The story of The Growing FLAG
(Less is More? No, not really, but...)

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Version 1.0, December 7, 2024

For a very long time I have been curious about trying a FLAG antenna. My DX-friend and colleague Thomas Nilsson in Ängelholm, Sweden, has been using a pair of reversable FLAG antennas for more than 10 years with success, which made me even more interested in trying one out. Until recently, I was using three 34 x 8,5 m Super-KAZ antennas in different directions. All of them were capable of bringing in some quite impressive catches on the Mediumwave band, but in the first half of 2024 my life situation dramatically changed, and I had to move to another location. A much smaller spot with no access to areas of the size that I would need for Beverages, BOG:s or KAZ-antennas. Quite naturally, I started to look at smaller versions of the FLAG antenna – to be more precise, the rotatable FLAG's. The problem was, however, that I couldn't even erect a "normal size" rotatable FLAG (which is about 7-8 m long in the horizontal part and the vertical segments is approx. 3-4 m). I had to start thinking about a smaller design, which was still useable for serious DX-ing on the medium-wave band. I have a small patio, with enough room for a tripod with a rotator, which is 5-6 m away from the house I live in. Luckily enough, I don't have much local noise or QRM here, which is making things a lot easier and keeps the level of frustration at a minimum. That was the starting point of my project, inspired by Thomas Nilsson's quote "Look at your surroundings. What are your possibilities? Make the best out of it and keep it simple". Hence, the first version of my very small rotatable FLAG was born – I called it the "microFLAG" or "µFLAG".

Version I, the microFLAG (µFLAG)
I started with defining three minimum criteria, all three of them a definite must:

- The antenna must fit on a small patio or in a very small garden.
- The antenna and its support must be constructed using very strong and sturdy materials to survive the quite harsh wind and weather conditions here on the Norwegian North Sea shore.
- The antenna must be easy to take down for maintenance or in case of extreme winds and weather, and (quite obviously) it must be just as easy to erect again.

The support frame
In order to make a robust construction, capable of "taking a punch" by the elements of nature, as well as "rough handling" (by me) without deformation, I opted for fiberglass tubing as my construction material of the support frame. Here in Norway, we are lucky because we have an excellent supplier of fiberglass tubes with extreme quality: PneumaBeam/Eidolon. This is not "fishing poles", but very high-quality tubes with 2 mm thickness, delivered in lengths of 2,38 m. I have used these tubes for many different purposes and projects during many years. I'm not sure if PneumaBeam/Eidolon is shipping outside of Norway, but I will give you the URL to their home page in the bill of materials in the end of this document, in case you like to find out yourselves. Otherwise, I'm sure you have a more local supplier of high-quality fiberglass tubes. At least one closer to your location. Hence, I ordered tubes in three different diameters:

- 1 x 2,38 m Ø38 mm for the vertical support tube
- 2 x 2,38 m Ø16 mm for the upper and lower horizontal support tubes
- 1 x 2,38 m Ø11 mm for the end pieces/sections for the upper and lower horizontal support tubes

Besides being very light and strong, the fiberglass tubes don't affect the antenna construction electrically. They also admit a little bit of flexibility, which I took advantage of in the final assembly of the FLAG antenna. More about that later. I also ordered 2 Cross clamps from Wimo in Germany, which is used to attach the two horizontal support tube assemblies to the vertical support tube.

