will be deleted from our records and our Club mailing list. They were all advised of this by email earlier this week.

The subject of our unrecovered Club QSL cards is now a closed subject.

Personalized Club membership cards were mailed out by Richard KA2KDQ, who will be handling all future membership cards for the remaining portion of 2017.

Mitch reported on our recent successful completed bi-annual membership mailing drive, which was how one of our new members Gustavo KD2MOJ found us!

Field Day was discussed. Milen N2NYU has set up a Google spreadsheet with items that would be useful for the next Field Day. It will be available to all members via the Club website. There were discussions regarding the need for a multi-band dipole, as well as other antennas, the consideration of acquiring fiberglass poles to keep wire antennas properly elevated, as well as the need for more operators, especially during the *graveyard shift*. Mitch N2RGA requested a vote for a new tent for Field Day, which passed unanimously. Different insulated poles were discussed, and Mitch advised us that he will check the prices for intermediate length polls and email them to members for approval of purchase. Different antenna options were discussed as well as hanging our end fed wire antenna in a different configuration was discussed. Please keep up to date with the Field Day 2017 spreadsheet, and volunteer what you can to make this Field Day our most successful one!

Our 2017 Club Roster will be emailed this month to every Club member in good standing along with our monthly minutes.

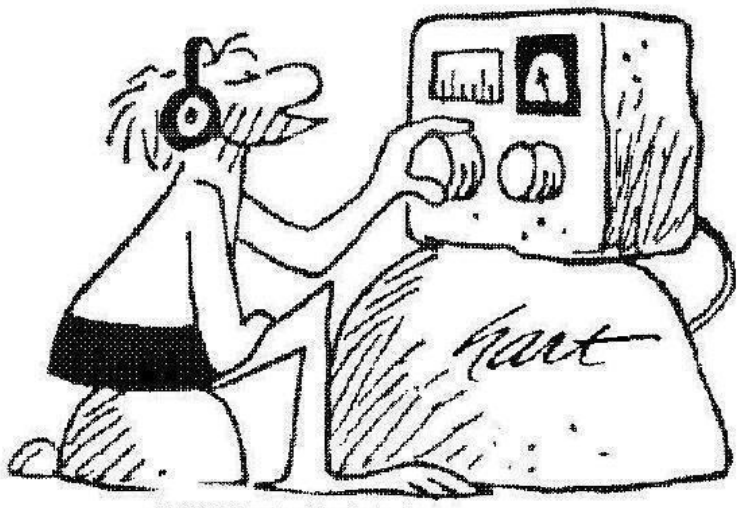
Roy AC2GS mentioned that a visitor to our Club, months ago Lucy KD2MFV, who attempted her SSTV experiment in Iceland would be joining us on our next meeting in May to tell us about it!

At 10:10 PM the meeting was adjoined.

See ya' all in May!

And to those that celebrate, have a Great Passover and a Great Easter!

These minutes were respectfully recorded and submitted by Roy AC2GS on this day, April 5th, in the two thousandth and seventeenth year of our Lord of Propagation…



What Does That Darn Antenna Tuner Really Do?
Well,
“It’s Complicated!”

There are many bones of contention heard on the HF Bands: the optimum length for a transmission line, the satanic side effects of the use of switching power supplies… The list is endless.

But the number one topic of discussion and unending argument is “What do antenna tuners actually do!”

This is discussed by engineer-types, technician-types, even appliance operator-types and it always seems to be distilled down to two extreme camps.

One group considers them almost magical – taking any antenna, be it a finely tuned phase arrayed log-periodic antenna, or a door knob, and turning them all into the “perfect antenna”, with the always sought after 1:1 Standing Wave Ratio (SWR). With the right kind of components, they posit, the insertion loss of an antenna tuner is insignificant and its benefits are almost infinite. In the other camp, an antenna tuner is little more than a parlor trick designed to fool the operator and his transmitter into thinking that a worthless piece of wire is what it isn’t, and never will be. To them the whole thing is a sham, a con, a pile of fertilizer for the less knowledgeable Hams among us!

So, what’s my opinion? Am I a born-again believer, or am I one of the guys crying HERETIC!?

Well, unfortunately, the answer to the title’s question, as Facebook often describes of relationships, is “It’s Complicated”…

The most concise explanation for what an antenna tuner actually does, is that it acts as an impedance transforming circuit, to present your antenna SYSTEM as a 50 ohm impedance load to your transmitter or linear amplifier’s output circuit. That’s it! Just an impedance matching circuit.

It isn’t quite accurate to state that everyone’s transmitter and linear amplifier’s output circuit has a 50 ohm impedance – it is more accurate to suggest that all of these device’s final stages are designed to feed into a circuit which has a 50 ohm impedance.

But what’s so special about 50 ohms?

Well, some might think that it’s because antennas that are resonant have a 50 ohm impedance, but they would be wrong. Resonant center fed half-wave dipoles in free space have an impedance of 73 ohms. The impedance of a classic quarter-wave vertical with transverse ground planes is 36 ohms. The driven element of a Yagi varies with its design, but its uncorrected impedance is often less than 50 ohms.

