EGGBEATER II – TPM II

AND AMAZING EXPERIENCE

I am Juan Antonio Fernández Montaña, also known as EA4CYQ. I live in Don Benito, province of Badajoz (Spain). With this article I have the intention to spread my personal experience working satellites since I began three years ago today. I expect to help all the beginners.

Reading you will discover a large story, most of which is pessimistic, but life is so, and each time I get a goal, I celebrate it with rejoicing.

I suppose you know some basic principles of satellites of hams.

1.- THE BEGINNING

Once a time, three years ago my friend and teacher EB4DKA known as Pedrito, only had "birds" on the brain. Then I thought that perhaps it would be worth trying to learn something about this world. Pedro lend me some information: a CD published by AMSAT-Spain, an old book written by EA8HZ "Satélites de Radioaficionado", and of course several URLs.

I quickly realized that this world is so different from that all of us know about 2 meters FM band. Perhaps the only thing it has in common is the transceiver.

2.- THE CURIOSITY

Pedro is a minimalist, and he always works with an HT. He is always telling the same, the most important thing is the polarity and listening and listening.

I would soon enjoy my holidays, as usual in September, that year I had decided to go to the Mediterranean coast. It will be a great chance to try working "the birds". I had a FT-3000M, it can transmit in VHF and receive in UHF simultaneously, it is capable of full-duplex, so I could work the AO-27, UO14 and SO-35 birds. But I needed a proper antenna.

I have always followed my own patterns, but paying attention to the experience of the others guys. Pedro usually works with a simple 1/4λ VHF whip attached to his double band HT, this antenna has the feature to work as a 3/4λ in the UHF band. So why not?, I could try to build a similar antenna to attach to my FT-3000M.

As you can see in the photos a) and b), I took a 1/4λ VHF collapsible whip that I had of an old handy commercial receiver, and I joined it to a male BNC connector. I took a piece of aluminium and put a female BNC connector in the centre point. I added a ground plane system that I was able to rotate 90 degrees up to fold it, so it would not room a big space to be transported. I added a handle from the handlebar of my old and useless bicycle, so I could handle it comfortably to get the right polarization. Finally I soldered three meters of RG58 feed line and a UHF connector. This device complied with all my expectations, but will it work?.

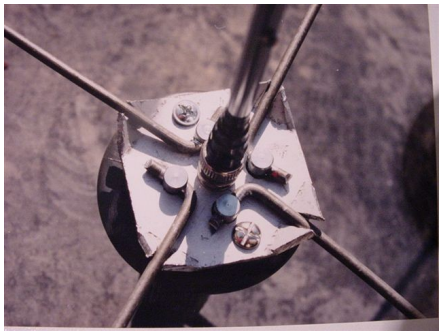
Then I memorized five frequencies for each operational FM satellite, AO27, UO14 and the nowadays no-operational SO35. Each five memories share the same pattern, +10kHz, +5 kHz, the central downlink frequency, -5 kHz, -10 kHz and the uplink frequency into the TX frequency in the whole of the five channels.

I wrote down in a little notebook the date, time, AOS, LOS, and maximum elevation of each pass. I took a pair of earphones, a hand mike and a compass.

It was astonished, when I was swimming and I realized that the satellite was on the brink to be listened I run to the parking, opened the car, took the earphones, the antenna in one hand and the mike in the other, the notebook to write down the call sign and locator was held between my right leg and the steering wheel, (you can reach the perfection if you practise it). I could receive all the satellites, even with signal, and the uplink was strong with the 50Watts even when the polarizations was not right. We should not have to forget that the most important and difficult thing is listening.

I can not forget that holidays, running from the beach to the car, and from the car to the beach. I can not forget too the face of the guys when I was working whit that strange device in my hand moving to anywhere, but the illusion was stronger than the sense of shame. (I could not do it in my little town, hi, hi.)

I even tried working with the 1/4λ fix VHF whip that I had on the car roof. When I was driving my wife was writing down the call sings and locators. I did several contacts using this method although I recognize that it was a bit dangerous even when you are an experienced operator.



a) Detail of the 1/4λ collapsible VHF whip

b) EA4CYQ working satellites handle antenna

3.- THE FIRST STUMBLE

After this amazing experience I was thinking about how much I will enjoy working satellites sitting at home.