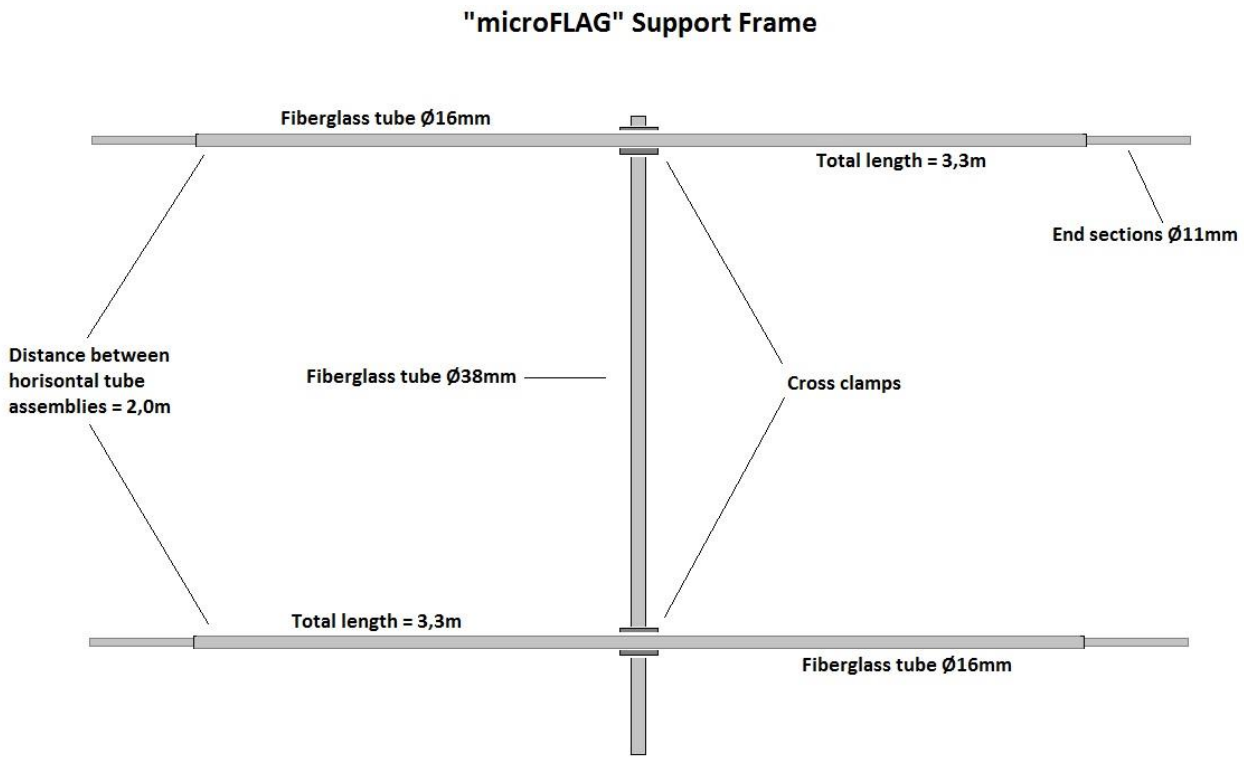


Fig.1: No it's not a 2 element beam for 6 m, it's the "microFLAG" Support Frame

Assembly of the Support Frame is very easy. The two 2,38 m, Ø16 mm horizontal support tubes are attached to the 2,38 m, Ø38 mm vertical support tube by means of the Cross clamps ordered from Wimo. Be very careful when centering the horizontal tubes in the Cross clamps. We want to end up with a rectangle, not a parallelogram or any other "funny" geometrical shape. The distance between the two Cross clamps should be appox. 2 m. This will be adjusted later in the "Grande finale" of constructing the antenna. Now, the Ø11mm fiberglass tube is to be cut in four equally long pieces (hint: 595 mm). These four pieces will serve as end sections on the two horizontal support tubes to make each horizontal tube assembly exactly 3,3 m long. They will slide into the Ø16 mm tubes easily, but do not fit the Ø11mm tubes into the Ø16 mm tubes yet. Instead, put a mark at 135 mm on each of the Ø11mm tubes. This is the length of each Ø11mm tube that will be inserted in each end of the Ø16 mm tubes, respectively. Hence, 460 mm will protrude from each end of the Ø16 mm tubes, and you will have two 3,3 m long horizontal support assemblies. Again: do NOT insert the Ø11mm tubes into the Ø16 mm tubes yet. Wait. Go and have a cup of coffee or something, and while doing that find the antenna wire that you want to use.

Antenna wire

You can use whatever antenna wire you have at hand, as long as the outer diameter (including insulation) isn't larger than the inner diameter of the Ø11 mm fiberglass tubes, which is 4 mm. The really neat thing with this construction is that the horizontal segments of antenna wire go *inside* the two horizontal support tube assemblies. The wire I'm using is Messi & Paoloni Diploflex wire, ordered from Wimo in Germany. This wire has a diameter of 3,1 mm and slides easily into Ø11 mm fiberglass tubes, without getting stucked. Wimo's own description: *"The Diploflex stranded conductor has another advantage, since it consists of 19 individual copper wires (19 x 0.29 mm), which is far more than is usually the case with comparable antenna wires. The large number of stranded wires creates a larger surface area, which plays a major role in the conduction of high-frequency signals (skin effect)"*.

Now, cut two 5,6 m pieces of your antenna wire. Each piece is 30 cm "too long", because we need to save 15 cm in each end of each wire, which will be used to make four small loops later on. If you have finished your coffee, you can now take the two 5,6 m wires with you and return to the antenna Support Frame. Feed one 5,6 m wire into each of the two 2,38 m Ø16 mm horizontal support tubes.

When finished, approx. 161 cm of wire is hanging out from each end of the two horizontal Ø16 mm tubes. Now you can return to the four Ø11 mm 595 mm long fiberglass tubes. Wind some electrical tape at the 135 mm marking on each tube. This will make it impossible to slide each Ø11 mm tube more than 135 mm into each end of the Ø16 mm horizontal tubes in the Support Frame. Slide each end of antenna wire into the "135 mm end" of each Ø11 mm tube, and then slide the "135 mm ends" of each Ø11 mm tube into its corresponding end of the two horizontal Ø16 mm tubes. Adjust the antenna wires so exactly 115 cm of antenna wire is hanging out from each end of the two horizontal fiberglass tube assemblies. It's a good idea to fix the Ø11 mm tubes into the Ø16 mm ones with shrinking tube. Do **NOT** use glue! If the antenna wire breaks, or you need to replace it for whatever reason, you will have a fun weekend trying to feed new wire into the horizontal tube assemblies, if the Ø11 mm tubes are glued into the Ø16 mm ones. Don't. Do. That. It's also a good idea to secure the antenna wire into each tip of the Ø11 mm tubes, using small diameter shrinking tube. Make sure that exactly 115 cm of antenna wire is hanging out from each end before doing that. And no glue.