SO, maybe it’s the inherent characteristic of transmission lines?

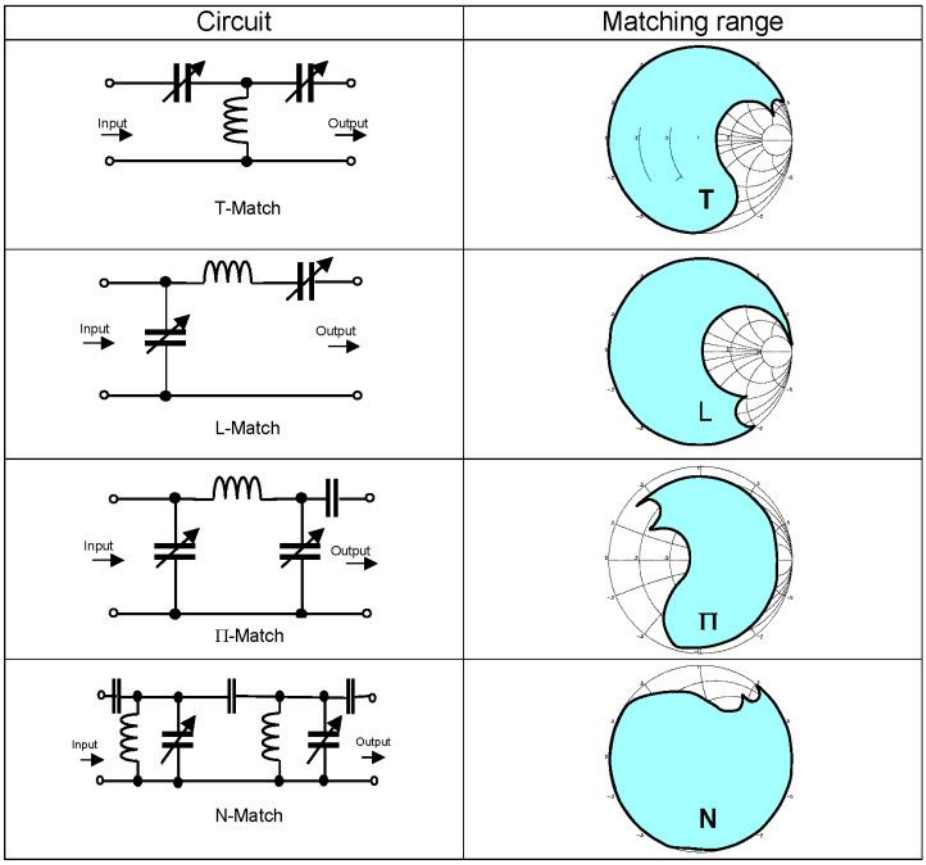
Nope!

You can design a transmission line to be just about any impedance. With open wire it is easy, just change the distance between the two wires. With coaxial cables, it is a bit more complicated – it is a function of the inner conductor’s diameter, the distance to the outer shield and the nature of the insulating dielectric in between. The only place that you can “dial in” its impedance characteristics is when you design and manufacture it!

So, why is it always 50 ohms? Well, like the congress in the good old days, it was basically just a compromise

agreed to by people with different goals. The optimum transmission line impedance for minimum power loss is 75 ohms – this is why your cable company uses nothing but 75 ohms impedance cable. The optimum transmission line impedance for sheer power carrying capability is somewhere around 35 ohms. Since most people who transmit signals over the airwaves are interested in both, the compromise was somewhere in the middle – 50 ohms nominal impedance became the standard!

Your **antenna SYSTEM** is your entire antenna-balun-transmission line-antenna tuner chain, not any particular part of it. An antenna tuner is simply a straightforward impedance transforming circuit made of inductors and capacitors – depending on how you arrange them, they are called "L", "T", or "Pi" impedance matching circuits (there are names for every conceivable way to put capacitors and inductors together). Most antenna tuners used today tend to use L impedance matching circuits – they are more efficient than T circuit designs, still seen in Palstar designs, but they are not quite as broadly capable of properly tuning some impedance mismatches.



(Those objects to the right are ***Smith Chart*** renderings of the impedances that can be matched successfully – ***Smith Charts*** are a fascinating subject, for another article.)

In the good olde days there were designs with mirrored pairs of impedance matching circuits for true balanced antenna tuning – these days most manufacturers that offer a balanced line just shove a 1:1 balun on one antenna input connection and call it a balanced connection!

So, once you've adjusted your antenna tuner for a nice 1:1 SWR your antenna is now fully resonant and radiating 100% of your transmitted signal, right?

Wrong.

All the antenna tuner REALLY does is transform the impedance at the point of the antenna tuner to your transmitter's output connection. That's why you are supposed to put your SWR meter between your antenna tuner and your radio – not on the other side of the antenna tuner, before the antenna tuner gets a chance to

transform its impedance – If your antenna has an impedance of 500 ohms at the frequency you want to transmit on, a SWR meter between your antenna tuner and your coax going to your antenna will still read a SWR of 10:1 even though the antenna tuner's SWR and your radio's SWR meters are reading a blissful 1:1!

