Interesting entertainment on the 630 meter range

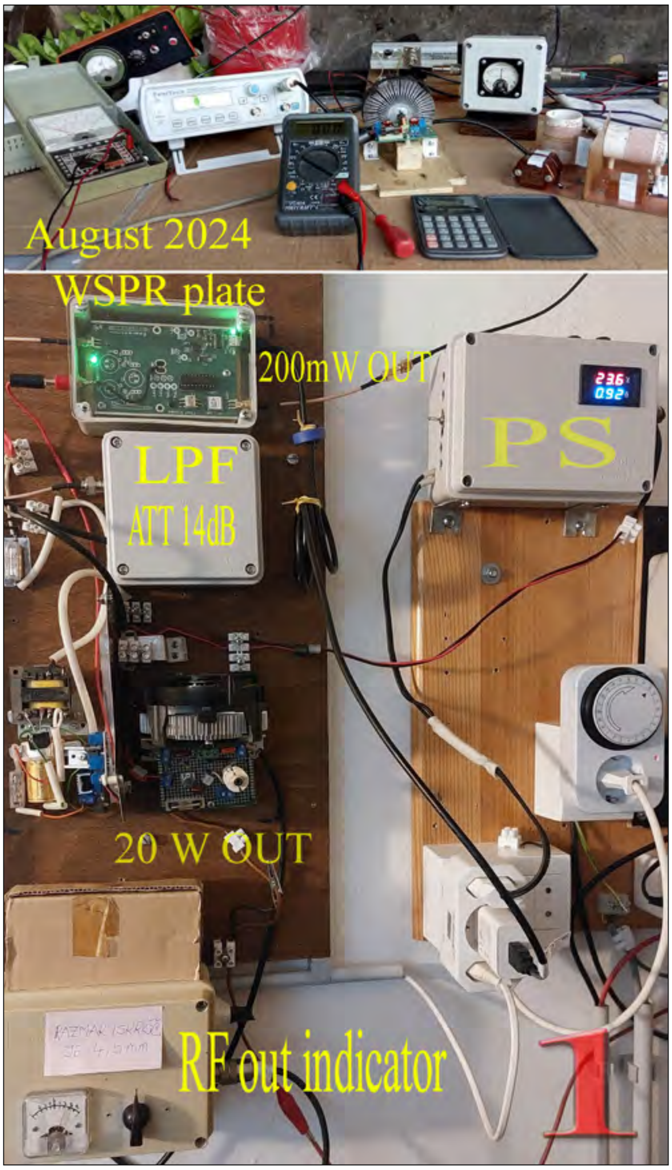
Avtor: Jože Konda, S52AB
email: s52ab.joze@gmail.com

Jože, with the antenna you plan to make for kilohertz frequencies, you will not achieve anything. It is not even worth trying. And if someone who considers himself an expert on antennas (not from S5) claims this, it can only be a challenge and not "throwing a gun at the corn".

The continuation is known ... "I have no comment. This is a miracle for me" was the expert's answer. And in his opinion, neither before nor after, he was not the only one.

So that it doesn't get boring

The idea came to me last year in the summer heat and in the shade, that it would be interesting to try again "at kilohertz" and with some smaller and simpler devices that would operate at a certain, for these frequencies, power at the output. Let's say that about ten watts would be enough for a start, but later I'll see how far the power will climb (top picture of picture 1). The radiated power here is measured in milliwatts anyway, because of the much too short antenna. I also had a condition that only the most necessary things were purchased, because after the tests were done, the devices went into storage. Something that would be screwed to a board and hung in the basement on the wall and turned on by a time clock, it would emit a signal that can be monitored on numerous SDR receivers around the world.



