Rochester DX Association

No December meeting.

Holiday Dinner Cancelled.

Next meeting:
January 19 2021.

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Deadline for next issue:
February 28, 2021

President's Letter

I hope this finds everyone well – seems like eons since we've been able to meet in person.

On a positive note, we're right in the middle of "contest season" with even some improvement in the SFI of late. I was stunned the other day by numbers above 100, first time in years from what I remember.

With that, there were even some "human decode" signals on 10m. I worked several westerly most European land masses on CW, some signals were 20 over! This also happened during CQWW SSB, actually heard some EU.

Great to see things coming back, it's been a long time coming.

One interesting observation, due to travel restrictions, not too many "score padding" Caribbean stations on. With even a modest station, you could almost work 'em on every band (with the possible exception of 160m). Overall, most DXpeditons have been shelved for at least a year.

Speak of QSO's, I had some time to upload 10 or so logs into LOTW, these were FD and a few "W2RDX" operations over the years. I was even able to convert some of the older (before N1MM) stuff into an ADIF format, these were well over 10 years old. Very nostalgic.

The DXAC met a week ago with some interesting comments on rare DX and how it "may" be handled in the future.

Try this on – a drone would deploy a "station" on an inaccessible (by geographic or "political" restrictions) location – that "station"

would be controlled remotely (let's say from a boat off the coast) and contacts could be made that way.

A smaller crew would need access to setup antennas and in the case of environmentally sensitive locations, no one would inhabit the island for the duration of the expedition – only brief exposure to string up antennas etc. Think of all the equipment that has to be deployed – no more. Limited "footprint" left behind.

This sounds like "star wars" but is being actively discussed. Don't know what that does for P5 but an interesting concept for sure. Not just an idea, this has been actively demonstrated (with a station on a land mass and remote operated from a boat just off its coast).

Interesting times for sure.

The brunt of the meeting always seems to end up with folks crying that they'll never complete top honor roll due to lack of certain entities activated and their age. Sure, I'm disappointed that I'm 3 shy but don't know if it's motivation enough for me to continually badger the ARRL and the PSC.

Looking ahead, FD discussions will begin soon. I sincerely doubt we'll be able to operate under conditions we were afforded in 2019 so what we "may" be able to do should be our focus.

Given current restrictions and the fact that the exercise is "outdoors", we may be able to devise a way to satisfy any mandates that may still be in force and provide an experience close to what we have been use to for years.

This may entail limited on site crews, distancing between operators, site logs that would indicate who was there, when and their temperature. Even though outside, masks may have to be worn (unless operating SSB). There are any number of things we may have to adhere to BUT this may allow us to hold a semi "normal" FD.

The BOD thought is to fashion a proposal that could be presented to the "powers that be", it may have to be approved by county health officials as well. This is entirely dependent on the club overall – do we as an organization want to pursue and if so, will members support that decision? It won't work if we go thru this exercise only to have 3 guys show up to setup and operate.

Granted, things aren't normal and obviously, some have circumstances that preclude activities such as these – full understood. We just need to know if there is a sufficient number of members that will participate.

Otherwise, I suspect the league will support the "D" concept and we can solicit participation that way.

Looking at other 2021 events, our hope is to hold the combined RDXA/RVHFG awards banquet in April. Obviously, this is entirely dependent on facility availability and overall restrictions.

As for meetings, we'll continue with "Zoom" sessions for the foreseeable future.

In the meantime, enjoy the upcoming contests and more importantly, the holiday season.

Best DX es 73
Chris, K2CS

Sunspot Cycle 25

Doug Stewart notes the following from the Butternut Reflector:

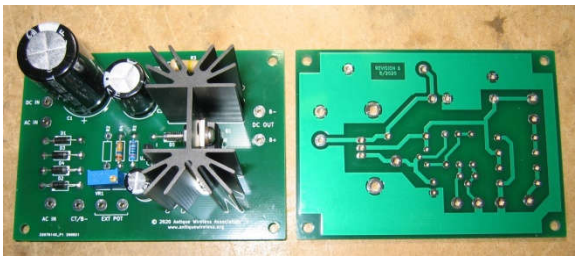
Here's some good news:
A research paper https://arxiv.org/pdf/2006.15263.pdf ,

> Overlapping Magnetic Activity Cycles and the Sunspot Number: Forecasting Sunspot Cycle 25 Amplitude," by Scott W. McIntosh, Deputy Director of the National Center for Atmospheric Research in Boulder, et al., has concluded that Solar Cycle 25 could be among the strongest sunspot cycles ever observed, and will almost certainly be stronger than the just-ended Solar Cycle 24 (sunspot number of 116). The scientists say it will also most likely be stronger than Solar Cycle 23 (sunspot number of 180)
>
> Recent observationally-motivated studies have illustrated a relationship between the Sun's 22-year (Hale) magnetic cycle and the production of the sunspot cycle landmarks and patterns, but not the amplitude of the sunspot cycle. Using (discrete) Hilbert transforms on more than 270 years of (monthly) sunspot numbers we robustly identify the so-called "termination" events that mark the end of the previous 11-yr sunspot cycle, the enhancement/acceleration of the present cycle, and the end of 22-yr magnetic activity cycles. Using these we extract a relationship between the temporal spacing of terminators and the magnitude of sunspot cycles. Given this relationship and our prediction of a terminator event in 2020, we deduce that Sunspot Cycle 25 could have a magnitude that rivals the top few since records began. This outcome would be in stark contrast to the community consensus estimate of sunspot cycle 25 magnitude.

Larry WB6BBB

AWA HV Power Supply

Dean NW2K, via Lynn W2BSN



The Antique Wireless Association is offering a bare printed circuit board of the W3NLB-N6GA regulated variable HV power supply The 2.5" x 3.5" bare PCB is $16.50 shipped to US. A schematic and representative parts list is shipped too.

Mine are set up with a pot for operation between 100-320VDC. Output current depends on the power transformer, pass transistor dissipation and the heatsink. The pass transistor is specified at 1A. Paypal to AWA might be the easiest. WM3D @arrl.net with an email alert to me at NW2K@arrl.Net. Payment goes to help AWA.

2020 NYQP CLI and FRA Activation

Doug N2BEG

For this year's NYQP I wanted to try to add another rare county to the mix while traveling to Franklin County where I have operated NYQP since 2016. There are several rare counties in the north country however they are not conducive to easy access from my base of operations at my friends' cabin. In scouting potential locations, I needed to break out the map and see what was doable. Since I operate portable and not mobile, I needed to find a place to set up an antenna that was not too long of a drive from my base of operations.