But I am not always on holidays so when I came back home, it did not make sense drive to a near open space each time a satellite is coming, I would be the odd one out in my little town. I began to think about which kind of simple antennas I could put on the roof to work at home.

At that time I was hooked on the AMSAT forum and I usually was surfing the Internet searching similar experiences. Then I read an article about the features of 1/4λ VHF whip and how it performed over 1 m2 chicken wire.

It is widely known that 1/4λ VHF works as 3/4λ in UHF, but less people know that the radiation pattern has very high angle, over 30º and 40º. This is the reason why it is not very useful to terrestrial communications. But this drawback is an advantage if we have the intention to use it to space communications. In VHF its low angle of radiation is not very convenience, but we use VHF band to uplink, so we can compensate this disadvantage with more power out.

I installed the whole on the roof of my building and attached it to my 25 meters long RG213 feed line, this is the distance from the antenna to my shack. It was disappointing, I barely could listen anything and the fading was very strong. I had made a mistake.

I was surfing the Internet again (there is the truth). If I could work with a 1/4λ VHF whip on the roof of my car, Why can I not work with the same antenna on the roof of my building?. It even was the same transceiver, the difference was the feed line length.

4.- THE FEED LINE IS IMPORTANT

I had two options, to install a preamplifier o change the feed line by a low loss feed line. Then I got a piece of 25 meters long ½ inch feed line from a commercial installation. This kind of feed line is very difficult to handle and the type "N" connectors are very expensive, but after all it was a gift.

I noticed a substantial difference, I was astonished, I could see signal up to two from UO14 and SO35, but the fading was so strong that I lost the reception intermittently for several seconds.

Another time I was surfing the Internet. Some information down on me, the satellites change the polarization because of its spin movement, so when the

polarization from the satellite agreed with my vertical antenna the signal was strong, but the opposite polarization cause a deep fading.

Again a disappointing failure, I could only work partially. I tried to imagine a 1/4λ VHF whip turning to match the right polarization (in the same way I did with my handy antenna while I was on holidays), but I did not find anything similar on the Internet, at the end I gave up this way.

5.- THE MAIN THING IS THE POLARITY!

I was remembering my beginnings of the radio with my father EA4ABV, I am not lazy to build antennas but I am living in a resident' association and I will have problems if I install a tower and a rotor system.

I had to focus my effort on improving the UHF downlink. The VHF uplink is no problem, I had tested a crossed dipoles known as Turnstyle, and it worked well with a bit of power.

I came back to surf the Internet. On that occasion my aim was to search an omnidireccional antenna but with circular polarization. So I will reduce the fading caused by the changing of polarity. Then I found an scheme which had horizontal polarization towards the horizon and circular polarity towards the sky. It angle of radiation was suitable to work space communications and the gain was around 6dB.

It commercial name is Eggbeater, and the brand is M2. But I followed searching and found that K5OE Jerry had improve it performance doing some mechanical changes. Jerry achieved a compromise, he increased the gain towards the horizon and reduced a bit the gain to the sky, doing it more suitable to work satellites. This model was named Eggbeater II, and if you want one, you have to build it because it is not commercialized.

This antenna consists of two squares with the lateral sides longer than the up and down sides. These squares are phased by means of a piece of RG62 to match the impedance and get the proper polarization. You can see the Eggbeater II scheme in the annexe nº1, and the photo is the c).

It was a bit difficult to get the RG62 feed line, but at the end I got all the stuff with a bit of patience. My friend Pedro EB4DKA lend me his THD7 HT, because my transceiver could not transmit in UHF band, and I needed to check the SWR. I finished a prototype in a couple of weekends. Then Pedro, who is an experienced ham working satellites under portable conditions, offered to check its performance. Pedro attached the antenna to a photograph tripod with a piece of insulating tape and hooked it up to his THD7 with 0.5 meters of RG58 feed line.

The test was made under the roof of his attic. We were astonished, the signal was not strong (of course), but we could listen nearly the whole pass with a minimal fading, AMAZING!.

You can imagine the follow step, I put the Eggbeater II on the roof with 25 meters of ½ inch feed line. What do you think the outcome was?, It was a TERRIBLE FAILURE, I could hear nothing.

Which would be the explanation?, it is clear the loss of the feed line, but How much loss could 25 meters of ½ inch feed line have?, The answer is clear too, enough to avoid listening the satellite. Perhaps the solution would be to install a preamplifier, but it is a bit expensive and I dismissed this option.

