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5 band folding antenna

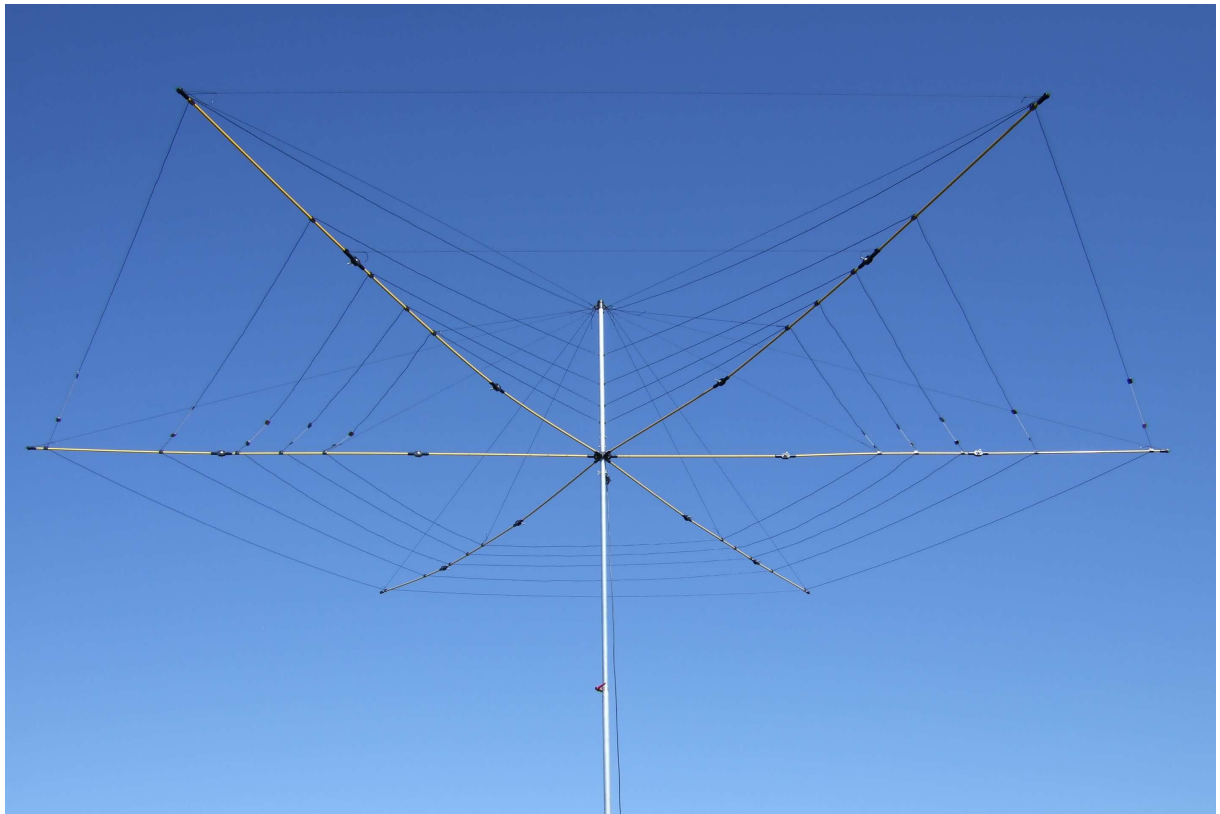
incl. options & accessories

Construction Manual

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**Please read this manual
completely and thoroughly
before starting assembly!**

1. Foreword & safety warnings

Dear YL, dear OM!

Thank you very much for purchasing the 5 band folding antenna. In your own interest, please read this construction manual completely and thoroughly **before starting assembly**.

Familiarize yourself with the working steps, and locate the required tools in advance. During assembly, please follow the instructions step by step, and tick the boxes for a better overview.

Take your time and proceed carefully and precisely. If you have ordered options (such as 6m band or permanent installation option), these are discussed within the manual in the relevant sections, so there are no separate manuals for options. Accessories are discussed in a separate section of this manual.

The dimensions of the drivers, reflectors and support cords are approximate values only. The final dimensions are depending on tolerances, height and near field conditions, hence a little extra length is strongly recommended as a start. The final dimensions will be determined during final trimming and swr metering, this is discussed in detail later.

For a proper function and good swr, the antenna requires a height of at least 5 meters (~16 ft) above ground. Raising the antenna further means substantial gain growth and lower take-off angles. Thus, the antenna should be mounted as high as possible, while respecting mast load limits and guying the mast if required. The resonance shift from 5 meters to 10 meters height (16 ft to 33 ft) is a marginal 10 kHz approximately.

Safety warnings:

The antenna is intended for use by experienced radio amateurs only. The user operates at his own risk and is solely responsible for any damage that is caused by abuse or installation that is not complying with the corresponding technical or building regulations.

Good craftsman skills and experience with amateur radio antennas are required for building the antenna, and determining the individual element lengths is essential. If in doubt, please ask for help from an experienced radio amateur!

During construction, wear adequate safety equipment and respect specific safety rules when at height. Always secure your working area to prevent others from injuries by trapping over antenna parts or being hit by falling objects.

Please respect the specific regulations of your country. A beam antenna like this will produce much higher field strength in the beam direction than a dipole or groundplane antenna.

Use adequate lightning protection and always disconnect the antenna when a thunderstorm comes close by.

Last but not least, touching the antenna while transmitting may cause burn marks or other injury.

Happy building, have fun and good DX!

Christian, DL1ELU

2. Tools required

Before you start assembling, please locate as follows:

- philips screwdriver PH1
- philips screwdriver PH2

- spanner 7 mm or ratchet with socket
- spanner 10 mm or ratchet with socket

→ If metric spanners are not present please use a small adjustable spanner.

- tweezers or long and slim shaped pliers
- precise flush cutters
- robust side cutters
- sharp scissors
- cable stripper or knife

- soldering iron (at least 30 watts)
- adequate acid-free solder
- lighter
- hot air gun (if available)

- multi meter or continuity tester
- accurate tape measure, at least 11 meters (36 ft) long
- ruler 2 m or 100"

- drill 4 mm or 5/32"
- drill 6.5 mm or 1/4"
- small hammer

- vaseline or similar as a mounting aid

- for final element adjustment: TX, antenna cable, accurate swr meter

3. Scope of supply

Please locate the following parts:

- 80 meters (262 ft) tinned stranded copper wire 1.0 mm² (AWG 18) with PVC insulation
- 45 meters (147 ft) Dyneema® support cord 1.5 mm
- 6 Meter (236") spacing cord 2.8 mm
- 30 cm (12") heat shrink tube 4.8 mm
- 5 velcro straps 50 cm (20")

- 1 center post aluminium 30 mm dia. with feedpoint and eyelets molded on
- 1 center conductor square aluminium 10x10 mm
- 1 fiberglass tube 1", 250 mm (10") long
- 6 inner spreader sections (hinge and locking swivel joint)
- 6 middle spreader sections (2 locking swivel joints)
- 6 outer spreader sections (locking swivel joint and tip)
- 1 scrap fiberglass piece approx. 10 cm (aid for cutting elements)
- 1 scrap solid wire piece approx. 15 cm (aid for cutting elements)

- 2 hub halves
- 1 top cap
- 32 wire clips (8 mold assemblies with 4 clips each)
- 20 universal detachable clamps (mold pieces)
- 6 centering discs (mold pieces)
- 6 feedthrough insulators (partially mold assemblies with 4 insulators each)

- 1 UHF/SO-239 flange socket (or N socket as an option)
- 11 solder tags 4 mm

- 1 cylindrical pin 4 x 50 mm
- 2 self tapping screws 2,9 x 9,5 mm
- 2 pan head screws M3 x 12
- 7 pan head screws M4 x 8
- 6 pan head screws M4 x 20
- 1 pan head screws M4 x 40
- 6 carriage bolts M6 x 30 *
- 12 carriage bolts M6 x 55 *
- 1 wing screw M6 x 40 *
- 2 standard nuts M3
- 6 square nuts M4
- 1 nylock nut M4
- 6 nylock nuts M6 *
- 13 wing nuts M6 *
- 2 lock washers M3
- 11 lock washers M4
- 2 washers M4
- 18 washers M6 x 16 dia.