Franklin county base of operations

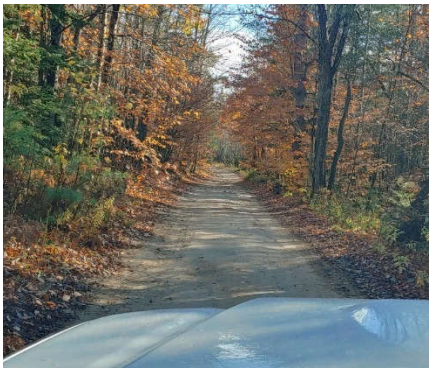
I spoke with my host a few times prior to our trip to see about lining up potential spots in CLI to operate from. The county line is about 13 miles from his QTH. Not bad. He was not sure of any place and was going to look if he had a chance. There are very few folks around up there after the summer ends. Well, he never had a chance, so after our trek up on Friday, we decided to take the hike "over the mountain" to the closest point in Clinton county. This was on a dirt seasonal access road used primarily for logging. It's also a main thoroughfare for anything with 2, 3 or 4 wheels, assorted animals of all shapes and sizes including black beer, deer and the occasional moose. It is 13 miles, but takes

Road sign on the way to Clinton

Clinton County end of the logging road near my operating spot

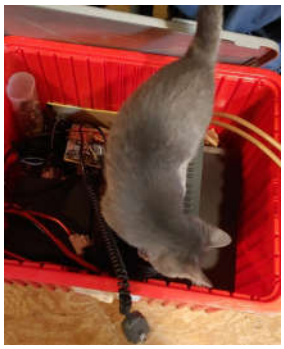
about 30 minutes at the speed necessary to arrive with ones kidneys still relatively in place.

The route was very scenic and offered some great views. The new truck's suspension got a good workout. After driving around the neighboring town and not finding anything suitable in the way of a park or other suitable area, I deciding on an area just off the entrance to the logging road from the other side on Piney Ridge Road. I set about getting the G5RV up as high as possible in a tree and tucked it out of the way for the morning. We then packed up the air cannon and headed back over the hill. Pete put on a great dinner and afterwards I set about unpacking my gear. I had unwittingly left it in the truck while we set over the hill and unbeknownst to me, I would find out latter that was a bad idea. We crashed early and were up early to get ready. I headed over the mountain again and set up. I ran my IC-7000 and ldg tuner and logged with my laptop in the truck. I ran a mix of CW and SSB starting on 20 phone. I had RF issues on CW on 20 so split the rest of the time in Clinton between 20, 40 and 80. 15 never really opened. managed 256 Qs from Clinton before I broke down the antenna and headed back.



On the way back to CLI
(good section of road)

Once back in Franklin, I had to set up the G5RV once again. Pete and my son Jack helped but I had lost a good hour and a half with lunch and the drive back. I got right to it this time using my 746, only to discover the computer wouldn't connect to the rig. Ugh. Nothing I could do but manual freq and mode changes. I had several good runs and totaled 483 Qs in just over 8 hours. Our host was awesome as usual and had added 2 more members to his cozy cabin, Storm and Shadow, both were a tremendous help, along with Oakley the wonder dog who also assisted. My highlight was finally after 4 years of operating in FRA, of working another station in FRA. Im already planning next year's adventure. I may try mobile and hit more northern counties. Thanks to all who got in my log.



Assistant "Storm"

Sunset on the road somewhere in CLI

A Visit with K2MP

Dave Wright

One of my new projects since I've been retired is refurbishment of a small 12v power wheel car for the grandkids to use in the back yard when they visit. My wife saw it on Facebook (of course) and when my son checked it out and saw it had 12v motors – he thought it might be worth throwing a couple bucks at it. It comes with a 12v 9.5 Ah rechargeable battery. After a few days charging in the garage I wondered how close it would come to rated output. I called the resident wizard, K2MP and asked if he could load test a small battery (I'll save you the suspense – it failed miserably). Ed told me to bring it over and he would kick the tires for me. The pretext of me being over there had nothing to do with this article; Ed mentioned that if I wanted some free entertainment that I should come over 9/11 as he was having a dead ash tree taken down.

Ed gave me a call when the crews were setting up, and I headed over for the show. When I got there the crew was hard at work – but given they were going to drop the tree where it stood vs climbing and removing in sections – Ed was concerned about a wire antenna in the back yard (an uneducated guess an 80/40 dipole) fed with ladder line. We grabbed a small step ladder from the garage, and one of the crew used the ladder to reach where the ladder line was tied off to a vertical support beam. The ladder line was allowed to drop to the ground so that if the tree fell a different way – the antenna wouldn't be at risk. As we were watching the crew make their plans for the drop, I noticed Ed examining his ladder line.

Ed – ever the consummate Amateur, took advantage of the ladder line being on the ground – and spent the time to examine it! When I saw this happening, I knew I had to snap a pic for the newsletter!

Lesson from this: Before the cold weather gets here – if you have the opportunity to examine outdoor feedlines, rotor cables, etc. – now's the time.

KX2NY in NYQP

By Bob Schwenk, W2XL

My lifelong friend and ham radio buddy, Bob Lukaszewski , K4HA and I have been doing various multi-ops for many years now. Mainly CQ WW 160 (sometimes from the QTH of Ron, N4XD) and ARRL DX. We swap between my QTH in ENY and his in NC every other year. In 2018 we decided to do a multi-multi from my QTH in Ulster Co. for NYQP. This was high power mixed mode and we won the Plaque in that category, using my call, W2XL . Last year (2019) we decided to change it up and put a real rare county on for NYQP. One of the guys in Hudson Valley Contesters and DXers , Bill NG2D, has a (non-ham) brother-in-law that lives in South Kortwright, Delaware Co. Bill has operated portable in past NYQPs' from there and his brother-in-law agreed to host the three of us. So we did a MM low power mixed mode and had a great time. The operation was FD style, we set up in the garage with two IC-7610s' and two home brew multiband dipoles in the trees at about 40 ft high. We used the call KX2NY, which we thought would be cool for NYQP. Our final score was 368 CW Qs' 251 SSB Q's 95 Mults for 93,765 points. We worked 52 NY counties.

2020 NYQP Air BnB location, Washington County

This year we decided to do another rare county and picked Washington. No QSOs' or logs were reported from there in 2019. I searched on line and found an Air B&B cottage in the town of Greenwich, just over the Hudson River from Saratoga Co. and less than two hours from my home QTH. From the picture on the web, it looked like a great location, on a small hill with a clear shot and a drop-off to the west and SW. I talked to the owner about setting up some ham antennas, in particular, could we put some holes in the ground because the one problem with this QTH was NO trees ! He was more than agreeable, as it turned out his dad (SK) was a ham and he was familiar with ham radio. My XYL and I took a day trip to the cottage a couple weeks before NYQP to scope it out and make sure I knew what we needed to bring.

Washington County antenna setup

The price for the Air B&B was $75 per night; the only drawback was that was for a minimum of 3 nights. We only wanted Friday and Saturday night, but since the price was so low we just bit the bullet and booked three nights, that allowed us ample time to get out on Sunday.