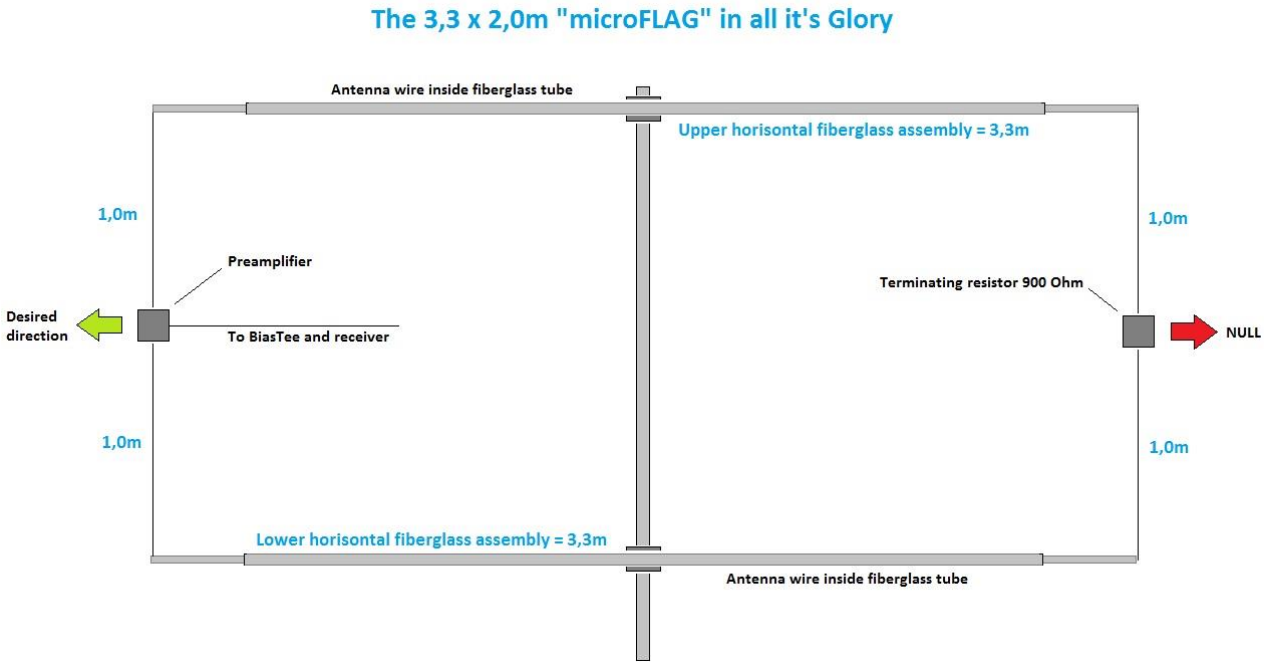


Fig.2: The complete "microFLAG"

Now it's time to tie the two "antenna halves" together. On each of the four ends of antenna wire, make a little loop at 15 cm. Secure the loops with cable ties. I'm also using cable ties to tie the "antenna halves" together, but if you like to use Dogbone insulators or something else, please go ahead! In that case, you fit the insulators before making the loops, quite obviously. What's important here, is that each of the two vertical segments of the antenna is 2 m long (or high). When everything is secured, you will have four "loose ends" of wire. We are soon going to populate them, but first we're going to do something fun: microFLAG stretching! Lay the microFLAG antenna flat on the ground, and carefully loosen the lower Cross clamp from the Ø38 mm vertical support tube. You only need to loosen up enough to allow you to slide the Cross clamp approx. 15-20 cm down on the vertical support tube. This will put some tension on the two horizontal tube assemblies and on the antenna wire, preventing the vertical wire segments from flexing around too much in the wind. When everything looks parallel, symmetrical, nice and beautiful – tighten the lower Cross clamp again.

Again, it's time for a coffee break, and maybe a sandwich. We also need to find the preamplifier that we're going to fit into the front of the antenna, the terminating resistor for the rear end, and some nice and fresh coaxial cable, prepared with a connector that fits the preamplifier of your choice.

Preamplifier

The premium preamplifier for an antenna of this kind, would be the Wellbrook ALA100FLG, which was designed for FLAG antennas. Unfortunately, as we all know Wellbrook no longer exists and its founder and constructor Andy Ikin went “Silent Key” a while ago. You may find an original ALA100FLG on the used market, or maybe “New old stock”, but be prepared to pay an arm and a leg plus maybe one of your kidneys for it. Beware of Chinese made poor quality clones! People are asking “collector prices” for Wellbrook units these days, and I understand why. However, there are alternatives. You just need to find them...