* alternative supply for permanent installation option:

- 18 carriage bolts M6 x 30
- 18 nylock nuts M6

The M6 wing screw and M6 wing nut are intended for fixing the antenna onto a portable mast, they are not supplied with the permanent installation option. Please supply adequate mounting hardware on your own.

6m Band option:

Please locate the following parts supplied for this option:

- 7 meters (23 ft) tinned stranded copper wire 1.0 mm² (AWG 18) with PVC insulation
- 0.7 meters (27") spacing cord 2.8 mm
- 10 cm (4") heat shrink tube 4.8 mm

- 6 wire clips (partially mold assemblies with 4 clips each)
- 4 universal detachable clamps (mold pieces)

- 2 solder tags 4 mm

- 2 lock washers 4 mm

Optional storm brackets:

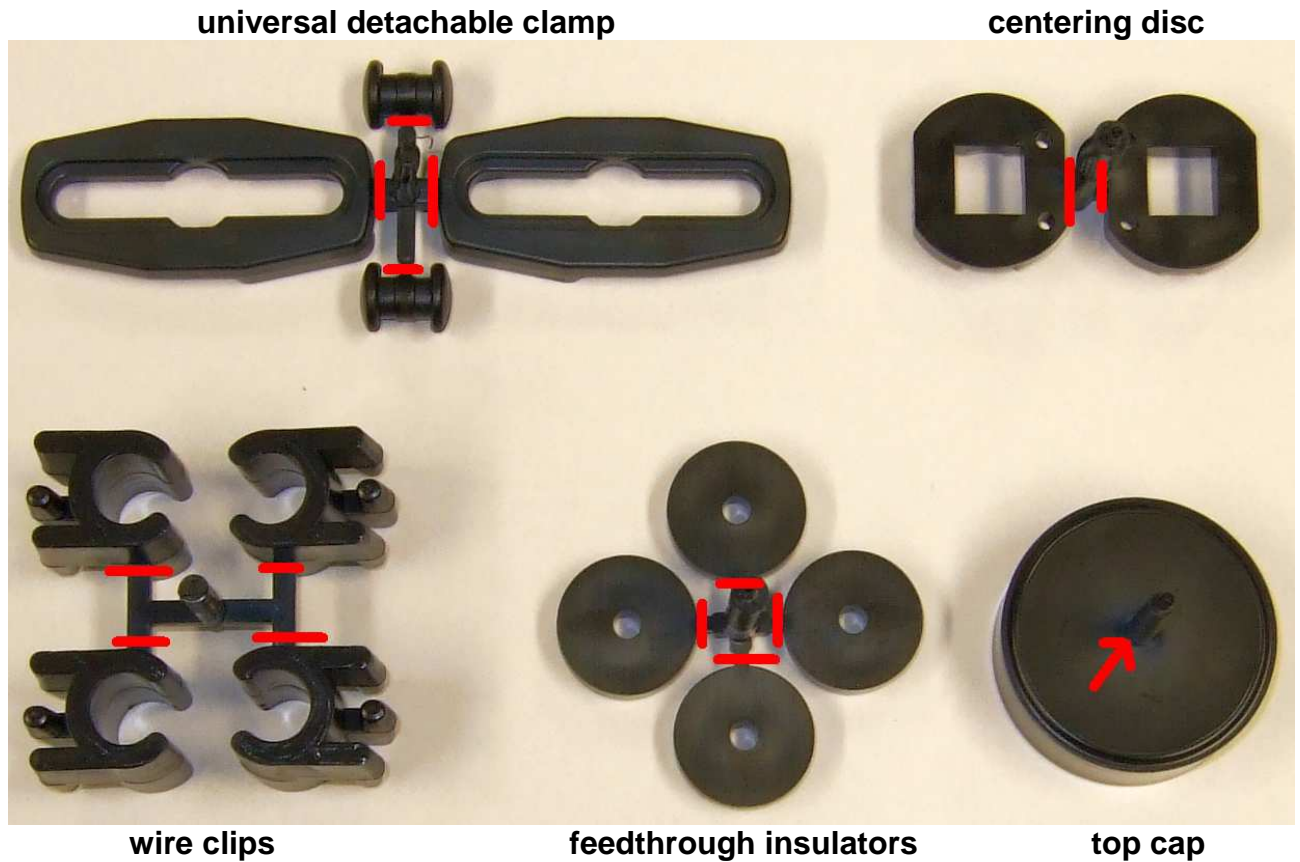
Please locate the following parts supplied for this option:

- 6 brackets

- 12 carriage bolts M6 x 30
- 12 washers M6 x 16 dia.
- 12 wing nuts M6 (or M6 nylock nuts with permanent installation option)

4. Preparation of parts

- First of all, the majority of plastic parts need to be separated. Please use small and precise flush cutters and separate the parts from the sprue. The cuts are indicated in the picture. Deburr razor edges with flush cutters or a knife.



- Now assemble the detachable clamps: Press together the two halves and then push one locking knob through the center opening. Push the knob sideways along the slot, insert the 2nd knob and slide it to the opposite side.



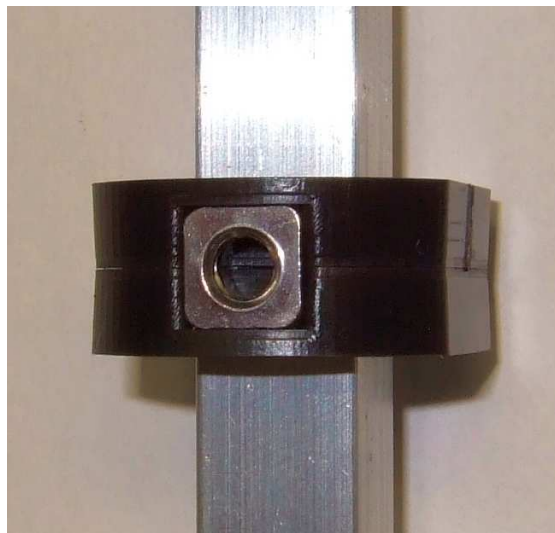
5. Center post assembly

The center post is a multi purpose item. It is a support for the ropes holding the spreaders in place, and is a coaxial feeder for the driven elements. Therefore a solid square center conductor running in the center post is connected to the center pin of the flange socket connector. One half of each driver is connected to the center conductor by a long screw, the other half is bolted to the aluminium tubing at the same height level. Feedthrough insulators and centering discs hold the center conductor in place and keep everything electrically isolated from the outer aluminium tubing.

- Please assemble the 6 centering discs: Insert a square nut in the slot of one centering disc half and press together with the other half. Now the square nut is locked tight between the disc halves.



- Push one centering disc onto the square center conductor, starting from the rounded end of the rod. Slide along the whole length until you have reached the very last thread of the center conductor. Use some vaseline or similar to reduce friction while pushing and wipe off afterwards, or use the fiberglass tube as a mounting aid. The centering disc stands correct when you can see the thread in the center conductor by looking through the hole in the backside of the centering disc.
- Repeat with the remaining centering discs. When finished, all threads on the rod must be occupied by centering discs. **The discs must be equally orientated, so the square nuts all need to be on the same side!**



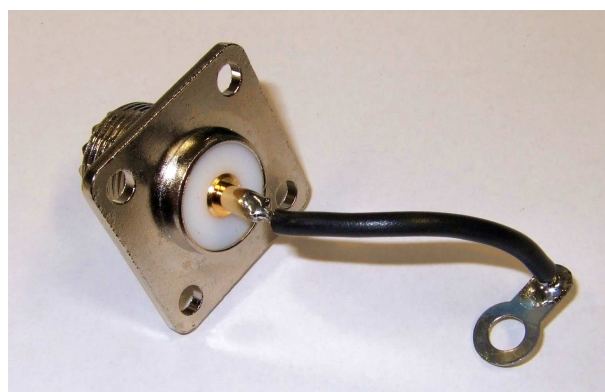
- Now carefully insert the center conductor into the center post with the rounded end of the rod facing the top of the center post. Move the rod until you can see the square nut's threads through the small holes, and the threads in the rod through the large holes (and through the centering discs, of course).