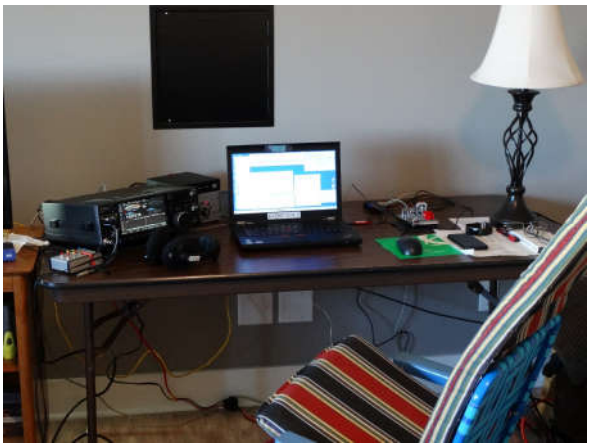
I fabricated a couple 35 ft. masts that attached to a hinged base on a 5 ft. 4 X 4 post. We took a post hole digger with us and put the posts about 2 ft. in the ground and then walked the masts up. We then

used the ends of the dipoles and 2 ropes at 90 degrees from the dipoles to guy the masts. The ends of the dipoles were secured to 6 ft. green metal fence stakes from Lowes and the ropes to short pieces of rebar. The antennas were about 200 ft. apart. The dipoles are 80-40 trapped dipoles with elements for the higher bands added off a common feed point. One is cut for CW and the other for Fone. Bandwidth is pretty good for trapped dipoles, but not enough to cover the whole band on 80 or 40, hence the tuner requirement. All this was tested BEFORE the trip !

Station 1

We used two ICE 419 Bandpass filters and two LDG IT-100 tuners. We found in 2019 from Delaware Co. that the internal tuners in the 7610s' didn't like working thru the ICE boxes and acted squirrely when doing so. We acquired a couple LDG external tuners to use between the antennas and the ICE boxes and that worked well. We also found that the IC-7610s' can co-exist on most band combinations even with-out the ICE boxes in line. We could even work 80 CW and 80 SSB at the same time with no interaction.

We arrived at 10am Friday. Set-up on Friday and Saturday morning went without any problems and at 1400Z we were off. We both operated SSB & CW changing bands and modes as conditions dictated. Conditions and activity were great. 80 – 20 rocked, 15 was a little disappointment but still had some action and 10, well you know. We both operated for 11 hours, just taking two short breaks for lunch and dinner. Our final score (MM, LP, Mixed) 649 CW Qs' , 401 SSB Qs', 99 Mults = 168,003. Our one complaint was we only worked 47 NY counties. We did not have internet at this location, so we didn't have packet. After the contest we celebrated with a little of Scotland's finest, Sunday morning we took down the equipment and were on the way home at 10:30AM



Station 2

Many TNX to the Rochester DX Association for sponsoring the NYQP ! K4HA & I really enjoy it. Also TNX on behalf of the Hudson Valley Contesters and DXers, we enjoy the club competition between us, RDXA and the Niagara Frontier Radiosport gang. Looks like they just beat us this year. Looking forward to 2021 NYQP from another rare county and maybe winning back the club trophy!

73, Bob W2XL

PS : Look for us in NCQP the end of February from Halifax Co. NC , either as K4HA or K4OO, we are hooked !

Efficiencies Reported in the Antenna Simulation Code 4NEC2

John H. "Jack" Kelly, WA2CHV[1]

4NEC2[2] is a free, widely-used[3] antenna-simulation package based upon the Numerical Electromagnetics Code[4] V 2.0, commonly referred to as NEC2. The package consists of two parts: the NEC2 engine[5] written in FORTRAN at the Lawrence Livermore National Laboratory, and a quasi-graphical-user-interface, "4NEC2", written by Arie Voors for the NEC2 engine. Together, the two parts permit rapid modeling of a wide range of rather complex antenna shapes with useful outputs that include VSWR, antenna gain patterns, efficiency, etc. Some of these outputs are directly from the output of the NEC2 engine, others, Arie computes from the data contained in the NEC2 engine output. Most of the package output is self-explanatory, or is well documented, but at least one of the outputs requires further explanation not easily found[6] anywhere.

The "Main" window of Arie Voors 4NEC2 front-end for the NEC2 code reports two numbers for antenna efficiency as shown in **Fig. 1**, below:

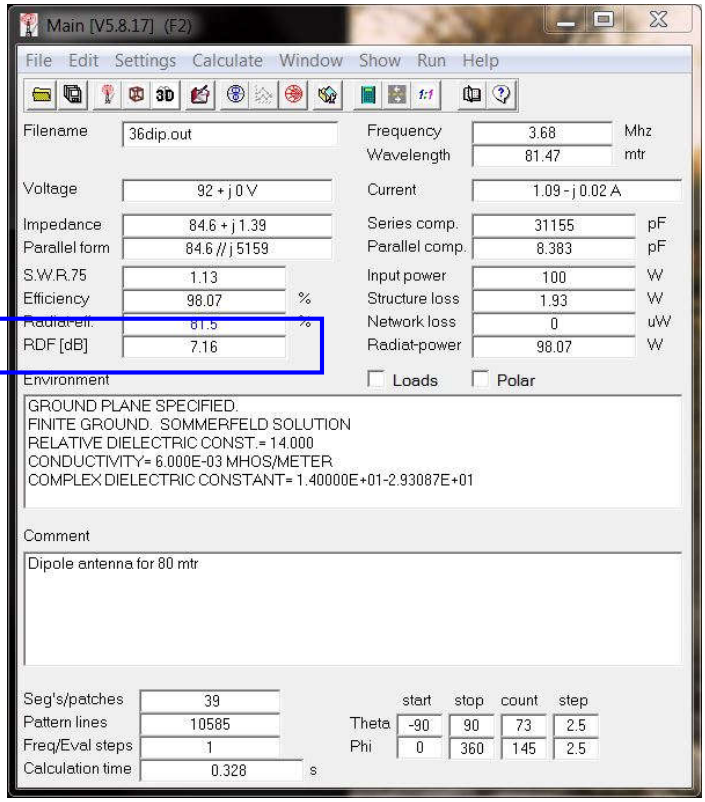


Fig.1: "Main" window for 4NEC2 outlining in blue the two efficiency numbers, "Efficiency" and "Radiat-eff.". The example here is an 80-meter dipole 20 meters above a realistic ground.

[1] Please direct questions, comments, criticisms, and corrections to WA2CHV at ARRL dot net
[2] Downloadable from: https://www.qsl.net/4nec2/
[3] See, for example, Sanchez, M., N2UJN , "Building a 6 (Amateur) Band, 2.5 kw, OCF Dipole for $44", https://www.eham.net/article/38499
[4] Burke, G.J., and A.J. Poggio. 1981 January. Numerical Electromagnetics Code (NEC)—Method of Moments, Lawrence Livermore National Laboratory, Livermore, California, Technical Document, Rep. UCID-18834.
[5] Other authors, in particular L. B. Cebik, W4RNL (SK), refer to the engine as the "core".
[6] At least not by me.