For a very short diversion, let's see why impedance mismatches are so bad. The short version of the answer is that when a circuit is designed to feed into a given impedance, it transfers the most amount of energy – when its load is not seen as the optimum impedance, it transfers less energy! Impedance in your antenna system is like different optical densities of transparent media and light rays. Air has a constant optical density, so light just keeps pushing forward, but if it hits a glass of water with two different optical densities (glass and water), that's where the fun starts! At the interface between two optical densities light does some wacky things – it reflects and refracts, and bounces all over the place. In the world of RF we see that with impedance mismatches – when RF strikes these transition zones the RF gets reflected back down in the opposite direction. What's more it can do this multiple times! A final output stage pumping 100 watts out, could possibly see a thousand watts reflected back at itself from multiple past reflections – this could lead to a burnt out final and a trip to the repair shop. Modern radios have "fold over" circuits that decrease your transmission power to a tiny bit of power – your transmitter is "saved" but almost no one will hear you at that transmission level!

So, what do you get out of using an antenna tuner? You get your final output circuit "seeing" the nominal 50 ohms of impedance it was designed to load into! You get the reflected power from the impedance mismatch minimized, so that you don't blow up your final output stage. You get to USE your antenna even if it isn't the perfect antenna for the frequency you need to transmit on!

And what do you **PAY** for the use of this little trick? Well the tuner itself introduces a little loss from its components, primarily its inductor coil. Where you see significant loss, is in the increased transmission line loss introduced by the mismatch reflection **BEFORE** your transmission line gets to your antenna tuner!

What does this kind of loss look like? Well, I just happen to have a line loss table on the truck (pardon to those that never watched "Green Acres")!

100 Watts of drive power with a 75 foot length of transmission line.

Band	LMR400	LMR400	RG8	RG8	RG8x	RG8X	RG58	RG58	Heliax	Heliax	Ladder	Line
SWR	5:1	10:1	5:1	10:1	5:1	10:1	5:1	10:1	5:1	10:1	5:1	10:1
10M	73W	64W	77W	63W	57W	41W	50W	35W	94W	90W	94W	88W
20M	83W	71W	83W	71W	66W	50W	60W	44W	96W	93W	96W	92W
40M	87W	78W	87W	78W	74W	60W	69	53W	97W	95W	97W	94W
80M	90W	83W	90W	83W	80W	68	75	61W	98W	96W	98W	96W

In other words, if you throw 100 watts of RF onto an antenna that had a 10:1 SWR *before* you used your antenna tuner, after traversing 75 feet of LMR400 cable, you'll be lucky if you have 64 Watts of power coming out of your antenna! There just ain't no such thing as a free lunch!

But chill out, power is all "relative" – if your initial 100 Watts ended up being only 25 Watts radiating off of your antenna, that would "only" be a drop of ONE single "S" unit!

What about the numbers with a "magic antenna" that is always a 1:1 SWR, 50 ohms impedance?

Band	LMR400	RG8	RG8X	RG58	Heliax LDF6	450 Ω Ladder
10M	89W	89W	76W	70W	98W	97W
20M	92W	92W	83W	78W	98W	98W
40M	95W	95W	88W	84W	99W	99W
80M	96W	96W	91W	88W	99W	99W

(I'm guessing that that old piece of Radio Shack RG58 isn't looking too much like a good choice to use on your next 10-20 Meter antenna project!?)

There are ways to minimize these losses – you can move your impedance transforming device closer to the antenna's feed point and before most of the transmission line, or you could use very low loss transmission line, like open wire. There are always prices to be paid for these "tricks" – an external tuner needs heavy duty weatherizing and a means to operate it and monitor it remotely, and open line is much more sensitive to metallic objects in its proximity which coaxial cable is indifferent to!

But if I could just get an antenna to REALLY be 50 ohms with a resultant 1:1 SWR and use some of that magic loss-less transmission line, then the Ham world would be my oyster, right?

Nope (anyone getting tired of this particular literary trick?)!

Life is complicated, and antenna design even more so.

You have to consider antenna efficiency (radiative resistance vs insertion losses, component losses, ground losses…

And don't get me started on directional gain and take off angle – an RF signal directed directly at your feet will make a great ground warmer and little else. If it's pointed straight up it might make a decent Near Vertical Incident Skywave (NVIS) for local communications only, but it will make a much better "cloud warmer" for those white puffy clouds above you…

Recall that a dummy load can be a perfect 1:1 impedance matched device, but anyone who would try to use one to win a Worked All Continents Award with it would be…. Well you know why they call it a ***dummy*** load, right?

But those are subjects for another article (or two, or maybe even three).

Anyway, that's my *take* on the subject, of what antenna tuners *really do*! Decide for yourself and try not to argue the point with any *true believers* out there on the HF bands!

73,

Roy AC2GS