My friend Paco EB4HBI tested it too with 0.5 meters and 10 meters of RG213, the outcome was the same that we had got before, with 10 meters he lost the reception.

I tried coupling a pair of Eggbeater II, and I also try listening with left circular polarization one, but all the probes turned out to be USELESS.

But this design had something that caught my eye, so I built one to VHF that I could use to uplink to the satellites. You can see in the photo d) my father holding the prototype. This antenna has an amazing performance, higher to the Turnstyle. Working satellites I never had problems in the uplink. Receiving NOAA satellites in 137Mhz without any modification I got impressive photos. But I have even made terrestrial contacts in SSB mode up to 400Km. with a station in its usual location. This antenna has given me a lot of satisfaction.

c) Eggbeater II (UHF

d) Eggbeater II (VHF) + EA4ABV

6.- POLARITY AND MUCH GAIN

I tried to get on the Internet an omnidireccional antenna with much gain, but I did not find anything, the miracles are not on the Internet yet. So I decided to search for something directional.

I proposed to myself that I will not install a tower, a rotor and some yaguis (I had still to save for a while). At that time I was an expert to search for things on the Internet. Again our friend Jerry K5OE had made a modification to the known Eggbeater II to make it directional. Jerry had change the shape of the squares and moved the reflectors closer. This design was called TPM II.

With my former experience building Eggbeater II, I did not have any problem to build a TPM II prototype, it took me the evenings of the workdays of a week. You can see a closed photo of a TPM II in g).

Again Pedro EB4DKA the expert on working under portable conditions took the prototype in his right hand and the THD7 HT in his left hand. We were ASTONISHED, we could see signal 5 and we could hear the satellite form AOS to LOS. This design had a gain over 9dB, an a bandwidth of 30 degrees. This features made me think …

Another time on the roof. It is true that I am a bit stubborn because if I would install one TPM II with 15 degrees fix elevation on an azimuth rotor I could test it performance at home. At that time I got a remote switcher with "N" connectors from MFJ. The features advised that it was usable in UHF. Then I dreamt a new scheme, if I would place four antennas with a fix elevation of 15 degrees towards four different directions, I could switch between them to follow the satellite movement, so I would take advantage of it enormous bandwidth. As I enjoy much building antennas than speaking to the mike, I got down to work.

It took me four weekends, but at the end I had four right circular polarization TPM II built. You can see the whole in the right hand of my father in the photo e) and h). I am sure that you are agree with me, "The whole is stunning", after all I was the father of the device.

I studied the orientation and placed two of them towards the East with an angle of 60 degrees between them and the other two towards the west with the same angle between them. The four of them were placed with a fix 15 degrees elevation. This configuration is due to the LEO polar satellites are always moving from North to South or vice versa with different elevations toward the East or West. And it is demonstrated that 80% of passes are between 0 and 30 degrees of elevation.

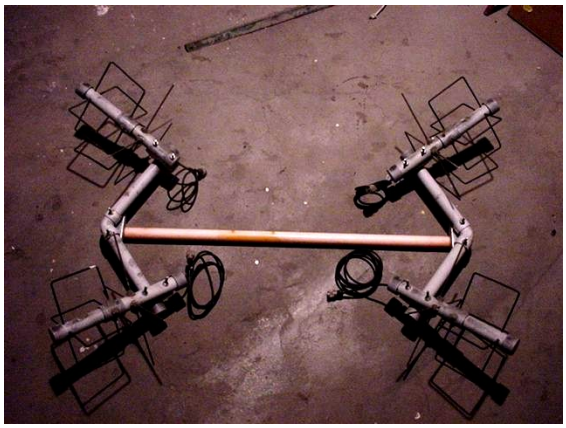
AT LAST I REACH THE AIM. That time all the things went well and I could work the FM satellites sitting at home, with enough signal to listen to the downlink despite the changes of polarization. The fading exist but it was not a serious problem. In the photo f) you can see my set of antennas on the roof, to myself they are impressive.