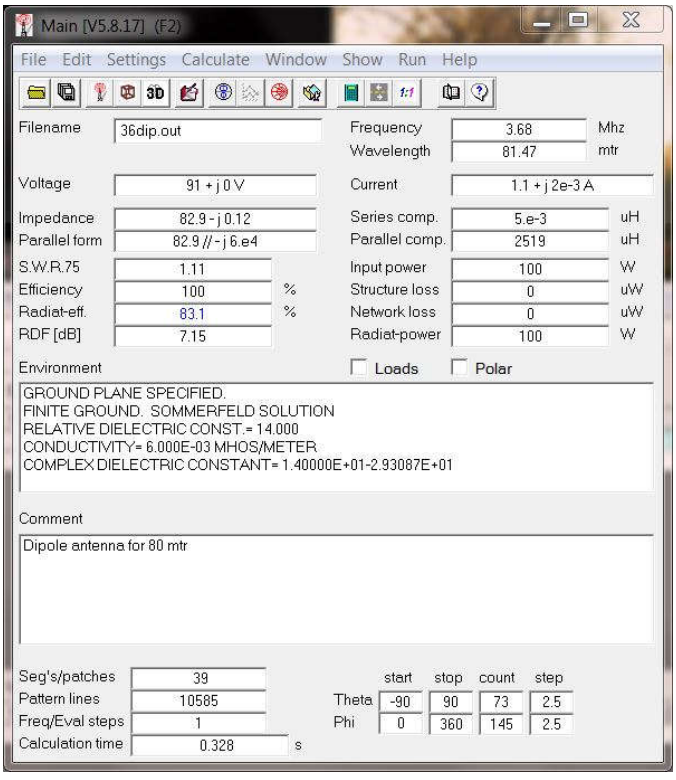
These are arguably the two most important numbers from any antenna simulation because they tell how much of the power delivered to the feed point of the antenna is useful. It is not clear from the available documentation[7,8,9] however, what the precise difference is between these two numbers.

The first "Efficiency" number, 98.07% in this example, comes directly from the NEC2 engine's output file "POWER BUDGET" "EFFICIENCY" as shown in **Fig. 2**, below:

```
- - - POWER BUDGET - - -
   INPUT POWER   = 5.9076E-03 WATTS
   RADIATED POWER= 5.7936E-03 WATTS
   STRUCTURE LOSS= 1.1399E-04 WATTS
   NETWORK LOSS  = 0.0000E+00 WATTS
   EFFICIENCY    =  98.07 PERCENT
```

Fig. 2: Excerpt from the NEC *.out file showing the power budget containing the "Efficiency" as computed by the NEC2 engine.

The "EFFICIENCY" is simply the electromagnetic power that leaves the wire ratioed to the feed point or "INPUT" power in this model. This "RADIATED POWER" is reduced from the "INPUT" power by the "STRUCTURE LOSS" or, more physically, by the I^2R losses in the antenna structure (wire). This is easily shown by rerunning the model with a perfect conductor for the dipole instead of a copper wire as shown in **Fig. 3** below:



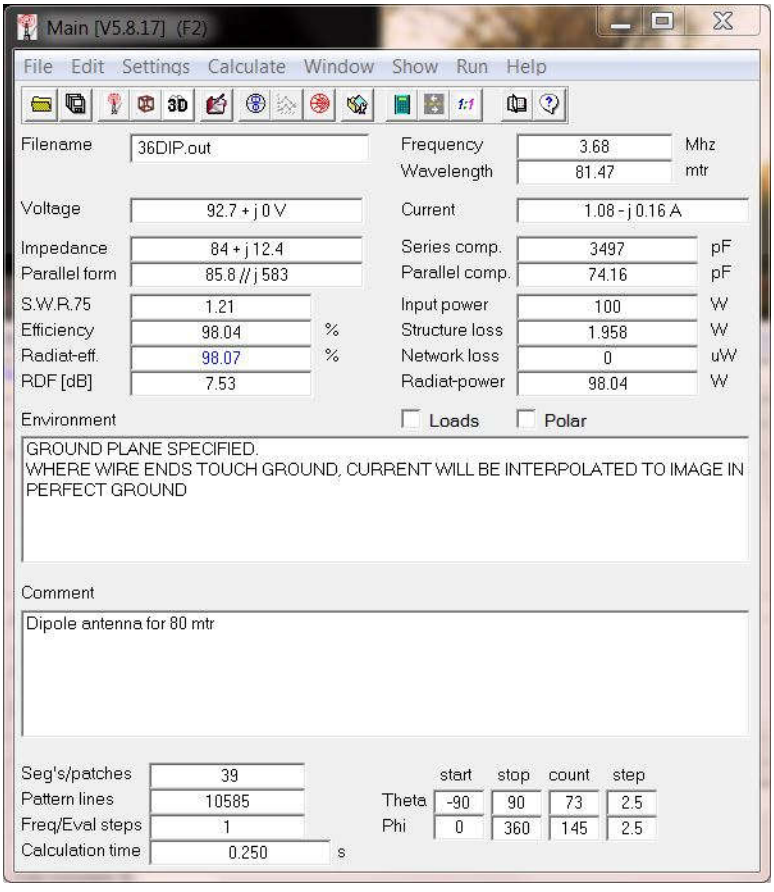
[7] https://www.qsl.net/4nec2/ under "Tutorials".
[8] https://leanpub.com/4nec2definitiveguide/read#leanpub-auto-remainder-of-main-window
[9] https://hamwaves.com/antennas/doc/4nec2.rtf.pdf

Fig.3: "Main" window for 4NEC2 output. The example here is an 80-meter dipole 20 meters above a realistic ground with a perfect conductor hence, "Efficiency"= 100%. There are no structure losses.

The second efficiency number "Radiat-eff." seems to have little explanation in any documentation and its source is thus unclear. This efficiency number appears only when a "Far Field pattern" calculation is selected in the "Generate (F7)" window. The far field of an antenna is physically the field at a distance, R, far enough from the antenna such that the antenna's entire field pattern is transverse, i.e. perpendicular to R. Various formulas are around for how large R has to be to get to the far field, but the important realization is that any DX stations are in the far field of *your* antenna.

Between when the field leaves the antenna structure and its arrival in the far field, it interacts with the ground below the antenna[10]. The field can be partially or totally reflected from the ground, or it can be partially or totally refracted into and absorbed by the ground. If the field is reflected from the ground it combines with the direct field from the antenna and modifies the *shape* of the far field pattern. If the field is refracted into the ground and absorbed, it is *power lost* to the far field pattern and affects antenna efficiency to those DX stations. The "Radiat-eff." reported in the "Main" window of a 4NEC2 far field simulation is the percentage of feed point power available to receivers in the far field of the antenna. It accounts for *both* structure losses *and* ground losses. It is thus, arguably, the most important number of any antenna simulation.

If the ground were a perfect reflector, no power would be lost to the ground although the far field pattern's shape would be affected. In this case "Radiat-eff." should be equal to "Efficiency" in the simulation as shown in **Fig. 4** below:



[10] The non-radiating reactive near fields also interact strongly with the ground and also affect its feed point impedance.

Fig. 4: The example here is an 80-meter dipole 20 meters above a perfect ground. "Radiat-eff." is 98.07% is equal to "Efficiency" at 98.04% within the numerical error of the code.