The preamplifier that I'm currently using comes from Larry / W6LVP and is part of his “Antenna Experimenter's Kit” (see picture to the right). It's delivered with a BiasTee, for supplying the little amplifier with DC via the coax, and a “wall wart” PSU. Larry kindly removed the “wall wart” from my order, to save shipping costs. I know some people have said that this preamplifier is noisy on low frequencies, and easily overloads on the mediumwave band. I can honestly say that I have noticed none of the above. I think it works excellently in the microFLAG. It's small and totally waterproof. However, I have nothing to compare with, so I have ordered another little preamplifier from the United Kingdom:

Cross Country Wireless in the UK is offering what seems to be a sweet little preamplifier for experimenters. Not surprisingly, they are labelling it the “Experimenter's Antenna Amplifier”. This amplifier is the replacement of their now discontinued FLAG antenna amplifier, and it offers possibilities to connect several different antenna designs, such as loops, flags and beverages. Gain is 25dB and the Noise Figure (NF) is as low as 0.79dB, which is excellent! CCW offers this little amplifier on their sales-page on eBay. It will be fun to try this one out to see if there is any difference from the one from Larry / W6LVP.

I'm a big fan of all equipment and units from RemoteQTH.com since many years. Jan Sustr is truly a brilliant engineer! I was using Jan's preamplifiers and BiasTees in my Super-KAZ antennas, connected via 16:1 baluns. The quality and performance of the units from RemoteQTH is no less than exceptional! Now RemoteQTH also offers a Feed Point Preamplifier, delivered together with a multi-purpose terminating resistor box. Hence, the combination can be used with several antenna designs, such as loops, flags and beverages. It would be the perfect preamplifier, but I think that the preamplifier box is way too bulky for my little microFLAG. I think this amplifier is designed for fixed loops and flags, since it for sure needs to be mounted on a support pole. Nevertheless, with no doubt at all, this will be my preamplifier of choice if I again will have the opportunity to erect big loop antennas, such as the Super-KAZ.

Now it's time for you to connect the preamplifier to the two “loose ends” in one of the vertical segments. This will become the front side of the antenna, i.e. the desired listening direction. Use

cable ties to fix/secure the little amplifier into the other cable tie (the one used to tie together the two loops of antenna wire) and connect the wires to the banana binding posts or wing nuts. Connect the coaxial cable. Don't forget to seal the coax connection with self-amalgamating tape.

Terminating resistor

The terminating resistor should be a non-inductive one with a value around 900 Ohm's. Mine measures 920 Ohm's, which is fine. These can be found on eBay, ready made in weatherproof boxes. It's, however, an easy task to fit the resistor in your own weatherproof box, add two banana binding posts or wing-nut binding posts if you prefer that. Homebrew is always more fun, right? Connect the little terminator box on the other side of the antenna, and fix/secure it the same way as the preamplifier – and voilá, the antenna/loop circuit is now complete!

Common Mode Chokes

FLAG antennas, and especially smaller ones are notorious for picking up noise from "civilisation" via the coax shield. A couple of CMC's in the coax feed is always a good idea. I use three CMC's with my microFLAG; The first one in connection with (or as close as) the preamplifier, the second one right before the coax is entering the house, and the last one right before the signal distributor (active splitter) and my receivers. The two outdoor CMC's are PNC100's, which are manufactured and sold by SV2CZF. These are "plug-and-play" CMC's with BNC-connectors, and they work fine. All connectors are sealed with self-amalgamating tape, of course. The indoor CMC is a CCMC 30 from NTI, sold by Bonito Hamshop in Austria. It is a little bit expensive but performs flawlessly. NB: The preamplifier from Cross Country Wireless has a CMC already built in, right before the BNC output.

Final assembly, rotator and tripod

First of all, you don't need a fancy USD 1000,00 Yaesu rotator to swing this little antenna around. A small TV-rotator, such as the HyGain AR-500, which is available from Wimo in Germany, is more than enough. However, to protect the rotator and keep the whole installation erected in strong wind gusts, you need a thrust bearing mounted on the Ø38 mm vertical support tube over the rotator. The Yaesu GS-050 is a good choice, and it's available from several ham radio shops, including Wimo in Germany and Christech in Norway. The GS-050 fits tube diameters up to 50 mm, which makes it ideal for this construction. Don't sacrifice the thrust bearing in order to save funds. That will make you sorry. Most likely very sorry. I'm securing the whole installation via the thrust bearing with 5 mm polyester cord line, which you will find in almost any hardware store. In Norway and Sweden, you will find it at Biltema, Clas Ohlson, Jula and a number of other hardware suppliers.

My choice of tripod is perhaps a little bit "overkill". However, my location is windy. Very windy to be honest, especially during the autumn and winter seasons. I wanted something heavy and robust, which would make a solid base for my rotator and microFLAG antenna. I also wanted the possibility to crank the antenna up and down vertically for maintenance and/or protection purposes. Hence, I opted for the Adam Hall SWU400T wind-up stand, which is commonly used by stage workers to attach stage lights or loudspeakers on it. With a weight of 27 kg, the SWU400T is extremely sturdy and robust, and it allows up to 80 kg(!) vertical load. It's supplied with a so called "T-bar" (used for stage lights). Instead of fitting the T-bar, I attached the AR-500 rotator in its place, and the AR-500 fits perfect! The SWU400T allows the rotator to be cranked up to a height of 4 m. I found out that 3 m is enough for my purposes. The whole thing can be cranked down to 2 m, which makes maintenance easy, when standing on a step ladder. It also makes it easy to take the whole antenna assembly down, in case of really bad weather and violent wind gusts.