- Put a feedthrough insulator on every large hole and secure loosely with a M4 x20 pan head screw. Enlarge the hole in the insulator a tad with a 4 mm or 5/32" drill if required. Insert M4 x 8 pan head screws in all 6 small holes and tighten loosely. The center conductor is now held in position.



- Cut 4 cm (1.6") of the stranded copper wire supplied, and strip approx. 5 mm (1/4") on both ends. Solder one end of the wire to the center pin of the flange socket, and solder a tag onto the other end. Do not allow solder to run onto the ring of the solder tag. Let the solder joints cool down shock-free and inspect carefully. Clean from flux residue if required.



- Insert a M4 x 8 pan head screw into the solder tag and push a M4 lock washer on the thread from the other side.



- Push the wire with the tag ahead from outside through the center hole of the feedpoint and insert the M4 screw into the top thread of the center conductor. Tighten loosely. Do not lose the lock washer, it must sit between the solder tag and the center conductor.
- Now for the tricky job: Mount the flange socket connector with 2 screws M3 x 12, 2 lock washers M3 and 2 nuts M3. It helps to start with the bottom screw and to let hang loose the flange connector a bit while putting on the the lock washer and nut with tweezers or long slim pliers. You need a calm hand and a bit of patience here. If you're not in luck at all, unsolder the wire from the connector, mount the connetor, and re-solder the wire. Finally tighten both screws.

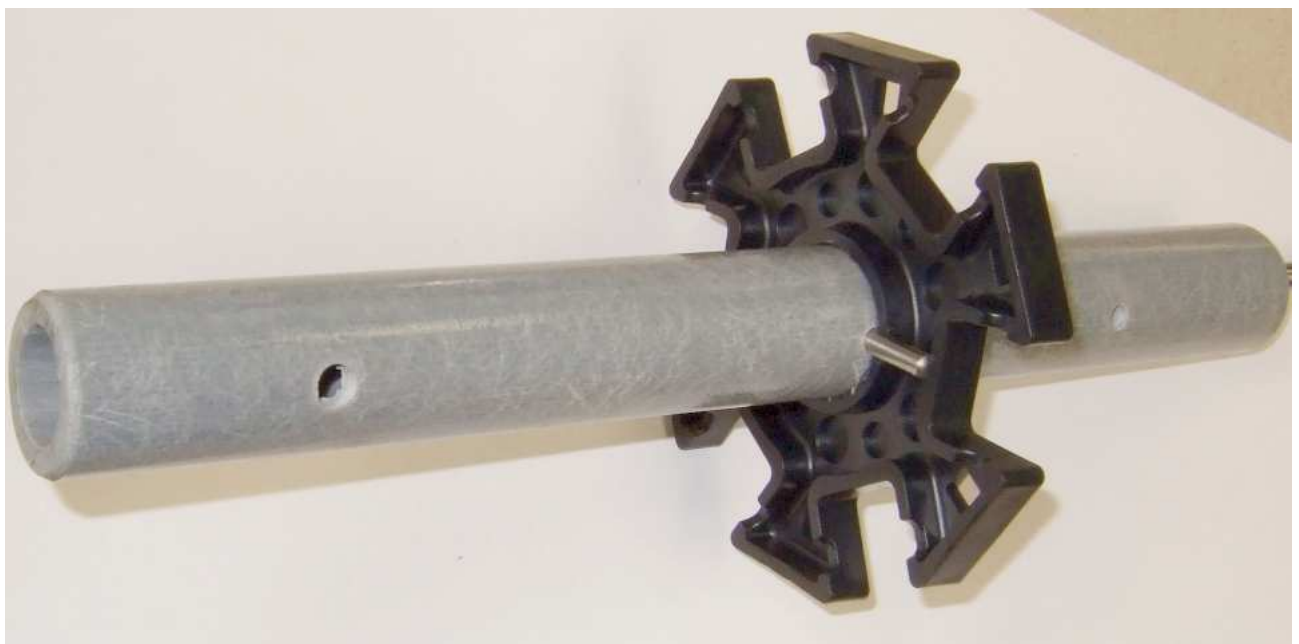


- Align the solder tag and tighten the M4 screw. Bend the tag upwards for maximum distance to the center post wall.
- Check the feedpoint area for filings, chips or dirt, and clean eventually.
- Take a multimeter or continuity tester and check for isolation between the center pin of the flange socket and the center post. If conductive, check the arrangement, disassemble and fix the short.

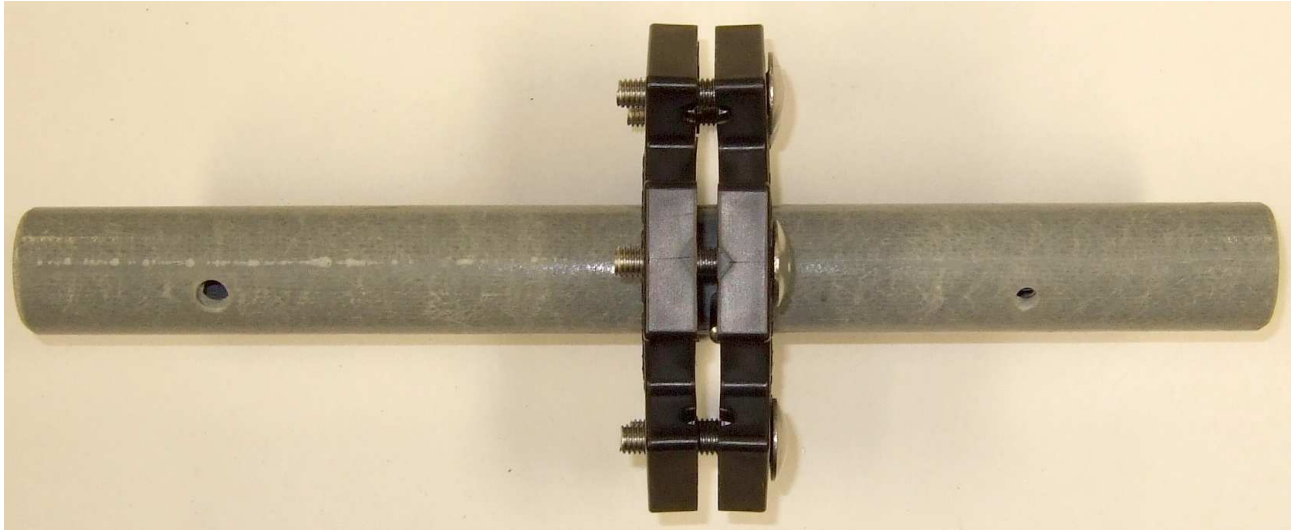
- Insert 2 self tapping screws 2,9 x 9,5 mm through the 2 remaining holes in the flange connector into the blind holes behind, push and tighten carefully until the flange touches on the plastic.
- Firmly push the top cap onto the center post.