Ground conditions can have a significant effect on "Radiat-eff." particularly for antennas like a dipole that are less than a quarter-wavelength above ground. **Fig. 5** is the 4NEC2 result for the example dipole over what is considered a poor ground:

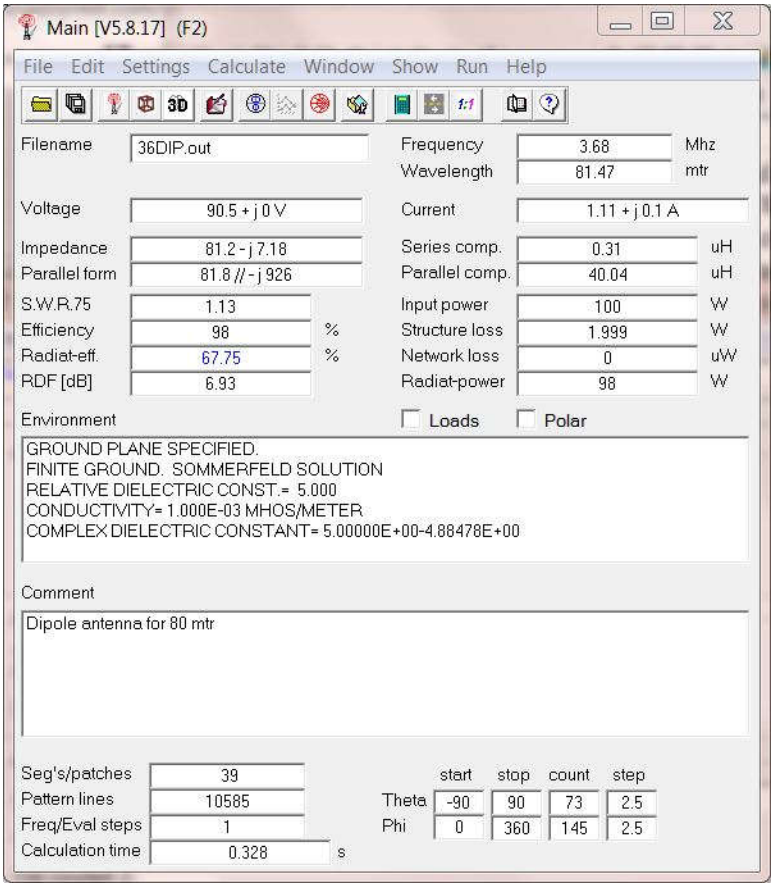


Fig. 5: The example here is an 80-meter dipole 20 meters or one-quarter wave above what is considered a "poor" ground. "Radiat-eff." is 67.75%. Thus, approximately one-third of the energy supplied to the antenna is absorbed in ground losses. Note that 20 meters is approximately 66 feet above the ground. Many amateurs struggle to get an 80-meter dipole even 35 feet above ground.

How is "Radiat-eff." computed? The NEC2 engine does not compute this number. Arie computes it in his 4NEC2 graphical user interface. Although Arie has not released the source code for 4NEC2, it is possible to deduce what he likely did. He calculated "Radiat-eff." from far field data in the NEC2 output file. The NEC2 outputs the far field radiation pattern as a table of electric-field values, for both E_{θ} and E_{ϕ} polarizations, on a grid in a spherical, i.e. (θ, ϕ) coordinate system as shown in **Fig. 6:**

- - - RADIATION PATTERNS - - -

- - ANGLES - -		- POWER GAINS -			- - - POLARIZATION - - -			- - - E(THETA) - - -		- - - E(PHI) - - -	
THETA DEGREES	PHI DEGREES	VERT. DB	HOR. DB	TOTAL DB	AXIAL RATIO	TILT DEG.	SENSE	MAGNITUDE VOLTS/M	PHASE DEGREES	MAGNITUDE VOLTS/M	PHASE DEGREES
-90.00	0.00	-999.99	-999.99	-999.99	0.00000	0.00		5.64556E-12	87.40	0.00000E+00	0.00
-85.00	0.00	-18.79	-999.99	-18.79	0.00000	0.00	LINEAR	6.84374E-02	-79.06	0.00000E+00	0.00
-80.00	0.00	-14.41	-999.99	-14.41	0.00000	0.00	LINEAR	1.13256E-01	-65.39	0.00000E+00	0.00
-75.00	0.00	-11.40	-999.99	-11.40	0.00000	0.00	LINEAR	1.60116E-01	-51.82	0.00000E+00	0.00
-70.00	0.00	-8.65	-999.99	-8.65	0.00000	0.00	LINEAR	2.19769E-01	-40.28	0.00000E+00	0.00
-65.00	0.00	-6.10	-999.99	-6.10	0.00000	0.00	LINEAR	2.94745E-01	-31.50	0.00000E+00	0.00
-60.00	0.00	-3.83	-999.99	-3.83	0.00000	0.00	LINEAR	3.83109E-01	-25.15	0.00000E+00	0.00
-55.00	0.00	-1.85	-999.99	-1.85	0.00000	0.00	LINEAR	4.81049E-01	-20.57	0.00000E+00	0.00
-50.00	0.00	-0.16	-999.99	-0.16	0.00000	0.00	LINEAR	5.84175E-01	-17.23	0.00000E+00	0.00
-45.00	0.00	1.26	-999.99	1.26	0.00000	0.00	LINEAR	6.88128E-01	-14.75	0.00000E+00	0.00
-40.00	0.00	2.45	-999.99	2.45	0.00000	0.00	LINEAR	7.88921E-01	-12.87	0.00000E+00	0.00
-35.00	0.00	3.43	-999.99	3.43	0.00000	0.00	LINEAR	8.83144E-01	-11.44	0.00000E+00	0.00
-30.00	0.00	4.23	-999.99	4.23	0.00000	0.00	LINEAR	9.68085E-01	-10.33	0.00000E+00	0.00
-25.00	0.00	4.86	-999.99	4.86	0.00000	0.00	LINEAR	1.04176E+00	-9.48	0.00000E+00	0.00
-20.00	0.00	5.36	-999.99	5.36	0.00000	0.00	LINEAR	1.10287E+00	-8.83	0.00000E+00	0.00
-15.00	0.00	5.73	-999.99	5.73	0.00000	0.00	LINEAR	1.15068E+00	-8.35	0.00000E+00	0.00
-10.00	0.00	5.98	-999.99	5.98	0.00000	0.00	LINEAR	1.18487E+00	-8.02	0.00000E+00	0.00
-5.00	0.00	6.13	-999.99	6.13	0.00000	0.00	LINEAR	1.20537E+00	-7.83	0.00000E+00	0.00
0.00	0.00	6.18	-999.99	6.18	0.00000	0.00	LINEAR	1.21220E+00	-7.77	0.00000E+00	0.00
-90.00	5.00	-999.99	-999.99	-999.99	0.00000	0.00		5.63428E-12	87.39	8.11104E-13	-7.77
-85.00	5.00	-18.80	-32.79	-18.63	0.18799	-3.89	RIGHT	6.82997E-02	-79.06	1.36529E-02	171.78
-80.00	5.00	-14.43	-26.95	-14.19	0.19448	-7.67	RIGHT	1.13023E-01	-65.39	2.67292E-02	171.40
-75.00	5.00	-11.42	-23.66	-11.17	0.16107	-10.42	RIGHT	1.59776E-01	-51.82	3.90338E-02	171.10
-70.00	5.00	-8.67	-21.44	-8.45	0.11439	-11.28	RIGHT	2.19281E-01	-40.28	5.04023E-02	170.87
-65.00	5.00	-6.12	-19.83	-5.94	0.07528	-10.88	RIGHT	2.94055E-01	-31.51	6.07060E-02	170.71
-60.00	5.00	-3.85	-18.61	-3.70	0.04817	-10.00	RIGHT	3.82162E-01	-25.15	6.98558E-02	170.62
-55.00	5.00	-1.87	-17.67	-1.76	0.03064	-9.05	RIGHT	4.79789E-01	-20.57	7.78043E-02	170.60
-50.00	5.00	-0.19	-16.95	-0.10	0.01949	-8.18	RIGHT	5.82554E-01	-17.23	8.45469E-02	170.65
-45.00	5.00	1.24	-16.40	1.31	0.01239	-7.45	RIGHT	6.86110E-01	-14.75	9.01200E-02	170.76
-40.00	5.00	2.42	-15.98	2.48	0.00784	-6.84	RIGHT	7.86485E-01	-12.87	9.45967E-02	170.92
-35.00	5.00	3.40	-15.66	3.45	0.00489	-6.35	RIGHT	8.80285E-01	-11.44	9.80814E-02	171.11
-30.00	5.00	4.20	-15.43	4.24	0.00299	-5.96	RIGHT	9.64817E-01	-10.33	1.00701E-01	171.33
-25.00	5.00	4.83	-15.27	4.87	0.00176	-5.64	RIGHT	1.03811E+00	-9.48	1.02594E-01	171.55
-20.00	5.00	5.33	-15.16	5.37	0.00098	-5.40	RIGHT	1.09889E+00	-8.83	1.03904E-01	171.77
-15.00	5.00	5.69	-15.09	5.73	0.00049	-5.22	RIGHT	1.14643E+00	-8.35	1.04763E-01	171.96
-10.00	5.00	5.95	-15.05	5.98	0.00020	-5.10	RIGHT	1.18042E+00	-8.02	1.05287E-01	172.11
-5.00	5.00	6.10	-15.02	6.13	0.00005	-5.02	RIGHT	1.20080E+00	-7.83	1.05564E-01	172.20
0.00	5.00	6.15	-15.02	6.18	0.00000	-5.00	LINEAR	1.20758E+00	-7.77	1.05650E-01	172.23