Mounting the rotator and microFLAG on the tripod is quite easy. Here's how you do it with a HyGain AR-500 rotator: after attaching the rotator to the tripod or another base of your choice, you need to calibrate it. The manual calls this process “INITIAL”. Just follow the rotator manual, and you will be all good. When this is done, turn the rotator via the control unit until the display says “18” which means 180 degrees, i.e. due South. After securing the coaxial cable to the vertical support tube with cable ties (you need to make a “half loop” of coax around the rotator to allow it to fully rotate from end to end position, without stressing the coax), put the antenna assembly on the rotator, and tighten the mast clamps just enough to hold it in place. Now, using a compass, turn the front side (the side with the preamplifier) until it points 180 degrees. Now the antenna is directed due South, and the rotator control is indicating the correct direction. Tighten the mast clamps. If you have a crank-up tripod, such as the SWU400T, crank it up to the height of your choice and then secure the installation by tightening the polyester cord lines hanging down from the thrust bearing. Congratulations, you're done! Connect the coaxial cable to the BiasTee and the coax from the BiasTee to your receiver and start enjoying your microFLAG.

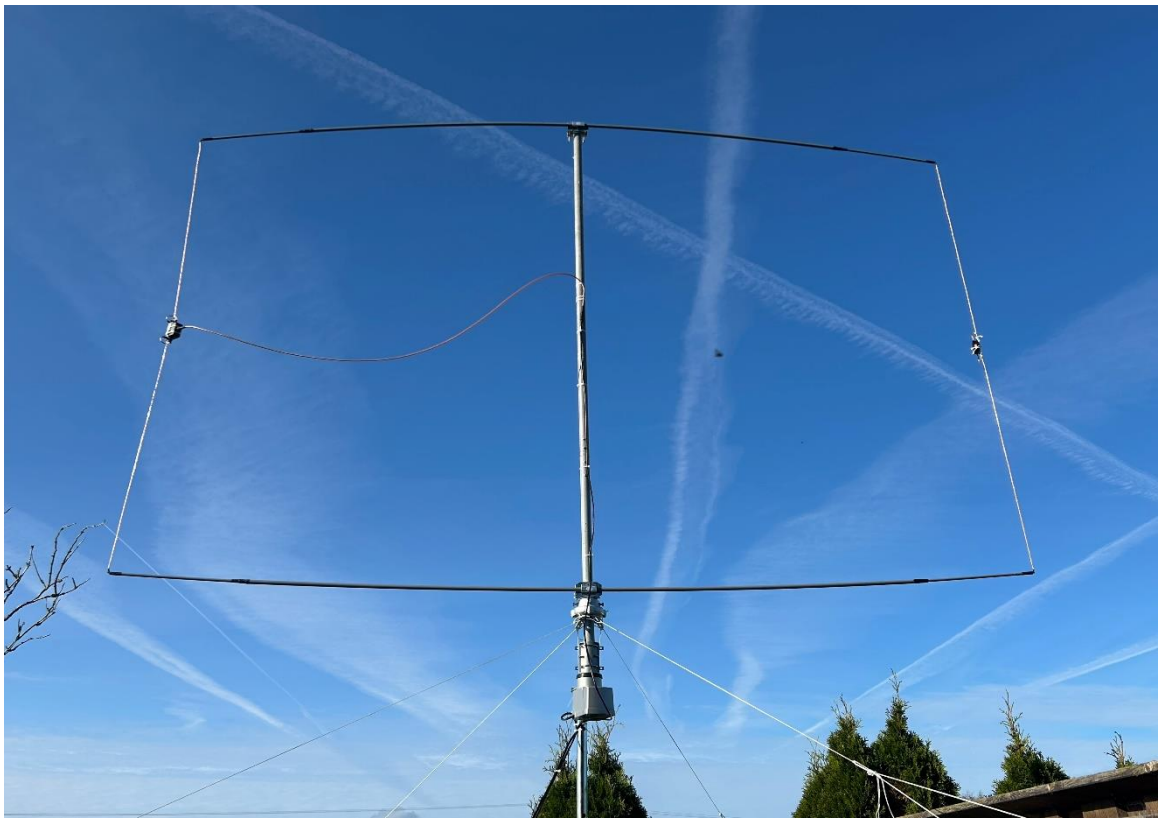


Fig.3: The “microFLAG” with rotator and thrust bearing on my small patio.

Some may ask “do I really need a hefty tripod and a rotator?” The answer to both questions is “no, you don't”. If you like to rotate the antenna by hand (so-called "Armstrong rotor"), by all means, go ahead. But you need some kind of means to prevent the antenna from "spontaneously rotating" in the wind. Furthermore, you need something better than an umbrella stand as base for the antenna assembly. Something heavier, such as a parasol foot which you fill with sand or water. That should be good enough to serve as a base for the construction.

However, and I say it again:

Do not sacrifice the thrust bearing!