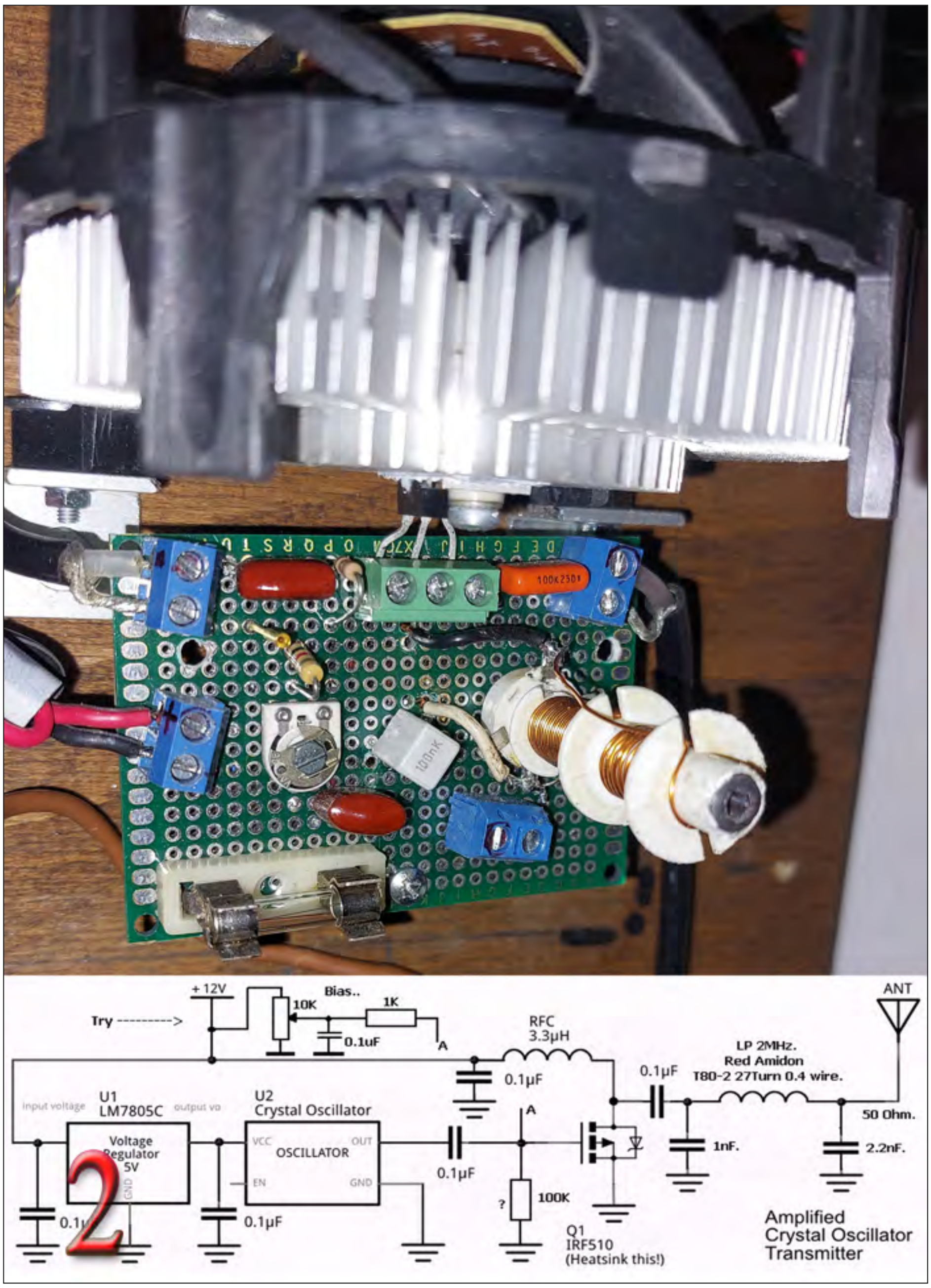
Picture 1: The picture above shows the individual elements at the start of the project. The picture below shows the placement of the elements of the transmitting part on the wall in the basement.

Implementation of the idea

The DDS, which I used years ago at 137, 500 and 472 kHz, was not suitable for these purposes. Neither were the amplifiers. For the signal generator, I used a FeelTech FY3200S, which I already had and which, for initial experimentation, can be set to a frequency accuracy of under one hertz (which is not necessary in this case) and also has a power from zero to about 100 mW. The signal from the generator to the amplifier will be switched by a mini coaxial relay at 12 V controlled by an Arduino board, which is mounted in a special box with its power supply and relay.

Next is the amplifier. I had some experience with this in experiments at 3.5 MHz and chose the simplest implementation with a low-cost IRF510 FET (picture 2). In my unprofessional opinion, it doesn't get any simpler. However, I did not take into account that the assemblies intended for shortwave frequencies require, in certain segments, appropriate processing for work in the 630 meter range. What followed was a “fun” of how to do it properly. Since I had a fuse in front of the drain, it only flashed in this place and the fuses did not burst in series as seen in similar experiments on the net. Well, there was a “swish” of the fuse and if it was in the basement, it could be felt in the air for quite some time. The fuse got dirty and the drain opened. If, for example, the amplifier with this fet worked “from the start” at 3.5 MHz, this was not the case at all on 630m. However, in the end, after numerous consultations, it was necessary to determine the value of the drain coil, the gate voltage and get the appropriate drain voltage, so that after all this, the amplifier would give as much power as the drain voltage for this fet allows.