Fig. 6: Part of a far field radiation pattern table from a NEC2 output file. A diagram of the NEC2 output coordinate system[11] is shown in **Fig. A2** in the Appendix.

These electric field values are squared and summed according to the following prescription:

$$P_{Radiat} = \frac{c\varepsilon_0}{2}\sum_{j=0}^{2\pi}\sum_{i=0}^{-\pi/2}\left[E_\theta^2(\theta_i,\phi_j)+E_\phi^2(\theta_i,\phi_j)\right]\sin(\theta_i)\Delta\theta\Delta\phi$$

to obtain the total power, P_{radiat} in the far field. This total power is then ratioed to the feed point power to compute "Radiat-eff." The derivation of this formula and the definition of terms is relegated to the Appendix.

This double-summation can be easily duplicated in a Microsoft Excel® spreadsheet. This can be useful for determining the power launched to the far field in either vertical (E_θ) or horizontal (E_ϕ) polarization[12] from antennas that have mixed-polarization output such as inverted-L's. The data from the NEC2 *.out file pattern table can be copied and pasted into the spreadsheet and then formatted into columns by using Excel's "Text to columns" feature. The E_θ and E_ϕ columns can be squared and summed and the sum multiplied by the appropriate constants to obtain "Radiat-eff.". A caveat is that in NEC2's polar coordinate system the polar angle, θ, runs from 0 to -180° (-θ) rather than from 0 to +180° (+θ). The inner, θ, sum will run from 0 to either -90° (-π/2) or to -180° (-π) depending upon whether or not a ground has been specified. A diagram of the coordinate system is included as **Fig. A2** in the Appendix.

A second caveat is the pattern table includes field magnitude values for ϕ=0° and ϕ=360°. This is naturally duplication and only one of these sets of field values should be included in the summation.

[11] L, B, Cebik, W4RNL (SK), http://on5au.be/content/amod/amod90.html

[12] This ignores any polarization rotation due to propagation. This also can be done for right-hand or left-hand circular polarizations but is more complicated.

The denominator in the ratio for Radiat-eff is taken from the power table just before the pattern table in the *.out file as shown in **Fig. 2.** In **Fig. 2** the number to be used in the denominator is "INPUT POWER = 5.9076E-03 WATTS".

In summary, there are two efficiencies reported by the antenna simulation package 4NEC2: "Efficiency" and "Radiat-eff." "Efficiency" is the power radiated by the antenna structure and accounts for I^2R losses in the antenna structure itself. "Radiat-eff." is only computed when a Far Field pattern calculation is requested. The "Radiat-eff." includes losses to the ground beneath the antenna as well as the I^2R losses. Given measurements of the ground conductivity and permittivity, ground losses can be modeled. Arie Voors computes "Radiat-eff." in his 4NEC2 graphical user interface from far field data in the NEC2 engine output file. Using the summation given, a 4NEC2 user can compute "Radiat-eff." for individual polarizations. This can be useful for modeling antennas that have mixed polarization outputs such as inverted-L's.

Appendix: Derivation of "Radiat-eff" in 4NEC2

The quantity "Radiat-eff" reported in the "Main" window of 4NEC2 mathematically is the surface integral[13] in the far field of the Poynting vector over either a hemisphere or a sphere depending upon whether a ground has or has not been specified in the 4NEC2 model. Physically it is the ratio of the power available to any receiving antennas in the far field to the power input to the antenna structure.

In order to compute "Radiat-eff" from the Poynting vector, the far-field electric field, or the far-field magnetic field, or both must be computed by NEC2. NEC2 only does this computation when the user selects "Far Field pattern" in the "Generate (F7)" window in the "Calculate -> NEC output-data F7" pull-down menu. When "Far Field pattern" is selected, NEC2 prints the pattern, in polar coordinates, as an ASCII table in the *.out file for the simulation. The table appears late in the file after the "- - - RADIATION PATTERNS - - -" heading.

The power available in the far field (R large) from an antenna, P_{Radiat}, is given by[14]:

$$P_{Radiat} = R^2 \iint S(R,\theta,\phi)\sin(\theta)d\theta d\phi$$

where $S(R,\theta,\phi)$ is the Poynting vector in units of power per unit area and the integration is over the surface of a hemisphere or sphere of large radius R in polar coordinates □ and □. At large R distances[15], the Poynting vector can be rewritten in terms of just the *magnitude* of the electric field, $E(R,\theta,\phi)$ which has units of Volts/meter as:

$$S(R,\theta,\phi) = \frac{c\varepsilon_0}{2} E^2(R,\theta,\phi)$$

where c is the speed of light, ε_0 is the permittivity of free space in units of capacitance/length and is equal to 8.854×10^{-12} Farad/meter, and the factor of $\frac{1}{2}$ converts the *magnitudes* of the electric fields to the rms average electric fields. The quantity $1/c\varepsilon_0$ is equal to 377 ohms, the impedance of free space. Ratioing P_{Radiat} to the input power to the antenna structure will yield "Radiat-eff".