Performance – does it work?
First of all, FLAG antennas – as well as all different flavours of loop antennas are low gain antennas. Hence, making an even smaller FLAG or loop means even less gain. Thats why the preamplifier probably is the most important unit in the antenna circuit. It needs to provide high gain (more than 20dB) and have a low noise-figure (NF). However, gain is not the most important parameter when it comes to receiving antennas. Signal-to-noise factor (S/N) is! As long as you hear increased noise in your receiver when you connect your antenna at daytime in your most noise-free direction, you're all good. You've got enough gain. Now it all comes to the antennas ability to detect readable signals over the noise. Of course, living in a low-noise environment helps a lot, and if one is as lucky as me – living close to the sea shore helps a little bit more.

But yes, the microFLAG works, and it works great. It has actually delivered some very surprising transatlantic DX on mediumwave the last months or so, and here I'm talking about US AM-stations that I never heard before, not even with my huge Super-KAZ antennas at my previous location. Actually this little “thingy” has stunned me more than once lately. Keeping in mind that we right now are in the “epicenter” of the sunspot maximum, makes it all more or less breathtaking. To be honest: I didn't expect the microFLAG to perform even close as well as it does. Not for a single minute! The receivers I'm using, a couple of Airspy HF+ Discovery, which are VERY sensitive, is of course also a factor which is important to have in mind.

To test the front-to-back ratio in my microFLAG, I directed the back side of the antenna towards BBC Radio Scotland on 810 kHz. This is “The Ultimate Crash Test” of all directional antennas that I construct. The station is on the other side of the North Sea from here, and it is always a huge signal 24/7. The rejection turned out to be better than 20 dB, which I think is as good as it gets for such a small antenna. The rejection of the other strong “daytime UK-stations” on 693, 909, 1053, 1071 and 1089 kHz is even better! So yes, the antenna works. I'm more than satisfied with its performance.

The microFLAG is also performing with excellence on the NAVTEX-frequencies 490 and 518 kHz, as well as the DSC frequency 2187,5 kHz, which has resulted in a number of really nice NAVTEX and DSC-catches.

Did I mention that it shines on the Shortwave bands too? Well, it does. By directing the antenna in 330 degrees, I was able to get a readable signal from CJFX on 6070 kHz, while – if not “rejecting” but at least “attenuating” the signal from the “always too strong” Channel 292 in Germany on the same frequency. Radio Educación in Mexico City on 6185 kHz, and ELWA Liberia on 6050? Easy. Radio Vanuatu on 7260 kHz, oh yes that one too, to mention a few. The microFLAG really shines on the lower shortwave bands. It also works fine on higher shortwave bands, but with increasing frequency the antenna is becoming more and more omnidirectional – just as expected.

To summarize: The 3,3 x 2,0 m microFLAG has been a really pleasant surprise for me. For its size, it performs very well and holds its own against (much) larger antennas, and I would like to say that it is a good allround antenna for the DXer with a small lot. Why not try it out?

But... We're not finished yet...

There is more to come!

Version II, the microFLAG on steroids

One day when I was outdoors, looking at and admiring my creation, I started to think "what if?". Guess it's quite natural for any antenna experimenter to start thinking about modifications and improvements of their antennas. So, I started to think about ways to make my little microFLAG a somewhat bigger, and I found out that it was not only possible, but also "doable".

I found out that it would be physically possible to lengthen the two horizontal support tubes to 5 m each and increase the vertical distance between the horizontal support tubes to about 2,5 m, provided that I also extended the vertical support tube a little bit and cranked up the whole antenna assembly another half a meter or so. By doing this, I would end up with a rotatable FLAG antenna measuring 5 x 2,36 m. So... did I? Of course, I did – but what I didn't think about at that time was that two rather small increases of the height and width of the loop would make quite some difference - "gain-wise".

Now, when we are discussing loop antennas and gain, we are often using the loop area, rather than the wire length, or circumference, as kind of a "starting point". The first version of my little Flag, the "microFlag" was 3,3 x 2 m, which equals a loop area of 6,6 square m. The modified "microFLAG" is 5,0 x 2,36 m = 11,8 square m! Now, that's quite a significant increase of the loop area, isn't it? That would give my antenna a bit more gain, wouldn't it? Yes, it would. But do you remember what I said about gain vs. Signal-to-noise ratio? Of course you do. A good S/N ratio is much more important than antenna gain. So, if an increase of antenna gain doesn't give at least a corresponding improvement of signal-to-noise ratio, all the time and effort making this modification would be a waste of time now, wouldn't it? Well, I was willing to take the risk and came up with the design below, and yes – the antenna works excellent!