In the end, the matter became routine, and the amplifier, with a fairly precisely defined excitation, appropriate voltages and drain coil values, which after tuning the antenna as described below, operates stably even with several minutes of continuous load. During this time at a power of 20 and even a few watts more. It is cooled by a star-shaped cooler with a fan (Figure 2), which is used in computer processors. I also made three examples of LPF filters. After measurements performed by Siniša S52ST, I decided to use the filter as shown in Figure 3.



Picture 2: The picture above shows the assembled assembly according to the plan below.

Antenna

The condition was that the antenna be made from existing material that was already unused, within reach and that only the most necessary little things were purchased. The next condition is that after manufacturing it, I have to set it up myself. To begin with, I combined a set of pipes about 10 meters high, which will allow me to carry the coil, which will be raised with “top-hat” wires with a pulley to a certain height, which was then possible about 8-9 meters from the ground. In this first attempt last September, it was at the aforementioned height, with a coil of 175 microH, from which three wires of 10 meters long descend from the “SMB coils” familiar to all of us older people, mainly in a westward direction with the lower end of the wire about 5 meters above the ground. The vertical “hot part” of the antenna was a 4mm2 copper wire.

The antenna was tuned with an antenna analyzer of the “spike” type. I did not use an RF ammeter, which would later turn out to be a mistake. But more on that later.

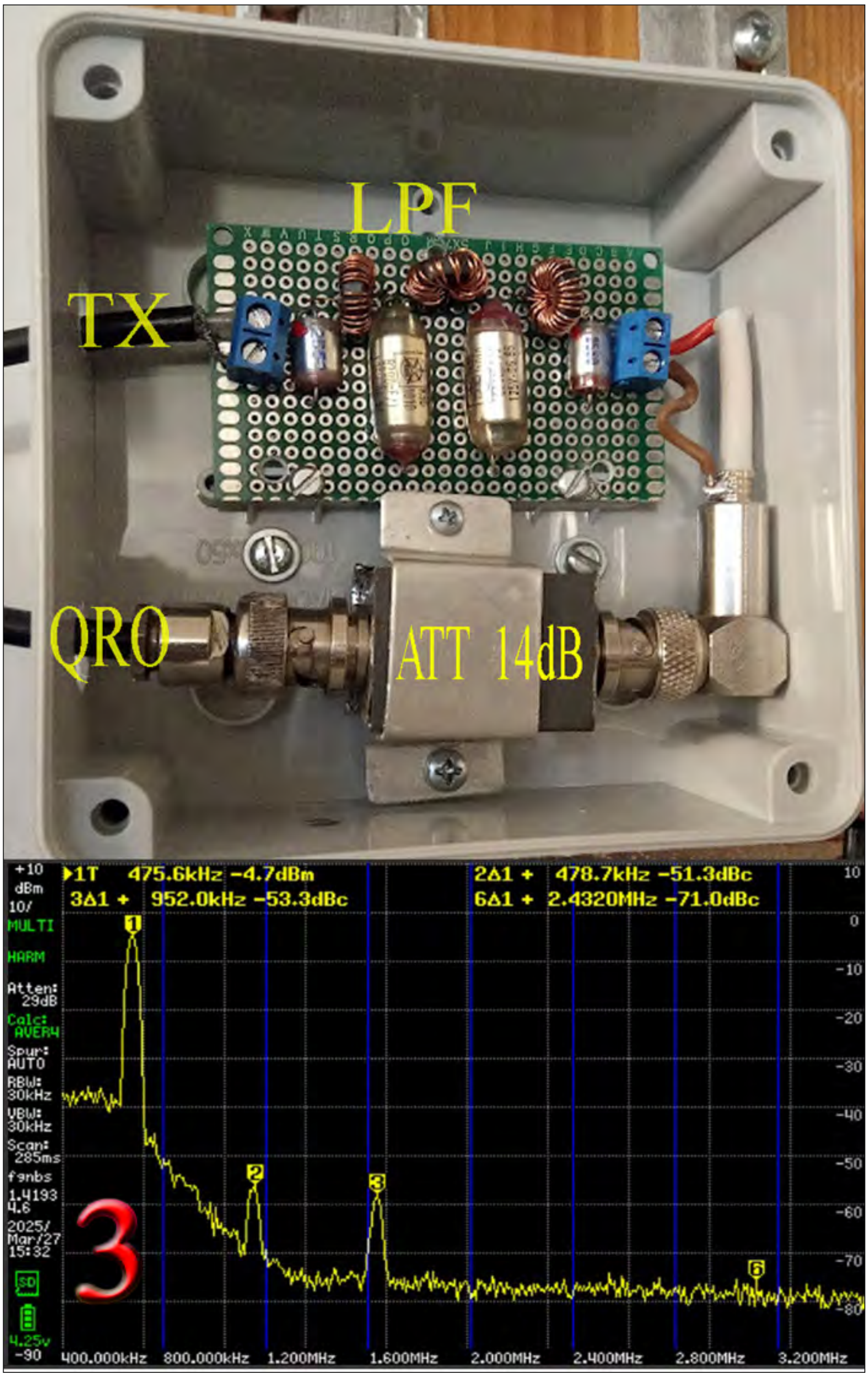
With Siniša S52ST, we also performed field strength measurements at a certain distance, which showed that the radiated power in the northeast direction, from where the signal is received the most, is around 100 mW ERP.