With this configuration I was working and enjoying for two years and I made hundreds of contacts working the UO14, AO27 and SO35 satellites.

e) EA4ABV holding 4*TPM II

f) Eggbeater of VHF + 4*TPM II of UHF (The roof of my fix station)

g) A close up photo of TPM II of UHF



h) 4*TPM II to 15º elevation and 60º between each one and 120º between each pair of them

7.- A GREAT CHANCE

At that point if I had the intention of improving my station, I had to invest in antennas of much gain, a tower and a rotor. After two years I had saved enough money and I took advantage of a second hand set of satellite antennas (How can anybody be bored with this hobby?). I got a pair of yaguis VHF (6+6) and UHF (15+15) with its remote relés to change between right and left circular polarization, and an azimuth-elevation rotor and an interface to control it by a computer (How much I could wish!).

Nowadays I can even work the SSB satellites, but I can not forget my beginnings and how much I have learnt since then, I usually said that the signals from the satellites do not have body, only soul, to express my own idea of this signals are very very weak.

I think you have had a glimpse of my intention. I felt the need to share my experience and I got down to work to tell other hams how much I have enjoyed this little jewels, the Eggbeater II and TPM II. I am sure you can find other experiences searching for it on the Internet.

CONCLUSIONS

This story is a bit wide, so I will try to resume the main ideas:

- EGGBEATER II of UHF: It is an omnidireccional antenna usable with LEO satellites if you have a short feed line of low loss, or you have the intention to use a preamplifier. It is advisable to use under portable conditions.

- EGGBEATER II of VHF: It is an omnidireccional antenna with enough gain to uplink and downlink to the LEO satellites. It is suitable to receive NOAA satellites in 137Mhz and even to work terrestrial communication because it has horizontal polarization to the horizon). It has better performance than a Turnstyle.

- TPM II of UHF: directional antenna with a bandwidth of 30º and enough gain to work with azimuth rotors and a fix elevation of 15º. You can choose to work with four of them and switch between them with a remote switcher. You can build it with right circular polarization and left circular polarization and you can switch between them. You should pay attention and use the best feed line that you can allow, or you can choose to use a preamplifier.

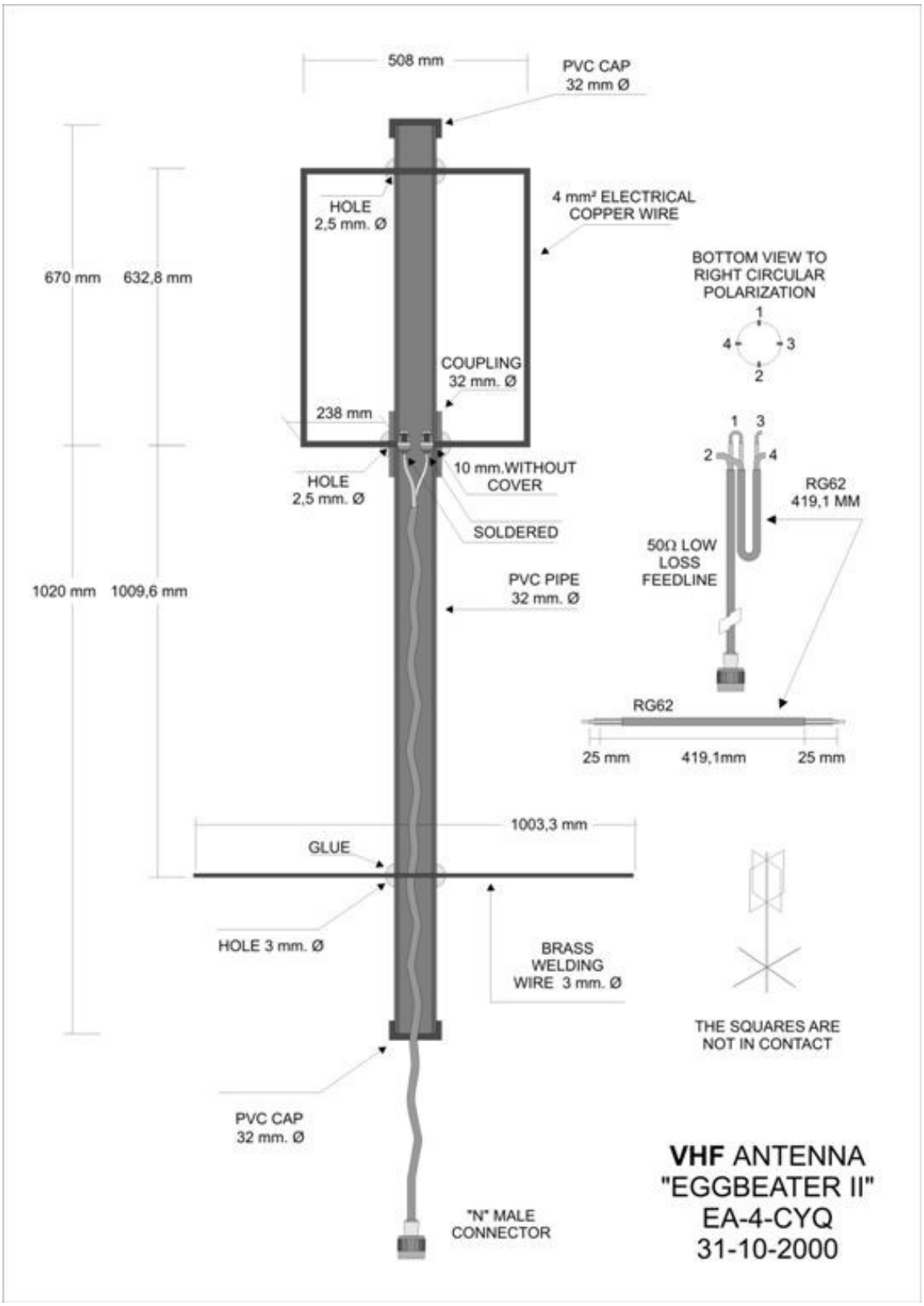
You have noticed that I enjoy building antennas more than speaking through a mike, but I do not build it to anyone. If you want one of them you should have a look at the annexes where you can find the details to build them. Do not be lazy!