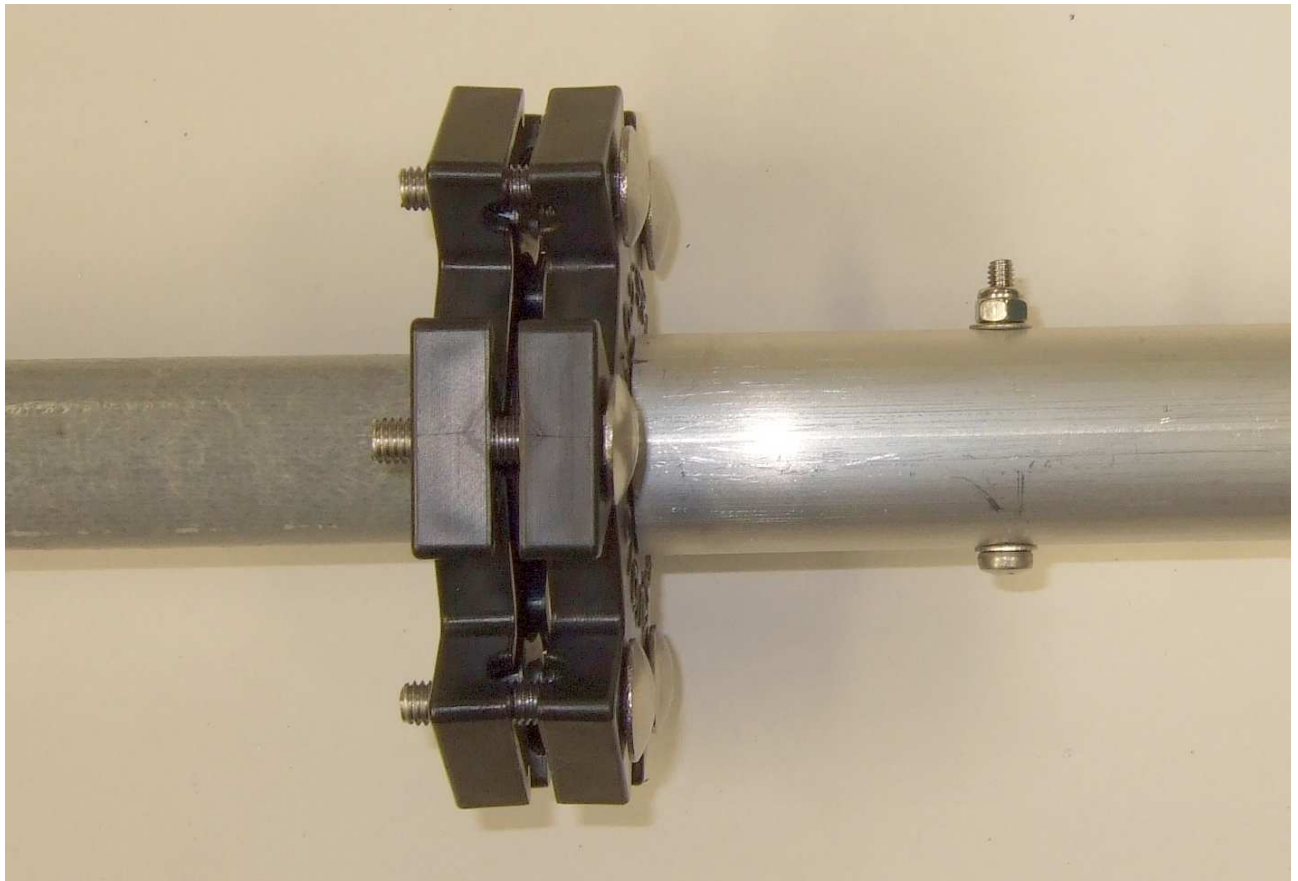
- Push one hub half onto the fiberglass tubing (grease slightly and rotate while pushing), the inside of the hub half has to face the large hole in the tube. Slide the hub half along the tubing almost to the center hole in the tube.
- Push the cylindrical pin 4 x 50 mm completely through the center holes of the tube.
- Turn the hub half until the blanks in the inner ring are in line with the pin.
- Press the hub half firmly against the pin to lock onto it. Now the pin is also fixed.



- Push the other hub half onto the tubing from the opposite side and align the blanks of the inner ring with the cylindrical pin. Near down the halves to a gap of 5 to 6 mm (1/4").
- Insert 6 carriage bolts M6 x 30 into the square holes of the hub halves and press in the square section of the bolts.



- Insert the fiberglass tube into the bottom of the center post, with the small hole ahead. Align the holes and secure with a pan head screw M4 x 40, a washer on each side, and a nylock nut M4. Do not overtighten as this may bend the aluminium and crack the fiberglass tubing.



6. Spreader assembly

Each of the 6 spreaders consists of 3 segments that are held together with locking swivel joints. In total there are $6 \times 3 = 18$ segments. The segments vary in length and shape.

Here you see the 3 different types of spreader segments:

Inner segment: (attaches to the hub) 1 hinge and 1 locking swivel joint, shortest segment



Middle segment: 2 locking swivel joints, 180° twisted to each other

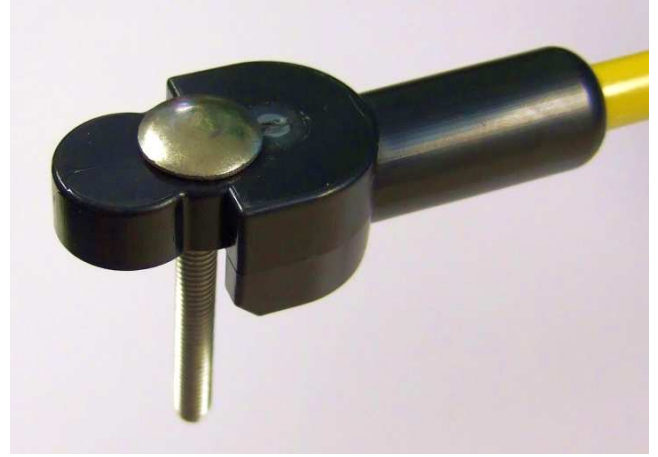


Outer segment: 1 locking swivel joint and 1 zig zag slotted tip (takes support cords)

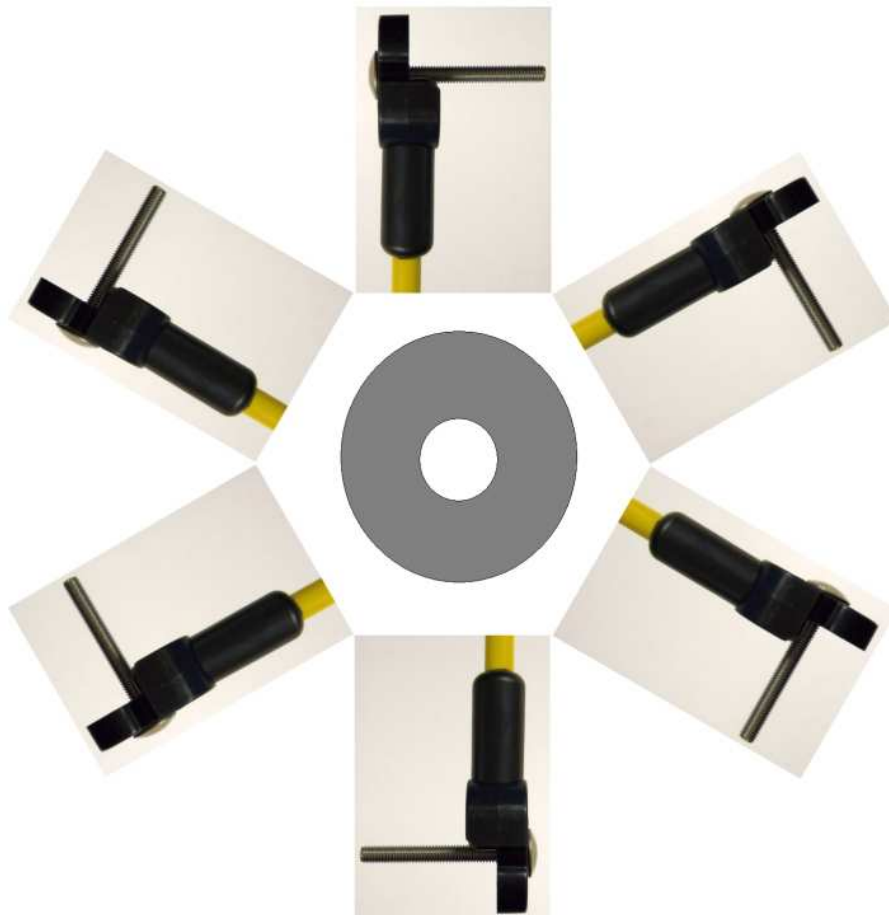


The spreader segments get connected by their locking swivel joints equipped with bolts, nuts and washers as follows:

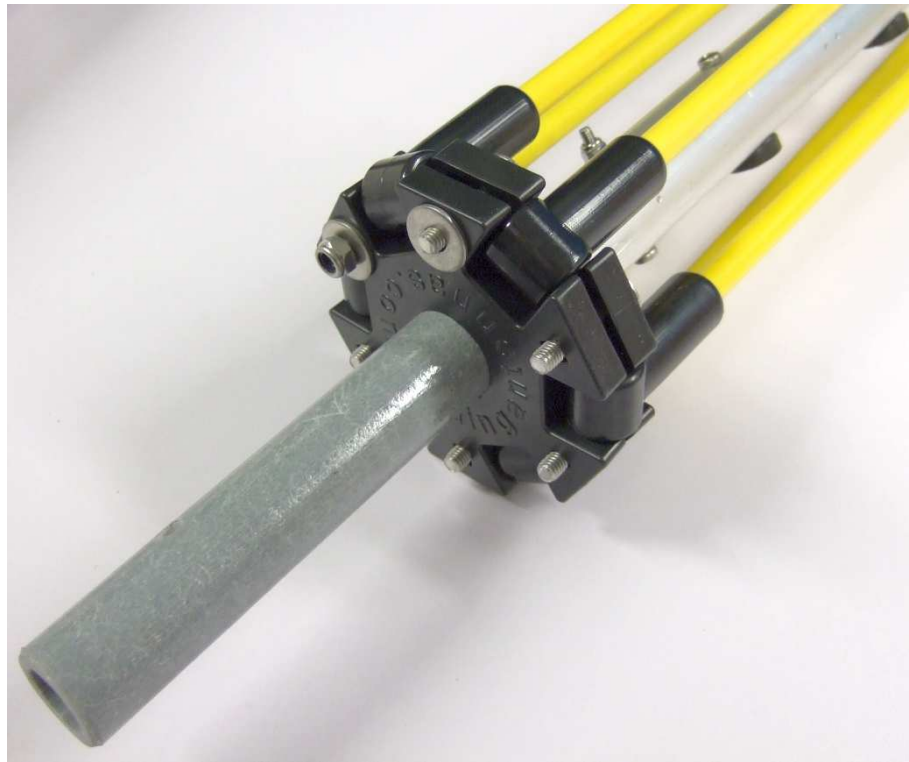
- Insert a carriage bolt M6 x 55 (or M6 x 30 for permanent installation option) into the swivel joints of each inner segment, and in **only one** swivel joint of each middle segment. That makes a total of 12 carriage bolts. Lay the swivel joints on a hard surface (work bench) and use a hammer to drive in the bolts. Stop a few millimeters before the end and verify the orientation of the square flanges under the bolt heads. Align with the square hole in the swivel joints if required and hammer completely in.



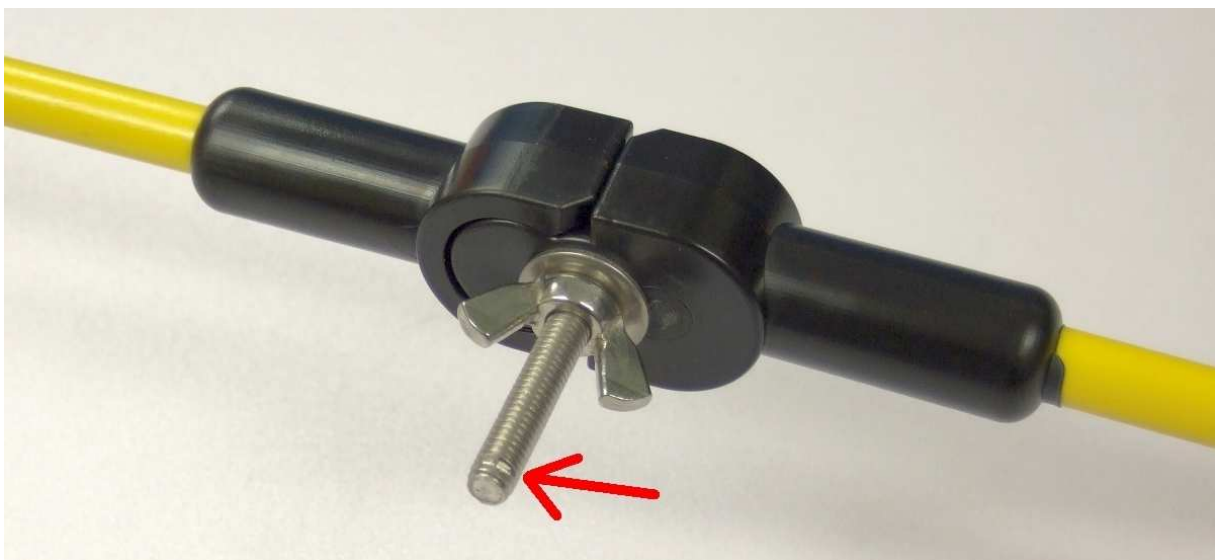
- Enlarge the holes in the remaining swivel joints of the middle sections, and all of the outer sections with a 6.5 mm (1/4") drill. If you don't, the bolt threads will not slide through properly.
- Attach the 6 inner segments to the prepared hub with the bolts in the swivel joints pointing clockwise when viewed from the top.



- Fold up the segments to the center post and bolt together the hub halves with washers M6x16 and nylock nuts M6.



- Now mount the antenna on a umbrella stand or tripod. If not available, simply ram the antenna in the (soft) soil and clean later on.
- Add the remaining spreader sections. Push together the locking swivel joints, slide a washer M6 x 16 on the thread and secure tight with a wing nut M6 (or nylock nut M6 for permanent installation).
- To prevent from losing parts when the swivel joints are opened, firmly dent the threads with a solid side cutter approx. 2 turns from the end.



The completed spreaders will now bend drastically and touch the ground, which is normal due to the support cords still missing.

7. Preparing the support cords

To provide rigidity and stability, each spreader is held in position with 2 support cords. Furthermore, additional cords between the spreaders with the driver wires running to the center post help to minimize element slack. These support cords are required:

6 cords 340 cm (133.9") final length
6 cords 183 cm (72") final length
1 cord 220 cm (86.6") final length
1 cord 325 cm (128") final length

ATTENTION:
These are the final dimensions!
Cut cords 40 cm longer (see below)!

The cords initially need to be cut approx. 40 cm (16") longer due to the loops at both ends and some extra headroom.

Cut cords from the 1.5 mm rope in the following dimensions, using sharp(!) scissors:

- 6 cords 380 cm (150")
- 6 cords 223 cm (88")
- 1 cord 260 cm (102")
- 1 cord 365 cm (144")
- Slightly singe the cuts with a lighter to prevent from raveling.

Do the following with all 14 cords:

- Make a static loop of 10 cm (4") length in one end of the rope using a kind of palomar knot: Reverse the end and lay in parallel to the rope. Then make a single knot in the pack. Difficult to describe, but very easy to do. Just look at the picture. Check loop length, then tighten the knot properly by pulling from each side.



- Reverse the other end of the rope at the point where the final length is reached and again make a palomar style knot with a loop of approx 10 cm (4"). Moderately tighten the knot.
- Check the final rope length (the maximum distance between the tips of the loops completely stretched out). If required, undo the knot, re-measure and knot again.
- Pull knot completely tight.

WARNING: DO NOT CUT EXCESS ROPE YET !!!

Now install the 6 long support cords with 340 cm (133.9") final length on the antenna:

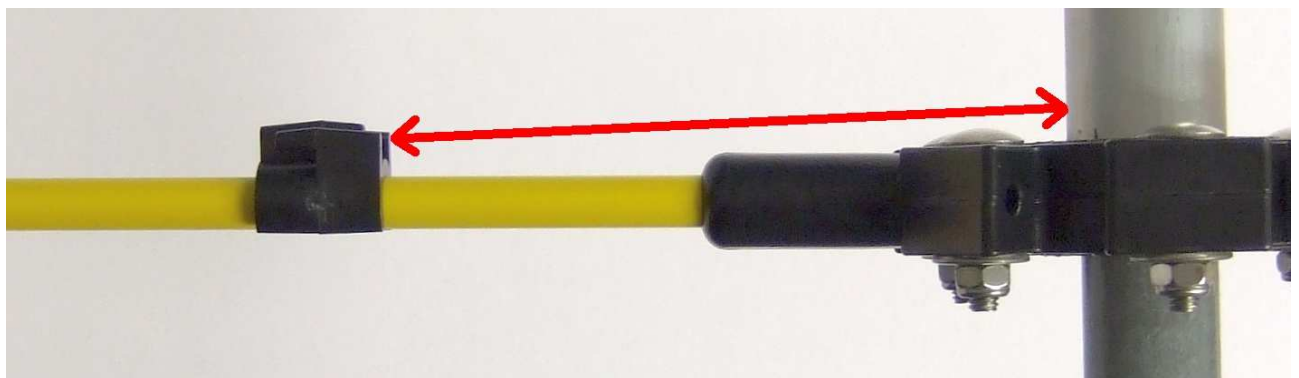
- Feed one looped end of the cord through the eyelet next to the feedpoint, then take the other end of the rope through the cord loop. Pull tight. Attach 3 ropes on each eyelet in this manner.