The first attempt

… in the season October 2024 – March 2025, was carried out with a CW signal and a 20-second long continuous signal, which on SDR receivers allowed an insight into how far this 15-watt signal reaches. I saw, heard and archived the signal on many SDR receivers from Ireland, northern Sweden. The furthest about 2300 km – SM3BYC. In doing so, I found that a CW signal of this modest power on this modest antenna, in favorable conditions, can be heard audibly up to about 600 km, and a 20-second beep can be seen graphically up to the distances mentioned above.

The second attempt

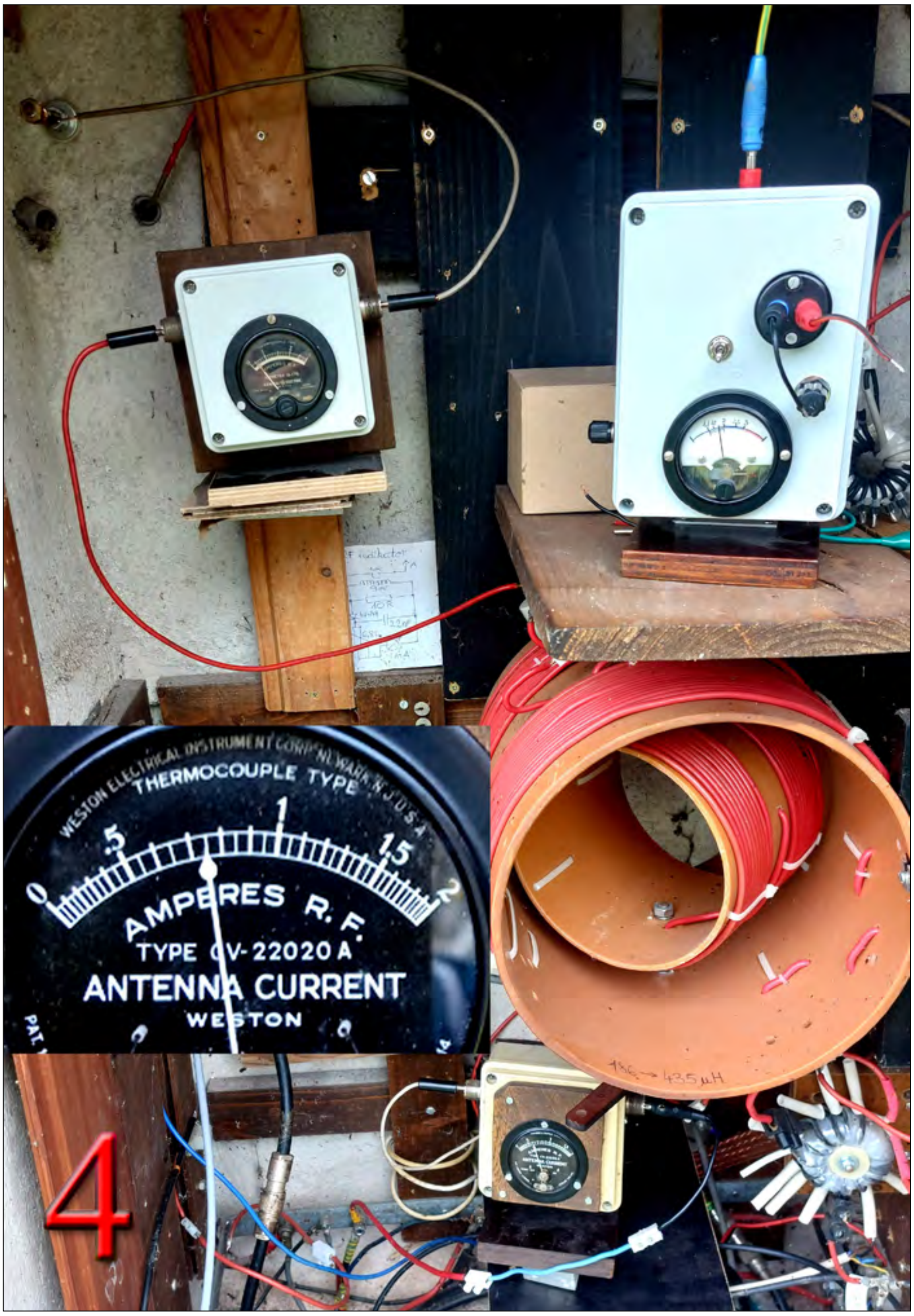
… which is underway, is taking place in the WSPR-2 (Weak Signal Propagation Reporter Network) transmission mode. The signal is archived on the WSPR.net network of receivers and if I summarize only the main parameters: SNR, CALL of the receiving station, distance in km and number of spots on the receiver in question. There are many other parameters, which allow for a detailed analysis of your signal over a certain period of time. These are extensive analyses, only a small part of which I use according to the instructions of Phil VK7JJ, who immediately comes to the rescue with detailed instructions on how to get some statistical data at every request.