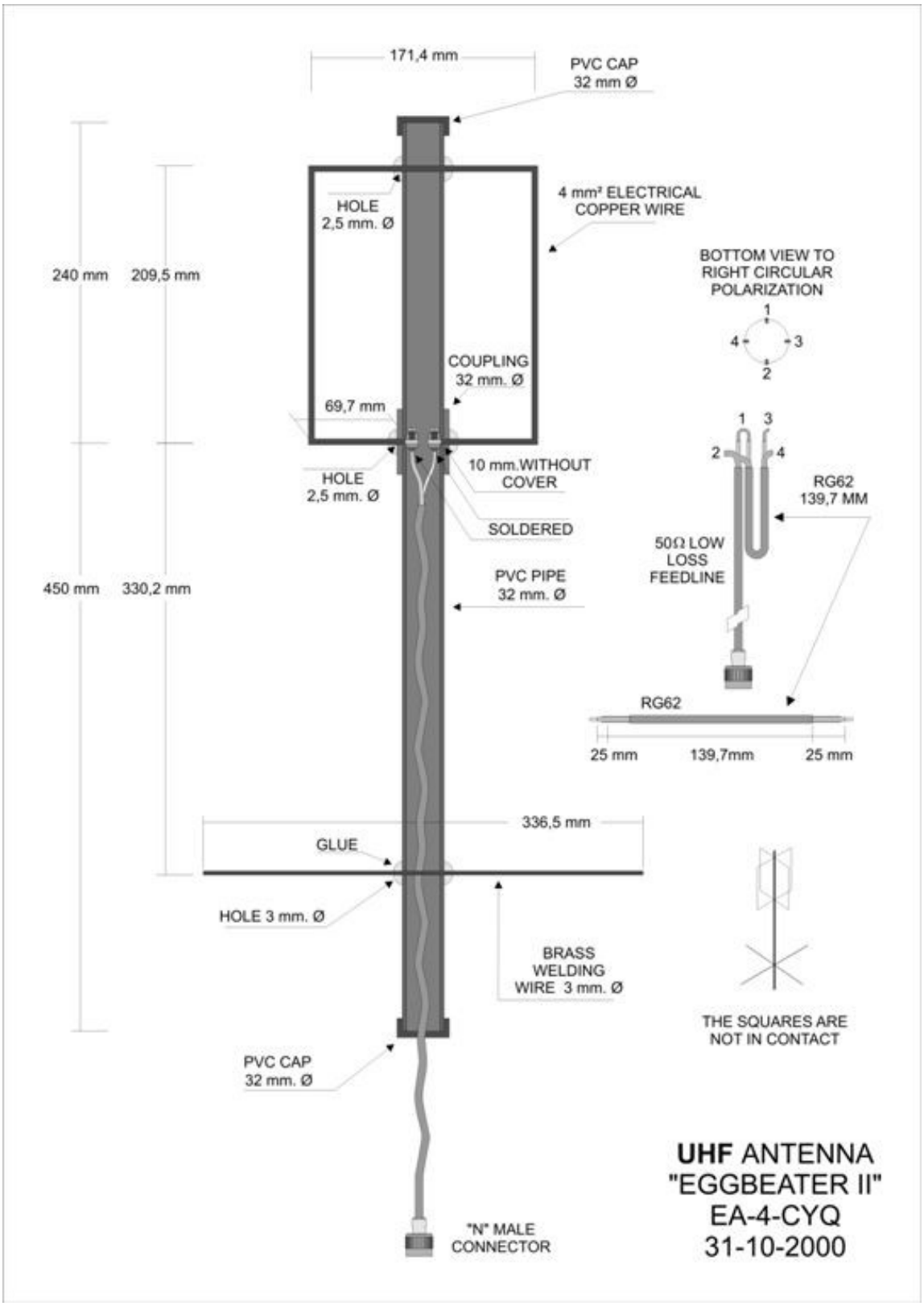
If you have read this experience and you need some additional information you can keep in touch with me at ea4cyq@amsat.org