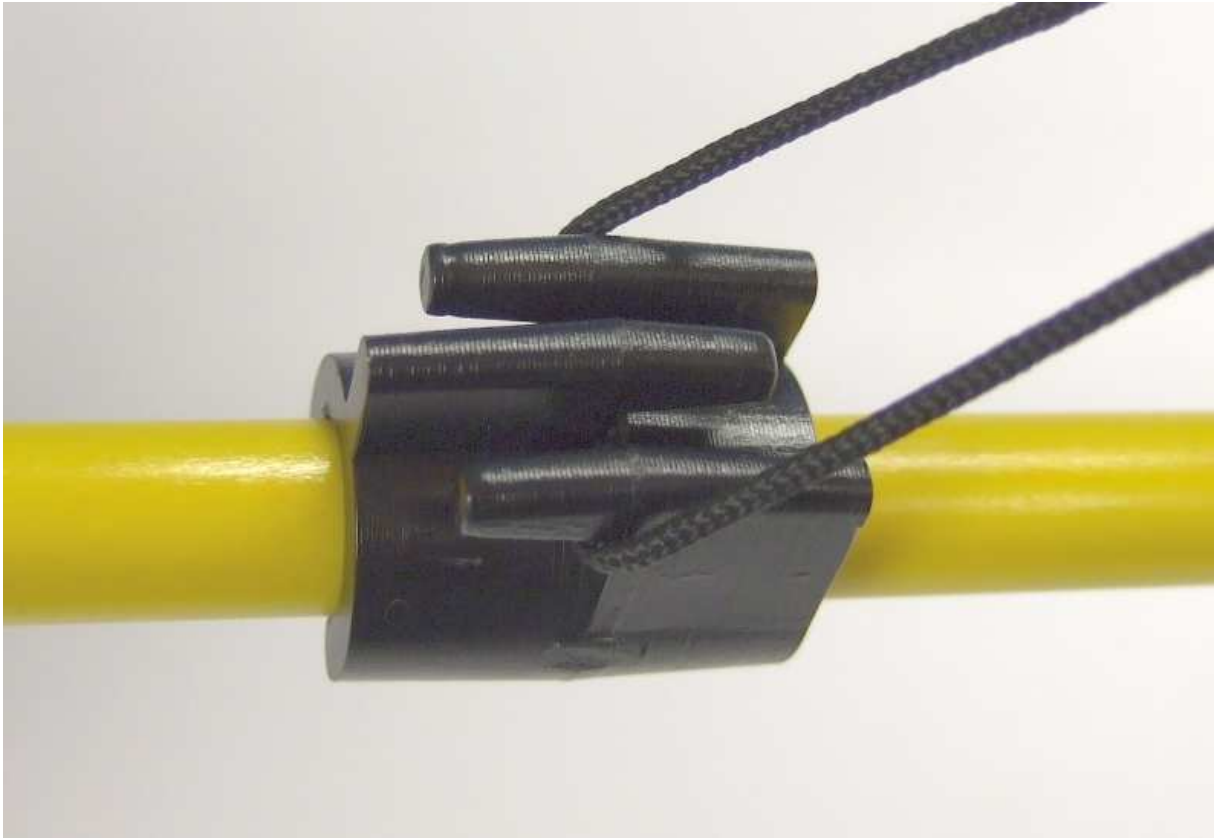
- Hang the other ends of the ropes into their corresponding spreader tips.



For the installation of the 6 short support cords (183 cm / 72") you have to mount a wire clip onto each spreader in advance. See the arrow in the picture below to understand how to determine the right position.

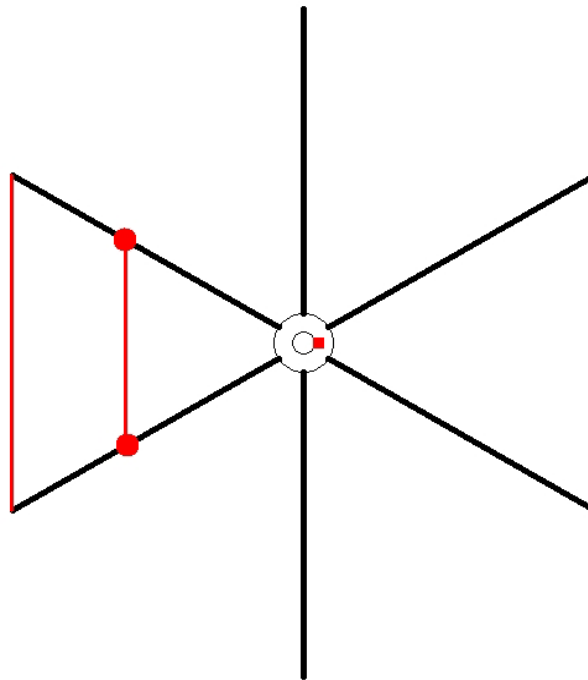


- On each spreader, measure a distance of 151 cm (59.4") from the outside of the center post and snap on a wire clip with the two fingers pointing away from the center post (see picture below).
- Attach the 6 short support cords (183 cm / 72") to the top eyelet.
- Attach the cords to the wire clips by dragging and locking the loop cord between the clip fingers.



- Adjust the center post perfectly perpendicular and look from the side. The spreaders now have to be absolutely horizontal without sags oder bows. A slight lateral bend is normal and will be cured with elements attached. If you find the shape distorted at some point, verify cord lengths and position of the wire clips.
- Measure a distance of 218 cm (86") on those 2 spreaders the farrest away from the flange connector (see red dots in the following drawing). That distance is very close to the locking swivel joint. Snap on a wire clip on both spreaders and rotate them until the tops face each other.

The diagram shows the position of the flange connector and the wire clips that need to be attached.



- Mount the support cord of 220 cm (86.6") onto the wire clips just attached.
- Mount the 325 cm (128") support cord in parallel onto the corresponding spreader tips.

On **each** spreader, install the remaining wire clips at the following distance to the center post:

- 306 cm (120.5") (20m band)
- 235 cm (92.5") (17m band)
- 201 cm (79.1") (15m band)
- 169 cm (66.5") (12m band)
- 84 cm (33.1") (optional 6m band)

For the 10m band, the wire clips already mounted and populated with the short support cords are used. Thus no need for extra clips here.

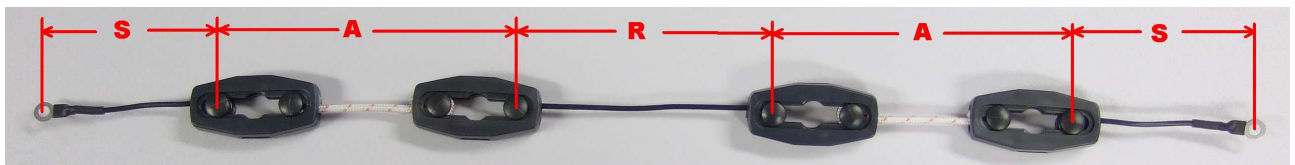
8. Preparing antenna elements

Being a 2 element beam, this antenna has a driver (consisting of 2 driver halves) and a reflector. The elements are attached to the spreaders in a concentric way. Sadly their ends never match with the spreaders, so spacing cords are required to join the elements and hold them in position.