Picture 3: A seven-element filter for attenuating higher harmonic frequencies. The graph below shows the attenuation of these harmonics.

Further preparation for WSPR work

In digital work such as WSPR-2, unlike the "classic", every decibel is important. So it does not matter whether the transmission will be carried out with a power of 15 or 20 watts with an ideally tuned antenna, of course, and the second task is what else can be done on the antenna under the above conditions. The WSPR signal is generated by a small board from Harri SM7PNV, type WSPR-TX_LP1, which contains the basic transmitter assembly, which can be changed via a computer and a simple program. From this board, the signal goes through a 7-stage LPF to a 14 db attenuator (Figure 3), which stably drives an amplifier with IRF510, whose power is increased to 20 watts or a few

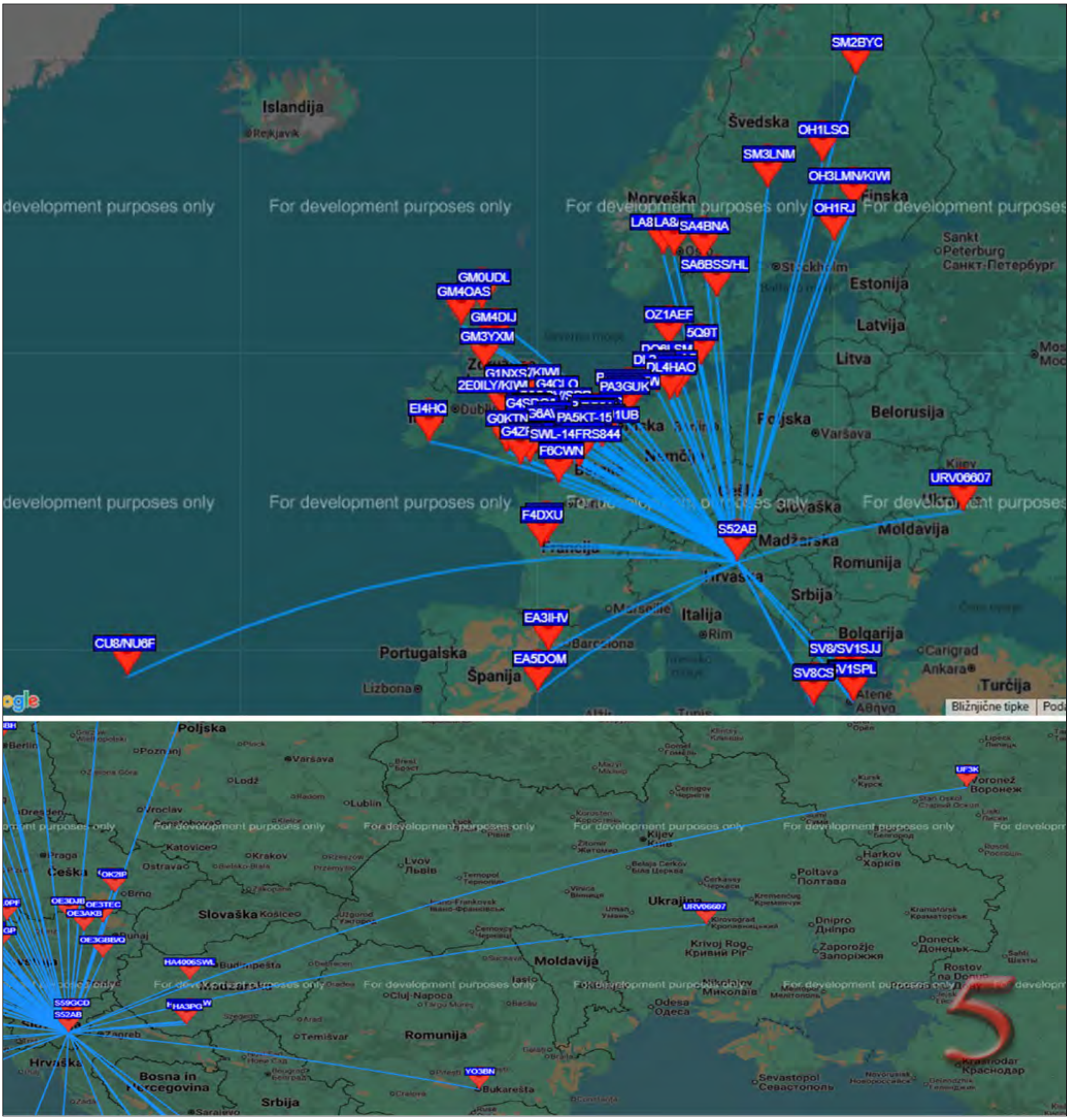


Picture 4: Measurement of the current towards the antenna part and the ground potential. The inner picture shows the antenna current, which is the same in both directions after the last modification to the antenna.

watts more with a 24 V power supply (bottom figure of Figure 1). Of course, this is immediately noticeable when detecting WSPR network signals. The next task is therefore to study the improvement in the antenna part. The antenna is raised a couple of meters to about 12 meters. In addition to the three existing "top-hat" wires, two more were added, which increased the capacitance by about 100 pF and reduced the inductance required to achieve antenna resonance. Of course, this increased the antenna current and thus the radiated power. I don't have an antenna analyzer. For this task of measuring the parameters on the antenna, I called my clubmate Siniša S52ST for help. Since he couldn't come right away, and the antenna can also be adjusted using a very simple procedure, I, impatient, used a