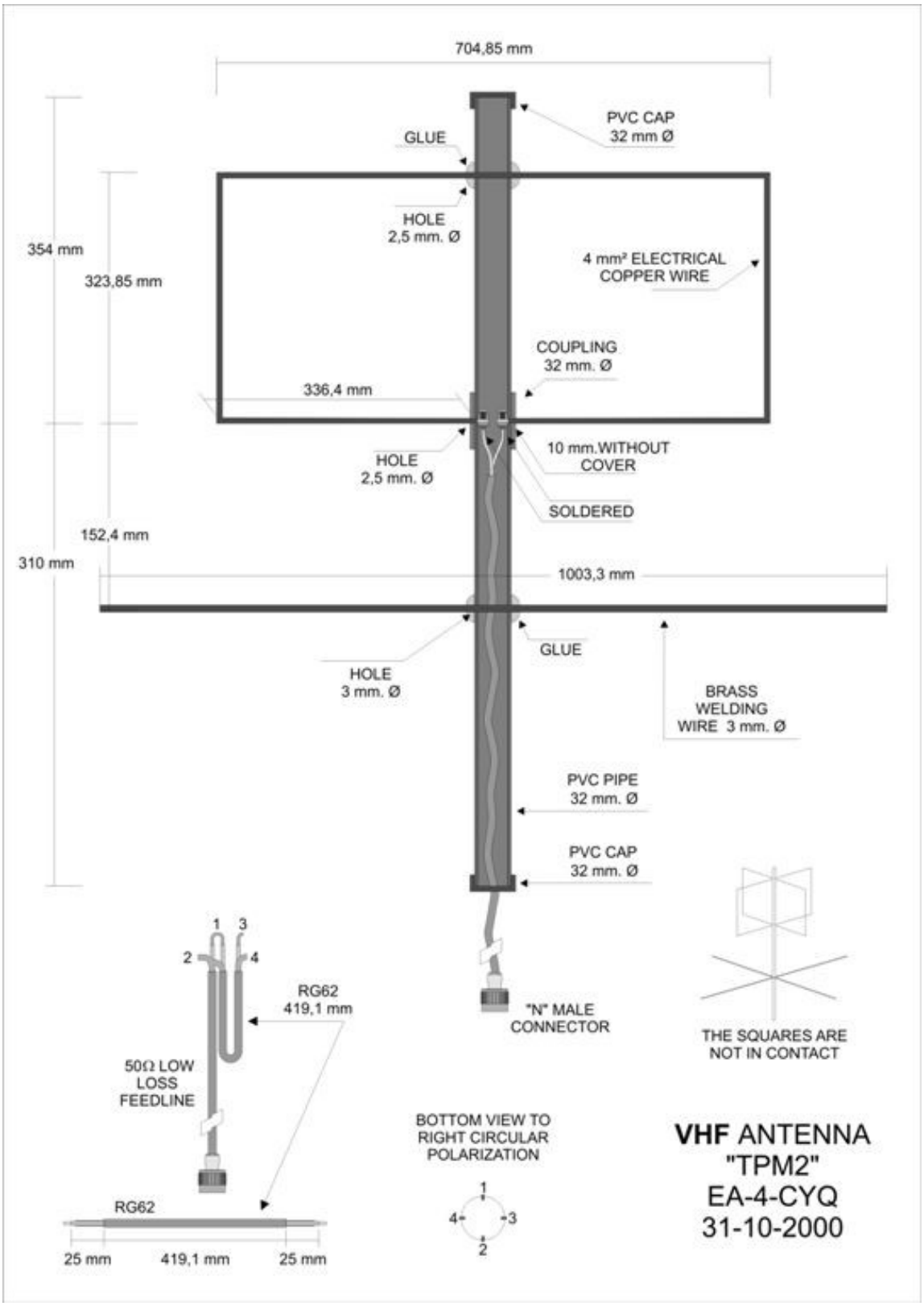
I looking forward to listening to you through the satellites…