The driver halves are connected to the corresponding feeder terminals with solder tags. The other ends and the reflectors are terminated in unversable detachable clamps. It is quite simple to mount and adjust wires and cords in these clamps, and they are good insulators.

Please understand and respect the definition of part dimensions:

- The length of the driver halves is defined as the distance from the eye of the solder tag to the center of the locking knobs of the clamp (measurement "S").
- The length of the reflector is defined as the distance between the centers of the locking knobs (measurement "R").
- The spacing between the driver halves and the reflector is defined as the distance between the centers of the locking knobs **where the elements are fixed** (measurement "A")



At my QTH and at a height of 5 meters (16 ft) above ground I found the following dimensions:

→→ DO NOT CUT THE WIRES YET, PLEASE READ BELOW HOW TO PROCEED!

Band	Driver halves „S“ (2x required)	Reflector „R“	Spacing „A“ (2x required)
20m	<input type="checkbox"/> <input type="checkbox"/> 534 cm / 210.2"	<input type="checkbox"/> 1007 cm / 396.5"	<input type="checkbox"/> <input type="checkbox"/> 61 cm / 24"
17m	<input type="checkbox"/> <input type="checkbox"/> 409 cm / 161"	<input type="checkbox"/> 775 cm / 305.1"	<input type="checkbox"/> <input type="checkbox"/> 47 cm / 18.5"
15m	<input type="checkbox"/> <input type="checkbox"/> 349 cm / 137.4"	<input type="checkbox"/> 663 cm / 261"	<input type="checkbox"/> <input type="checkbox"/> 40.5 cm / 16"
12m	<input type="checkbox"/> <input type="checkbox"/> 292 cm / 115"	<input type="checkbox"/> 556.5 cm / 219.1"	<input type="checkbox"/> <input type="checkbox"/> 34.5 cm / 13.5"
10m	<input type="checkbox"/> <input type="checkbox"/> 260.5 cm / 102.5"	<input type="checkbox"/> 498.5 cm / 196.25"	<input type="checkbox"/> <input type="checkbox"/> 30.5 cm / 12"
6m*	<input type="checkbox"/> <input type="checkbox"/> 145.5 cm / 57.3"	<input type="checkbox"/> 280 cm / 110.25"	<input type="checkbox"/> <input type="checkbox"/> 16.5 cm / 6.5"

*6m option only

As mentioned in the beginning, these dimensions are approximate values only and may differ at your location. In opposite to the picture I **strongly** recommend not to cut the wires flush with the clamps but to leave a tail of 10 cm (4") everywhere.

This enables you to extend the elements if required and to cut the tails step by step during fine tuning.

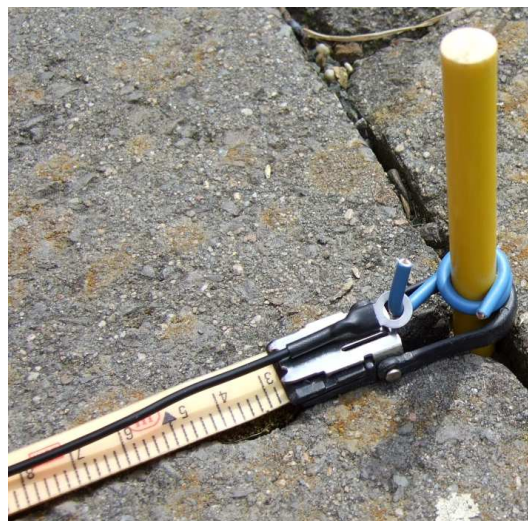
Prepare the driver halves (2 for each band!) as follows:

- Cut a 2 cm (0.8") piece of heat shrink tubing and slip over the end of the stranded copper wire reel. Use the small cable reel for the optional 6 m band!
- Strip insulation approx. 10 mm (0.4") and twist the strands.
- Center a solder tag onto the stripped area.
- Fold the stripped wire in a sharp bend.



- Solder the tag onto the wire, using a hot and clean soldering iron and plenty of solder. Prevent solder from running onto the ring of the tag. The solder shall soak into the wire and thus solder the back side as well. Let cool without shaking and clean if needed.
- Slide the heat shrink tubing over the cold solder joint and shrink with a hot air gun (or a lighter paying extreme attention).
- Roll out the wire and make a soft kink at the appropriate length.

A little notice: Precise measurement can be difficult with long wires and no helping hand. Help yourself: Hammer the scrap piece of fiberglass supplied into the soil or between paving stones. Attach the tape measure to the fiberglass, roll out the tape to at least 11 meters (36 ft) and secure with a stone or similar. Now wrap the scrap solid wire around the fiberglass, form a hook and hang in the solder tag. Adjust the wire so that the eye of the tag is exactly at the „0“ mark of the tape measure. Now you can easily roll out the wire and precisely measure the corresponding lengths.



- Take a detachable clamp and remove one locking knob.
- Narrow the kink in the wire to a loop and push the wire with the loop ahead sideways into the clamp, up to the eye.
- Widen the loop and re-insert the locking knob. Now the loop shall run around the locking knob.
- Slide the locking knob sideways until the wire starts to get clamped. Now adjust to the exact length and lock tight.
- Cut the wire from the reel **leaving a tail of 10 cm (4") from the clamp.**
- Mark the driver halves in a useful way (e.g. „S 20“ for 20m driver half) and tick the corresponding box in the dimension table.

Building the reflectors is quite similar, but there are detachable clamps on both ends. You can put the clamps onto the scrap fiberglass. Check for the “0” mark being at the right level and use the solid wire for adjustments in case.

Keep in mind to leave a wire tail of 10cm (4") **on both sides** of the reflectors!

- Build the reflectors according to the dimensions given in the table. Mark properly, e.g. „R 20“ for 20m reflector. Use the small cable reel for the optional 6 m band! Tick boxes.

Now the driver halves are joined with the reflectors to complete the wire assemblies. Please proceed as described now:

- Assign the driver halves to their reflectors.
- Secure the spacing cord (2,8 mm / 0.11“ dia.) in the detachable clamp of one driver half.
- Insert and loosely lock the spacing cord in a detachable clamp of the reflector.
- Precisely adjust the distance given in the table (remember: the distance is between the centers of the locking knobs that hold the element wires!).
- Secure the loose spacing cord and check the distance under tension. Adjust if required.
- Cut the spacing cord flush at the clamps, no tails required here. Tick box.
- The other driver half is joined the same way. Tick box.

Repeat the above for all bands.

When finished, all boxes in the table should be ticked and there should be 5 (or 6 with 6m option) complete element assemblies in front of you.

The following section describes how to mount the element assemblies, and the final tuning.

9. Final assembly and testing

If you like, mark the element assemblies at where the wire clips sit later. This will ease the final assembly and lead to a symmetric shape from the beginning.

For each element assembly, lay the ends (solder tags) onto each other and lay the assemblies out straight. The element assemblies now should lay folded in the middle, with the two halves in parallel.

Measure the distances given in the table below from the eye of the solder tags and mark both element halves with nail polish, locking varnish or equivalent, or use some adhesive tape. The marks don't have to be permanent, so don't worry too much.

Band	1. mark	2. mark	3. mark
20m	<input type="checkbox"/> 323.5 cm / 127.4"	<input type="checkbox"/> 633.5 cm / 249.4"	<input type="checkbox"/> 943.5 cm / 371.5"
17m	<input type="checkbox"/> 248 cm / 97.6"	<input type="checkbox"/> 486 cm / 191.3"	<input type="checkbox"/> 724 cm / 285"
15m	<input type="checkbox"/> 211 cm / 83.1"	<input type="checkbox"/> 415 cm / 163.4"	<input type="checkbox"/> 619 cm / 243.7"
12m	<input type="checkbox"/> 176 cm / 69.3"	<input type="checkbox"/> 347.5 cm / 136.8"	<input type="checkbox"/> 519 cm / 204.3"
10m	<input type="checkbox"/> 155.5 cm / 61.2"	<input type="checkbox"/> 309.5 cm / 121.9"	<input type="checkbox"/> 463.5 cm / 182.5"
6m*	<input type="checkbox"/> 87 cm / 34.25"	<input type="checkbox"/> 173 cm / 68.1"	<input type="checkbox"/> 259 cm / 102"

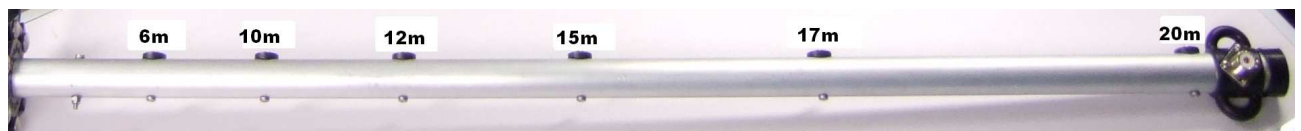
*6m option only

Now every element assembly should have 2 x 3, or 6 marks in total.