simple method. For the signal generator, I used a FeelTech generator set to a frequency and power regulated to somewhere half - a few tens of milliwatts, so that the RF ammeter showed me a deviation after which I could regulate the antenna current to the maximum - for this power! Here comes the first surprise: when I connected 20 watts, I had to reset the inductance on the variometer to get the maximum current!

The role of the earth potential

…and other nearby metal parts. Then I remembered that it would be very useful to also measure the current towards the radial system around the antenna, which I had of course already done years ago in some previous tests. This is connected to all the metal parts in the area: the lightning ground and overhead installation, which is over a hundred meters long, the iron braid, which is about 60 meters long, the gutters and metal roof edges. The hundred meters of fence around the plot are not directly connected to this system, but numerous moles from under the entire length of the fence indicate that the HF gives life to the earth, and the mole has a feast along the entire length of the fence. So, this also participates in some way in the signal radiation. So, I placed an RF ammeter towards the antenna and another on the line towards the radial system (Figure 4). This is very rarely checked in practice. Usually never. And they did not show the same value. The value towards the ground was more than half smaller. With the correction on the variometer, the current towards the ground rose and equalized with the current towards the antenna, the radiated power field meter showed the maximum, which in the final phase of finishing on the antenna,



Picture 5: The picture above shows the received signal at receivers over a thousand kilometers to the Cape Verde Islands and northern Sweden. The picture below shows the received signal near Voronezh in Russia.