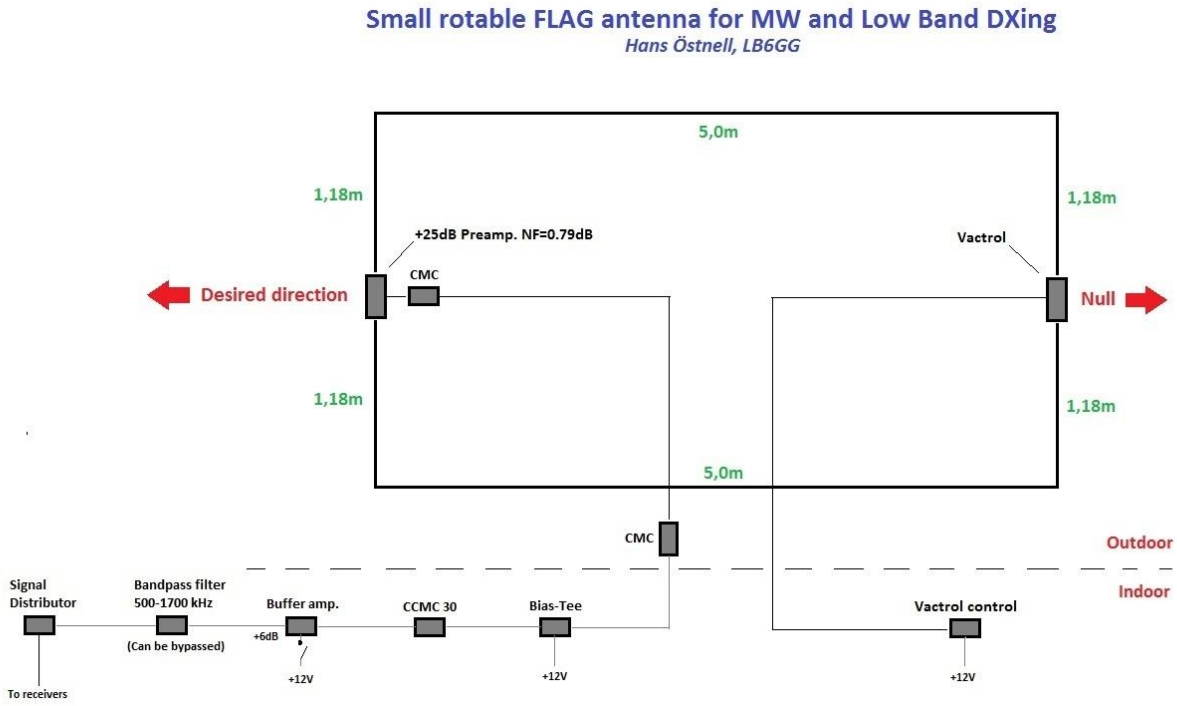


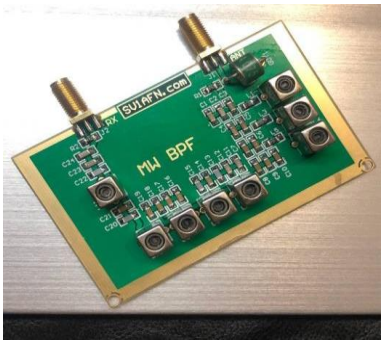
Fig.4: Small rotatable FLAG antenna fully loaded with "extras"

Now, this antenna can't hardly be mentioned as the "microFlag" anymore, so from now on I will refer to it as the "small rotatable FLAG". I remember reading a very good article by Dan / N3OX about his small rotatable FLAG project. It was very inspiring and as it turned out, my small rotatable FLAG is a little bit bigger than his. This, however, ends all "FLAG-measuring" in this article! However, I recommend you to read Dan's excellent article about his small rotatable FLAG. There is good stuff to learn. He has had some great success with it on 160 m, and I will publish the link in the reference list in the end of this paper.

The only additional materials I had to order was another two 2,38 m Ø16 mm fiberglass tubes, and some other minor stuff from PneumaBeam/Eidolon, to do the mechanical modification of the antenna. I already had most of the materials that I needed. The mechanical work was done using exactly the same techniques as described in the building instructions for the "microFLAG", including cutting new antenna wire lengths, etcetera. However, I decided to add a few other "goodies" into the antenna system to "spice it up" even more: A vactrol controlled terminating resistor, a mediumwave bandpass filter, a 6 dB buffer amplifier and a new (passive) antenna splitter since my current (active) antenna splitter/signal distributor seems to show some early signs of ageing, maybe dementia.

The Vactrol – Why?
Well, as you know, the value of the terminating resistor in a FLAG antenna is somewhere around 900 Ohm's. However, this is a compromise which is selected to "fit" somewhere "mid-band" in the mediumwave band. It's only optimal somewhere around 1000 kHz (but "good enough" for the whole spectra 500-1700 kHz). In most cases, it will work just fine – but why not try to make it even better? The remotely controlled Vactrol kit is produced by Colin Newell in BC, Canada, and more information about this brilliant solution, as well as some great videos, is found at dxer.ca. By varying the termination resistance and optimizing it to the frequency that you currently are monitoring, you will be able to create some very deep nulls – in some cases up to 60 dB(!), completely rejecting signals which are coming from behind the antenna. It's nothing less than stunning! The Vactrol is of course optional. The FLAG antenna will perform great also with the fixed termination resistance of 900-940 Ohm's.