[13] Technically just the normal part of the surface integral

[14] The derivation here follows that of Constantine A. Balanis, "Antenna Theory", 3rd edition, Wiley-Interscience, N.J. 2005, §2.4. I have used Physics/Optics terminology thought rather than the Electrical Engineering terminology for the quantities involved.

[15] By this is meant that the electromagnetic wave is a TEM wave and its k-vector is parallel to the surface normal of the integration sphere.

The "*Numerical Electromagnetics Code (NEC) – Method of Moments* manual Part III: User's Guide" states in Section IV, "NEC Output", on page 95 that: "The radiation-pattern format also includes the radiated electric field in □ and □ components. These are labeled with the units 'volts/m' for $E(R,\theta,\phi)$. Unless the range, R, is specified on the RP card, however, the quantity printed is the limit of $RE(R,\theta,\phi)$ as R approaches infinity, having units of volts." The range, R, is a floating-point number entered in columns 61 through 70 of the RP or "Radiation Pattern" card[16] and is not specified anytime in this work so that the printed radiated electric field will, indeed, have units of volts. To be precise the printed electric field in this case has units of volts per unit solid angle.

So for very large R which is the case here, RE(R,□,□) can be replaced by E(□,□) in the above integral for P_{Radiat} and rewriting as a summation of the data in the NEC2 *.out file's pattern table:

$$P_{Radiat} = \frac{c\varepsilon_0}{2}\iint E^2(\theta,\phi)\sin(\theta)d\theta d\phi = \frac{c\varepsilon_0}{2}\sum_{j=0}^{2\pi}\sum_{i=0}^{-\pi/2}E^2(\theta_i,\phi_j)\sin(\theta_i)\Delta\theta\Delta\phi$$

where $\Delta\theta$ and $\Delta\phi$ are the angle increments (default value of 5°) in the 4NEC2 simulation expressed in units of radians. The quantity $E^2(\theta,\phi)$is the sum of the radiated electric field's □ and □□polarization components' magnitude:

$$E^2(\theta,\phi) = E_\theta^2(\theta,\phi) + E_\phi^2(\theta,\phi)$$

The quantities $E_\theta(\theta,\phi)$and $E_\phi(\theta,\phi)$ in units of volts per unit solid angle are exactly the numbers in the columns "E(THETA) MAGNITUDE VOLTS/M" and "E(PHI) MAGNITUDE VOLTS/M" of the NEC2 *.out file's pattern table shown in **Fig. A1** below:

- - - RADIATION PATTERNS - - -

- - ANGLES - -		- POWER GAINS -			- - - POLARIZATION - - -			- - - E(THETA) - - -		- - - E(PHI) - - -	
THETA	PHI	VERT.	HOR.	TOTAL	AXIAL	TILT	SENSE	MAGNITUDE	PHASE	MAGNITUDE	PHASE
DEGREES	DEGREES	DB	DB	DB	RATIO	DEG.		VOLTS/M	DEGREES	VOLTS/M	DEGREES
-90.00	0.00	-999.99	-999.99	-999.99	0.00000	0.00		5.64556E-12	87.40	0.00000E+00	0.00
-85.00	0.00	-18.79	-999.99	-18.79	0.00000	0.00	LINEAR	6.84374E-02	-79.06	0.00000E+00	0.00
-80.00	0.00	-14.41	-999.99	-14.41	0.00000	0.00	LINEAR	1.13256E-01	-65.39	0.00000E+00	0.00
-75.00	0.00	-11.40	-999.99	-11.40	0.00000	0.00	LINEAR	1.60116E-01	-51.82	0.00000E+00	0.00
-70.00	0.00	-8.65	-999.99	-8.65	0.00000	0.00	LINEAR	2.19769E-01	-40.28	0.00000E+00	0.00
-65.00	0.00	-6.10	-999.99	-6.10	0.00000	0.00	LINEAR	2.94745E-01	-31.50	0.00000E+00	0.00
-60.00	0.00	-3.83	-999.99	-3.83	0.00000	0.00	LINEAR	3.83109E-01	-25.15	0.00000E+00	0.00
-55.00	0.00	-1.85	-999.99	-1.85	0.00000	0.00	LINEAR	4.81049E-01	-20.57	0.00000E+00	0.00
-50.00	0.00	-0.16	-999.99	-0.16	0.00000	0.00	LINEAR	5.84175E-01	-17.23	0.00000E+00	0.00
-45.00	0.00	1.26	-999.99	1.26	0.00000	0.00	LINEAR	6.88128E-01	-14.75	0.00000E+00	0.00
-40.00	0.00	2.45	-999.99	2.45	0.00000	0.00	LINEAR	7.88921E-01	-12.87	0.00000E+00	0.00
-35.00	0.00	3.43	-999.99	3.43	0.00000	0.00	LINEAR	8.83144E-01	-11.44	0.00000E+00	0.00
-30.00	0.00	4.23	-999.99	4.23	0.00000	0.00	LINEAR	9.68085E-01	-10.33	0.00000E+00	0.00
-25.00	0.00	4.86	-999.99	4.86	0.00000	0.00	LINEAR	1.04176E+00	-9.48	0.00000E+00	0.00
-20.00	0.00	5.36	-999.99	5.36	0.00000	0.00	LINEAR	1.10287E+00	-8.83	0.00000E+00	0.00
-15.00	0.00	5.73	-999.99	5.73	0.00000	0.00	LINEAR	1.15068E+00	-8.35	0.00000E+00	0.00
-10.00	0.00	5.98	-999.99	5.98	0.00000	0.00	LINEAR	1.18487E+00	-8.02	0.00000E+00	0.00
-5.00	0.00	6.13	-999.99	6.13	0.00000	0.00	LINEAR	1.20537E+00	-7.83	0.00000E+00	0.00
0.00	0.00	6.18	-999.99	6.18	0.00000	0.00	LINEAR	1.21220E+00	-7.77	0.00000E+00	0.00
-90.00	5.00	-999.99	-999.99	-999.99	0.00000	0.00		5.63428E-12	87.39	8.11104E-13	-7.77
-85.00	5.00	-18.80	-32.79	-18.63	0.18799	-3.89	RIGHT	6.82997E-02	-79.06	1.36529E-02	171.78
-80.00	5.00	-14.43	-26.95	-14.19	0.19448	-7.67	RIGHT	1.13023E-01	-65.39	2.67292E-02	171.40
-75.00	5.00	-11.42	-23.66	-11.17	0.16107	-10.42	RIGHT	1.59776E-01	-51.82	3.90338E-02	171.10
-70.00	5.00	-8.67	-21.44	-8.45	0.11439	-11.28	RIGHT	2.19281E-01	-40.28	5.04023E-02	170.87
-65.00	5.00	-6.12	-19.83	-5.94	0.07528	-10.88	RIGHT	2.94055E-01	-31.51	6.07060E-02	170.71
-60.00	5.00	-3.85	-18.61	-3.70	0.04817	-10.00	RIGHT	3.82162E-01	-25.15	6.98558E-02	170.62
-55.00	5.00	-1.87	-17.67	-1.76	0.03064	-9.05	RIGHT	4.79789E-01	-20.57	7.78043E-02	170.60
-50.00	5.00	-0.19	-16.95	-0.10	0.01949	-8.18	RIGHT	5.82554E-01	-17.23	8.45469E-02	170.65
-45.00	5.00	1.24	-16.40	1.31	0.01239	-7.45	RIGHT	6.86110E-01	-14.75	9.01200E-02	170.76
-40.00	5.00	2.42	-15.98	2.48	0.00784	-6.84	RIGHT	7.86485E-01	-12.87	9.45967E-02	170.92
-35.00	5.00	3.40	-15.66	3.45	0.00489	-6.35	RIGHT	8.80285E-01	-11.44	9.80814E-02	171.11
-30.00	5.00	4.20	-15.43	4.24	0.00299	-5.96	RIGHT	9.64817E-01	-10.33	1.00701E-01	171.33
-25.00	5.00	4.83	-15.27	4.87	0.00176	-5.64	RIGHT	1.03811E+00	-9.48	1.02594E-01	171.55
-20.00	5.00	5.33	-15.16	5.37	0.00098	-5.40	RIGHT	1.09889E+00	-8.83	1.03904E-01	171.77
-15.00	5.00	5.69	-15.09	5.73	0.00049	-5.22	RIGHT	1.14643E+00	-8.35	1.04763E-01	171.96
-10.00	5.00	5.95	-15.05	5.98	0.00020	-5.10	RIGHT	1.18042E+00	-8.02	1.05287E-01	172.11
-5.00	5.00	6.10	-15.02	6.13	0.00005	-5.02	RIGHT	1.20080E+00	-7.83	1.05564E-01	172.20
0.00	5.00	6.15	-15.02	6.18	0.00000	-5.00	LINEAR	1.20758E+00	-7.77	1.05650E-01	172.23