showed as can be seen in this fourth picture. And this is undoubtedly an indication that the antenna system is only now tuned optimally. The following surprise followed: when measuring with the analyzer Rigexpert AA200 and Zero II, it showed resonance with the best parameters, six kilohertz higher! At 481 kHz! I had already had to make a correction earlier with a low power from the generator, when supplying a higher power of 20 W. The antenna analyzer of course gives even less power to the antenna than the signal generator, which was used for the purpose of initial tuning. Then we S52ST, S52AS and myself present at the measurement, determined that the same thing happens when tuning very shortened antennas at lower shortwave frequencies. What could be the cause of this could be many things. For example, the dimensions of the wires, which are too thin. By the way: high-power transmitters on VLF use variometers and large coils of several meters in diameter and conductors

Picture 6: Antenna in space in the final version.

of 10 cm in diameter made of several hundred mutually insulated wires. Comparative explanation: you cannot quickly push a large amount of water through a pipe that is too small. So we could not rely on the antenna tuning measurements with the antenna analyzer, because they give undoubtedly wrong results. Further tuning was therefore carried out in the above-described manner with an RF ammeter and a field meter as can be seen in Figure 4. It is also interesting that now I no longer needed additional tuning on the antenna with a coil against the drain of the fet (Figure 2), which was necessary before. The transmitter simply tried to repair the antenna mismatch.

Further improvements to the antenna

The upper wires themselves, which descend diagonally from the top coil to about 5 meters above the ground, do not radiate at the ends, but they do work due to high voltages at the ends of the wires, problems with the insulators, which must be ceramic here, and the anchoring to the support is done with a rope. That's why I finally connected them together. First three. The antenna capacity rose as expected, and the current towards the antenna (and the ground potential!) of course increased. The radiated power as well. The frequency test showed an unexpected improvement overnight. Since I wanted to see for myself directly by additionally checking the signal reception on SDR receivers outside the WSPR system, which send data to this WSPR network, I was completely surprised. I did not expect such an improvement. The signal range was already above what would be expected for this modest power and antenna. The signal also appeared in parts of Europe where it had never been before. And this was stable and recorded several dozen times. For the first time, it reached the western part of the Azores Islands in the Atlantic and Voronezh in Russia (Figure 5). I had two more wires that went down to the ground and connected them to each other from the ends (Figure 6). The antenna capacity increased and the inductance of the top coil of the antenna, 175 microH, exceeded the inductance of the variometer, 134 microH, which was needed for tuning. The synchronous operation of the antenna current towards the antenna and ground parts again showed improvement. From the beginning before connecting the ends of the wires, which represent the antenna capacity, to connecting their ends, the signal on the control Kiwi receiver of the Radio Club Laško S59GCD rose by two S levels, the antenna current towards the antenna and ground increased to 0.75 RF amperes (Figure 4).

Top Beacons by spot count distance band duplicates

v2.0.0 Database by Arne, Hosting by Rob, Site by Phil VK7JJ

prefs | 24 hours to midnight UTC | 24 hours to now UTC | midnight to now UTC | custom day selector...

•click a line for band rankings •click => copy table data to clipboard

=> 131 rows

close

rank	tx_sign	raw	unique	dBm	W	max_k	avg_k	avg_kpw	avg_snr	avg_Q
1	S52AB	7498	142	20	0.1	3795	752	7520	-21	18048
2	DL5ABH	3625	137	23	0.2	3400	588	2940	-16	5292
3	F6CWA	7677	136	27	0.5	3002	790	1580	-18	3160
4	OH1LSQ	3554	127	27	0.5	4325	1592	3184	-17	6033
5	LA8AV	4210	123	30	1	3912	1109	1109	-16	1996
6	DC0DX	3182	123	20	0.1	3211	517	5170	-16	9306
7	DK2DB	2404	121	27	0.5	3285	598	1196	-16	2153
8	GM3YXM	1323	120	27	0.5	3046	965	1930	-12	2895
9	N4WLO	9987	118	30	1	12356	1602	1602	-13	2507
10	K9KFR	5482	115	30	1	4532	960	960	-12	1440
11	F1AFJ	2045	113	30	1	2683	858	858	-14	1404
12	NV4X	10265	110	33	2	3464	920	460	-16	828
13	G4CLO	578	110	30	1	2876	631	631	-11	909
14	EI0CF	3012	107	23	0.2	3012	897	4485	-18	8970
15	N9BNN	4645	107	37	5	3185	866	173	-14	283
16	F6CWN	2501	102	20	0.1	2808	566	5660	-20	12735
17	KY4DF	4089	98	37	5	3422	1013	203	-16	365
18	PA0MLC	574	91	30	1	2073	539	539	-15	924
19	KE7A	3587	90	33	2	2967	1368	684	-20	1539
20	WD9EKA	2364	89	37	5	3145	879	176	-20	396
21	W3TS	2054	89	50	100	3922	667	7	-9	9
22	DG4CVD	1162	89	17	0.05	2058	547	10940	-21	26256
23	IW3RMR	5547	86	37	5	1973	524	105	-20	236
24	OK0EMW	2220	83	10	0.01	1958	696	69600	-23	192738