MW bandpass filter
The bandpass filter is also optional, but I can highly recommend it for use with any kind of serious MW DXing antenna. It helps keeping the MW signals clean from "out of band stuff and artefacts". SV1AFN is offering a very good 500-1700 kHz MW bandpass filter. It costs around 50,00 EUR for a built and tested PCB, and around 70,00 EUR for the encased, built and tested. It's worth every Cent! You need, of course, to disconnect or bypass the bandpass filter when you are listening to LF or HF frequencies. See bill of materials.



Passive signal distributor/splitter and buffer amplifier
Also, optional equipment. However, a signal distributor, either it is active or passive, is a very handy piece of equipment if you want to use more than one receiver, and it becomes a must if you are using more than one receiver simultaneously. In a passive splitter, there is a 6 dB signal loss on each output and you may want to compensate for this loss, using a 6 dB buffer amplifier. In most cases this is not necessary. If you are using an active signal distributor, the buffer amplifier is already built into the circuit. SV1AFN is offering a very nice and well-built passive splitter. See bill of materials.

Bill of materials

Version I, the 3.3 x 2.0 m "microFLAG":

Fiberglass tubes:	1 x 2,38 m Ø38 mm (vertical support tube) 2 x 2,38 m Ø16 mm (upper and lower horizontal support tubes) 1 x 2,38 m Ø11 mm (cut to 4 equally long pieces. End sections for the upper and lower horizontal support tubes) (or use lengths/dimensions from your local supplier. In Norway: (www.eidolon.no)
Cross clamps:	2 pcs. of 20 x 20 mm cross clamps. (Add some duct tape around the middle of the Ø16 mm support tubes to make them fit the 20 x 20 mm clamps). Clamps available at www.wimo.de
Antenna wire:	11m Messi & Paoloni Diploflex 3.1 mm from www.wimo.de, or use whatever you have, as long as the cable diameter (including insulation)

	doesn't exceed the inner diameter of the end sections of the upper and lower horizontal support tubes.
Preamplifier:	W6LVP Antenna Experimenter's Kit (www.w6lvp.com) or Cross Country Wireless "Experimenter's Antenna Amplifier" found at https://www.crosscountrywireless.net. Both amplifiers are delivered with a BiasTee for DC-feed via coax to the preamplifier.
Terminating resistor:	900-940 Ohm non-inductive resistor. Make your own weatherproof box, or order from https://www.ebay.com/usr/mins_radio
Thrust bearing:	Yaesu GS-050 from www.christech.no or www.wimo.de
Rotor (optional):	Small TV-rotor, such as HyGain AR-500, from www.wimo.de
Base/Tripod:	Parasol foot or something similar with a heavy base (if so, you need additional tubes to get the lower antenna wire up to 3-4 m over ground). I'm using an Adam Hall SWU400T crank up tripod from https://soundstorexl.no/.
Coax:	H-155 low loss coax from www.wimo.de
Common mode chokes:	2 x PNC100 (https://www.sv2czf.com/pnc100.html), 1 x NTI CCMC 30 (https://bonito.net/hamradio/common-mode-noise-filter-ccmc30/)
Additional stuff:	Self-amalgamating tape, shrinking tube, cable ties, polyester cord line, coffee and sandwiches from your local hardware and food supplier.

Version II, 5.0 x 2.36 m "Small rotatable FLAG":
The materials that you need for building the larger version of the rotatable FLAG antenna is the same as for the "microFLAG", with the following exceptions:

Fiberglass tubes:	You need an additional: 1 x 2,38 m Ø44 mm fiberglass tube (to make a longer vertical support tube) 2 x 2,38 m Ø16 mm fiberglass tube (to make longer upper and lower horisontal support tubes) 2 x 2,38 m Ø11 mm fiberglass tube (joint pieces and new "end sections")
Antenna wire:	15m Messi & Paoloni Diploflex 3.1 mm
Vactrol / Control unit (Optional):	Designed by Colin Newell - https://dxer.ca/index.php/vactrol
Bandpass filter (opt.)	www.sv1afn.com
Buffer amp. (optional):	Any low noise 6 dB amplifier will do. It compensates for the 6 dB signal loss in a passive signal distributor/splitter. In most cases you won't need it.
Passive signal distr. (opt.):	www.sv1afn.com
Additional stuff:	More self-amalgamating tape, shrinking tube, cable ties, coffee and sandwiches, and poly-line from your local hardware and food supplier.

References

Thomas Nilsson:	Antenna compendium	https://www.dxinfo.se
Dan / N3OX:	Small Rotatable Flag	http://www.n3ox.net/projects/flag/
Martin / OK1RR:	Flag and pennant antennas	https://ok1rr.com/

Postscript

I'm not a RF-engineer nor a scientist. The intention with this document is to give building instructions for a small rotatable FLAG antenna, with a mechanical construction that gives the antenna a chance to survive the harsh Nordic autumn, winter and early spring weather conditions. This is not "re-inventing" the FLAG antenna or even the rotatable FLAG. It's just a description of how I constructed my rotatable FLAG antenna to fulfil my needs. Perhaps it will inspire other DXers, who doesn't have the possibility to erect huge loops or build long beverage antennas. Small antennas work! And sometimes they even work much better than expected!

Never give up and Good DX!