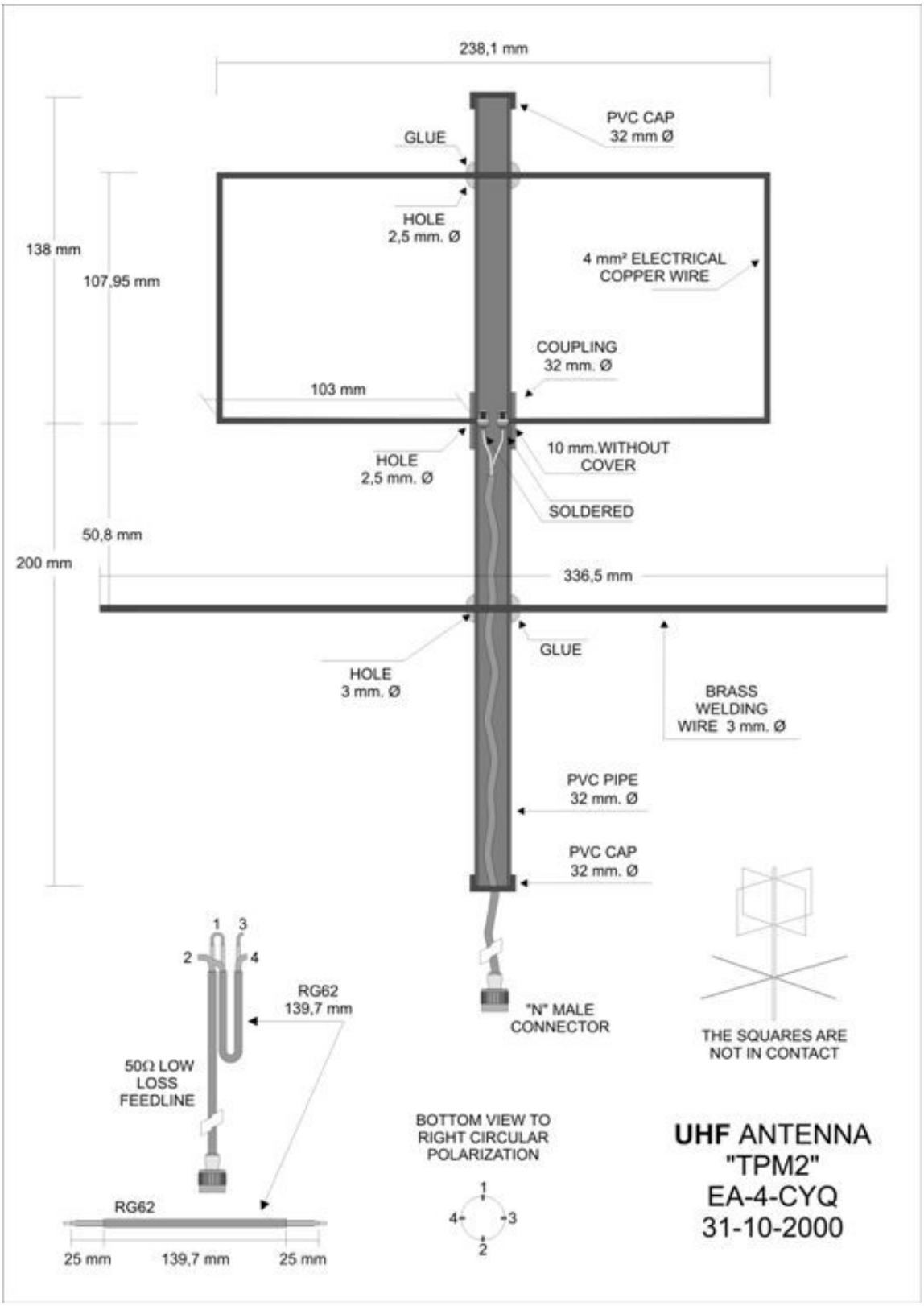
Juan Antonio Fernández Montaña
EA4CYQ

Note: This article was published the first time at http:/www.ea1uro.es


508 mm
PVC CAP
32 mm Ø
4 mm² ELECTRICAL
COPPER WIRE
HOLE
2,5 mm. Ø
670 mm
632,8 mm
BOTTOM VIEW TO
RIGHT CIRCULAR
POLARIZATION
1
4
3
2
COUPLING
32 mm. Ø
238 mm
1 3
2 4
RG62
419,1 MM
10 mm.WITHOUT
COVER
HOLE
2,5 mm. Ø
SOLDERED
50Ω LOW
LOSS
FEEDLINE
PVC PIPE
32 mm. Ø
1020 mm
1009,6 mm
RG62
25 mm
419,1mm
25 mm
1003,3 mm
GLUE
HOLE 3 mm. Ø
BRASS
WELDING
WIRE 3 mm. Ø
THE SQUARES ARE
NOT IN CONTACT
PVC CAP
32 mm. Ø
"N" MALE
CONNECTOR
VHF ANTENNA
"EGGBEATER II"
EA-4-CYQ
31-10-2000


171,4 mm
PVC CAP
32 mm Ø
HOLE
2,5 mm. Ø
4 mm² ELECTRICAL
COPPER WIRE
240 mm
209,5 mm
BOTTOM VIEW TO
RIGHT CIRCULAR
POLARIZATION
1
4
3
2
COUPLING
32 mm. Ø
69,7 mm
1 3
2 4
HOLE
2,5 mm. Ø
10 mm.WITHOUT
COVER
RG62
139,7 MM
SOLDERED
50Ω LOW
LOSS
FEEDLINE
450 mm
330,2 mm
PVC PIPE
32 mm. Ø
RG62
25 mm
139,7mm
25 mm
336,5 mm
GLUE
HOLE 3 mm. Ø
BRASS
WELDING
WIRE 3 mm. Ø
THE SQUARES ARE
NOT IN CONTACT
PVC CAP
32 mm. Ø
"N" MALE
CONNECTOR
UHF ANTENNA
"EGGBEATER II"
EA-4-CYQ