228 spots:

Timestamp	Call	MHz	SNR	Drift	Grid	Pwr	Reporter	RGrid	km	az	Mode	# Spots
2025-10-16 23:34	S52AB	0.475790	-31	0	JN75nu	0.1	CU8/NU6F	HM49kk	3795	276	W-2	2
2025-10-16 22:26	S52AB	0.475774	-22	0	JN75nu	0.1	SM2BYC	KP25ax	2300	10	W-2	11
2025-10-19 20:10	S52AB	0.475802	-25	1	JN75nu	0.1	OH1LSQ	KP03sd	1965	10	W-2	350
2025-10-23 04:28	S52AB	0.475801	-27	1	JN75nu	0.1	GM4OAS	IO76cx	1893	318	W-2	704
2025-10-21 20:28	S52AB	0.475641	-27	0	JN75nu	0.1	UF3K	KO91oo	1868	61	W-2	1
2025-10-20 02:00	S52AB	0.475801	-27	0	JN75nu	0.1	GM0UDL	IO77vo	1853	322	W-2	302
2025-10-16 21:06	S52AB	0.475741	-25	1	JN75nu	0.1	OH3LMN/KIWI	KP11wm	1831	15	W-2	13
2025-10-23 05:00	S52AB	0.475802	-23	1	JN75nu	0.1	SM3LNM	JP82qg	1831	4	W-2	508
2025-10-23 04:12	S52AB	0.475802	-18	1	JN75nu	0.1	EI4HQ	IO51uu	1829	300	W-2	1074
2025-10-16 20:06	S52AB	0.475792	-26	0	JN75nu	0.1	EI4JY	IO63xd	1721	306	W-2	3
2025-10-22 21:04	S52AB	0.475802	-24	0	JN75nu	0.1	LB3BJ	JP40lt	1711	349	W-2	458
2025-10-22 18:00	S52AB	0.475801	-22	0	JN75nu	0.1	OH1RJ	KP10	1705	15	W-2	10
2025-10-19 02:06	S52AB	0.475799	-28	0	JN75nu	0.1	GM4DIJ	IO85iw	1701	318	W-2	25
2025-10-23 03:44	S52AB	0.475801	-26	1	JN75nu	0.1	GM3YXM	IO75xc	1693	314	W-2	700
2025-10-22 18:56	S52AB	0.475737	-27	0	JN75nu	0.1	SM5AUS	JP90ff	1613	7	W-2	2
2025-10-23 05:00	S52AB	0.475801	-27	1	JN75nu	0.1	LA8AV&RX	JO49rt	1597	348	W-2	323
2025-10-17 18:18	S52AB	0.475800	-27	0	JN75nu	0.1	LA8AV/RX	JO49rt	1597	348	W-2	242
2025-10-23 04:56	S52AB	0.475767	-24	0	JN75nu	0.1	LA8AV	JO59ds	1580	350	W-2	1157

Picture 7: The table above shows part of the participants in the "Top Beacon" list of WSPR transmitters on 630 meters. I collected 142 WSPR receivers from the WSPR.net network and a few SDR receivers next to this network in 24 hours and ranked them among the others at WW level. This table shows some other interesting parameters. Part of the table below shows some of the most distant SDR receivers that received my signal during the fourteen-day period. The total number of these during this time is 228. On the left is the number of times each receiver received me during this time.

After these improvements, the WSPR signal constantly reaches practically most of the space of Europe. And this is a nice achievement for this modesty in terms of power and antenna. So, the party was a success. It was worth it (picture 7). Of course, the fun continues at least this winter season. It is quite possible that it will be interesting.

Thanks...

… to everyone who participated in this project of mine in the form of suggestions:

- *Jure S52CQ, Miran S57UMU, Roman S52AS, Ivan S51DI, Phil VK7JJ, Matjaž S57MK*
- *Siniša S52ST for the measurements of LPF filters, antenna parameters and field measurements of signal strength for calculating ERP.*