[16] I have not been able to identify a place in Ari Voors' front-end where the range can be entered.

Fig. A1: Radiation pattern table from a NEC2 output file.

The rolled-up prescription for obtaining P_{Radiat} from NEC2 *.out file's pattern table is therefore (finally):

$$P_{Radiat} = \frac{c\varepsilon_0}{2}\sum_{j=0}^{2\pi}\sum_{i=0}^{-\pi/2}\left[E_\theta^2(\theta_i,\phi_j)+E_\phi^2(\theta_i,\phi_j)\right]\sin(\theta_i)\Delta\theta\Delta\phi$$

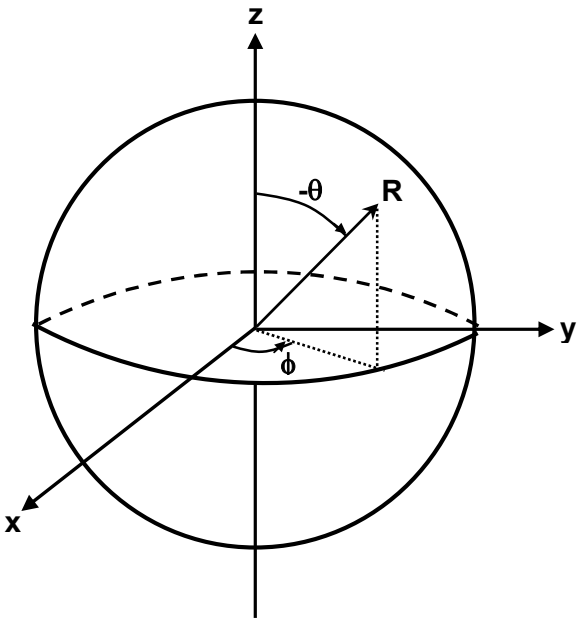


Fig A2: Coordinate system used for the far field output in NEC2

RDXA 2020-21 Calendar

September 2020

~~1~~	~~BOD – K2CS (MacGregor's)~~
~~10-12~~	~~**ARRL September VHF**~~
~~15~~	~~Meeting – Zoom – Show shack~~
~~**26-27**~~	~~**CQWW RTTY**~~

October 2020

~~6~~	~~BOD - K2TER~~
~~20~~	~~Meeting –Zoom – DX Eng~~
~~**17-18**~~	~~**NYQP**~~
~~**24-25**~~	~~**CQWW SSB**~~

November 2020

~~4~~	~~BOD – **WED** – K2DH~~
~~**7-9**~~	~~**ARRL SS CW**~~
~~**16-18**~~	~~**ARRL SS SSB**~~
~~17~~	~~Meeting – Zoom - TBA~~
~~**21-23**~~	~~**CQWW CW**~~
~~**30**~~	~~**BULLETIN DEADLINE**~~

December 2020

2	BOD - **WED** - Zoom - FD
4-6	**ARRL 160m CW**
12-13	**ARRL 10m**
26-27	**Stew Perry 160m CW**

January 2020

2-3	**ARRL RTTY Roundup**
5	BOD
16-18	**ARRL January VHF**
19	Meeting - Zoom
29-31	**CQWW 160m CW**

20
??

February 2021

2	BOD
13-14	**CQWW WPX RTTY**
20-21	**ARRL DX CW**
16	Meeting - Zoom
25-28	**CQWW 160m SSB**
28	**BULLETIN DEADLINE**

March 2021

2	BOD
6-7	**ARRL DX SSB**
16	Meeting - Zoom
27-28	**CQWW WPX SSB**

April 2021

6	BOD
20	Meeting - Zoom
??	Combined Awards Banquet ??

May 2021

4	BOD
18	Meeting - Zoom
21-23	Dayton Hamvention ??
29-30	**CQWW WPX CW**
31	**BULLETIN DEADLINE**

June 2021

1	BOD
??	Rochester Hamfest ??
15	Meeting - Zoom
17-18	**ARRL June VHF**
26-27	**ARRL Field Day ??**

July 2021

10-11	**IARU**
18-19	**CQWW VHF**

August 2021

??	ROC City Hamfest ??
31	Contest season concludes
	Membership year concludes
31	**BULLETIN DEADLINE**

Rochester DX Association

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This Bulletin is the official publication of the Rochester DX Association and is published Quarterly.

All those with an interest in amateur radio, DXing and contesting are cordially invited to any meeting and to join RDXA.

Meetings are held at 19:30 [illegible] 3rd Tuesday [illegible] une.
M[illegible]
En[illegible]
Sc[illegible]

IN-PERSON MEETINGS ARE CANCELLED DUE TO THE PANDEMIC.
See Calendar and first page for online meeting schedule.

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