31-10-2000


704,85 mm
PVC CAP
32 mm Ø
GLUE
HOLE
2,5 mm. Ø
354 mm
323,85 mm
4 mm² ELECTRICAL
COPPER WIRE
COUPLING
32 mm. Ø
336,4 mm
HOLE
2,5 mm. Ø
10 mm.WITHOUT
COVER
SOLDERED
152,4 mm
310 mm
1003,3 mm
GLUE
HOLE
3 mm. Ø
BRASS
WELDING
WIRE 3 mm. Ø
PVC PIPE
32 mm. Ø
PVC CAP
32 mm. Ø
"N" MALE
CONNECTOR
THE SQUARES ARE
NOT IN CONTACT
1
3
2
4
RG62
419,1 mm
50Ω LOW
LOSS
FEEDLINE
RG62
25 mm
419,1 mm
25 mm
BOTTOM VIEW TO
RIGHT CIRCULAR
POLARIZATION
1
4
3
2
VHF ANTENNA
"TPM2"
EA-4-CYQ
31-10-2000


238,1 mm
PVC CAP
32 mm Ø
GLUE
HOLE
2,5 mm. Ø
138 mm
107,95 mm
4 mm² ELECTRICAL
COPPER WIRE
COUPLING
32 mm. Ø
103 mm
HOLE
2,5 mm. Ø
10 mm.WITHOUT
COVER
SOLDERED
50,8 mm
200 mm
336,5 mm
GLUE
HOLE
3 mm. Ø
BRASS
WELDING
WIRE 3 mm. Ø
PVC PIPE
32 mm. Ø
PVC CAP
32 mm. Ø
"N" MALE
CONNECTOR
THE SQUARES ARE
NOT IN CONTACT
1
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4
RG62
139,7 mm
50Ω LOW
LOSS
FEEDLINE
RG62
25 mm
139,7 mm
25 mm
BOTTOM VIEW TO
RIGHT CIRCULAR
POLARIZATION
1
4
3
2
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"TPM2"
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