Mounting the element assemblies onto the spreaders:

The elements are mounted with wavelength in ascending order, so you begin with the highest band (10m or 6m, respectively).

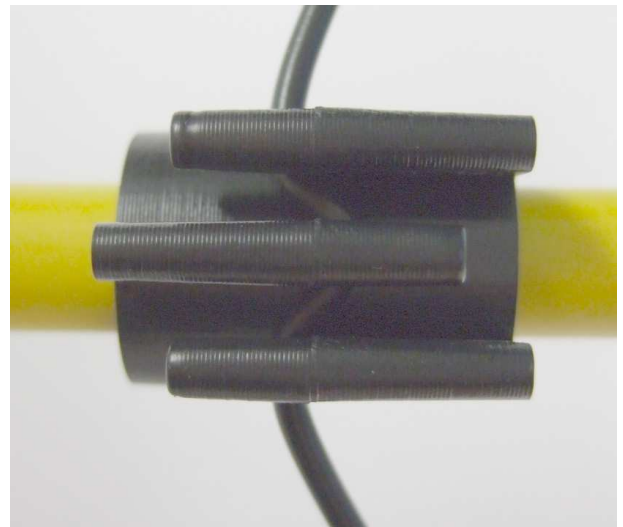
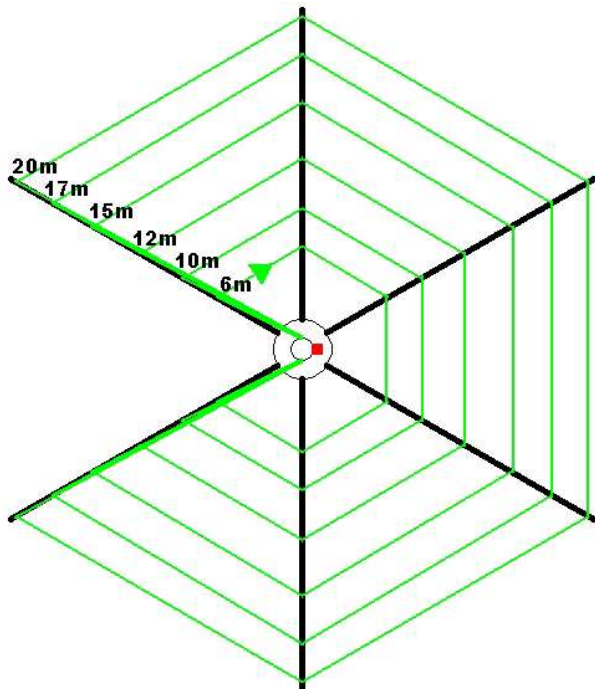
- Locate the corresponding feed terminals, see picture.



- Remove the M4 x 8 screw and slide a solder tag of one driver half onto the thread.
- Put a lock washer onto the thread and re-insert the screw. Please verify the lock washer sitting between the solder tag and the center post, see the following picture. Tighten loosely.



- Take the wire to the corresponding wire clip on the spreader top left, and attach to the clip. There should be no or little sag in the wire. Now run the element assembly clockwise along the spreaders and attach to the appropriate clips.



For the 10m band, the wire clips were previously occupied by the support cords. Simply lay the wire in parallel with the cord, there is enough room and now the wire even prevents the cords from slipping off.

- Take the wire back to the center post from the last spreader. Remove the M4 x 20 screw and the feedthrough insulator. Put a lock washer onto the thread, followed by the solder tag and the insulator. Run the screw back into the post and tighten loosely. Please verify the lock washer sitting between the screw head and the solder tag, see the following picture.



- After the completion of one band always check spreader symmetry by measuring the distances from tip to tip all around. Slightly move wires a bit in their clips if necessary. The wire should sag slightly between the spreaders to reduce stress and eliminate spreader bending, and run rather straight on their way to the terminals.
- If you find the wires too saggy or too tight, please move all wire clips simultaneously a few millimeters and realign the wire. Re-check for symmetry and wire sag. On 10m, you may need to readjust the support cords when moving wire clips.
- Attach the remaining element assemblies as described.
- Adjust solder tags and tighten all terminal screws.
- Finally, please re-check again for symmetry and wire sag. Eventually move single wires a bit to achieve a perfect result. This can be a trial of patience, if you were not accurate enough in the beginning you may have to take off single elements and restart.

You're done! Your antenna should now look similar to the photo on the front page. 😊

Reminder in advance of antenna tuning:

If you are not experienced and familiar with tuning wire antennas, or if you don't have appropriate and precise measurement equipment, PLEASE ASK FOR HELP from another skilled radio amateur. This is no shame and instead you are honest to yourself. I am not responsible for elements cut too short or popped transmitters and linears!

Hookup and tuning:

- Connect an antenna cable and lift the antenna to at least 5 meters (16 ft) above ground. The antenna should be far away of trees, buildings, power lines, other antennas or metal objects (mast excluded).
- Locate and note minimum swr frequency for each band.

Please consider: Cable losses let the swr look better. The longer and worse the cable between the swr meter and the feedpoint, the better the swr. Hence use a low loss cable or reduce the cable length between the antenna and the swr meter.

- If there is no resonance on a single band, please check element dimensions and continuity. Also check the terminals. Otherwise the cable length may be unsuitable and you got unwanted resonance, please change the length or use a suitable ferrite to form a common choke. Apart from that, a ferrite common mode choke is always a good idea with non symmetrically driven antennas.
- With an accurate build and 10 cm (4") wire tails on all element ends as described, the swr minima should appear somewhat below the lower band limits. If you can confirm this, you can cut the 4 wire tails of the corresponding elements by half. Locate swr minima again. If now the deviation from the band edge is by half also, simply cut the remaining tails flush with the clamps and you are done.
- If the minima appear far below the lower band limits, shorten the elements affected by 10 cm (4") on all 4 ends. Simply loosen the locking knob in the clamp and pull the tail. Do not cut the tails. Now relocate the minima and shorten in the elements again or start cutting the tails step by step.
- If the swr minima are too high in frequency, extend the affected elements somewhat on all 4 ends. Do not cut any tails. Relocate the minima and decide whether to extend the elements further or start cutting the tails.

Ideally, the minima should appear around 50 kHz above the lower band limits. Swr raises faster to lower frequencies than to higher frequencies, hence a minimum in the low end should be aimed for.

On 10m, you may need to readjust the support cords when moving wire clips.

While tuning, always trim all 4 wire ends simultaneously and by the same length.

Never change the spacing cords, only the wires!

- If you're done with tuning, again please have a thorough look on symmetry and wire sag.
- Finally, cut the excess support cords.

10. Collapsing the antenna

- Take the antenna down from the mast and fix it in a umbrella stand, ideally. You can also collapse the antenna without a fixture by holding it upright with one hand or your upper body.
- Remove the antenna cable.
- Loosen the wing nuts of all locking swivel joints and rotate the nuts to the dent in the thread.
- Widely open the swivel joints (this may need some wiggling and force the first time) and lay the loose spreaders on the ground.
- Flip the inner spreader sections upright and lay them in parallel to the center post. Start with the spreaders where the wires run to the center post and put those wires into the open swivel joint as a guide.
- Wrap a velcro strap around the top and thus secure the upright inner spreader sections.
- Arrange the middle spreader sections around the hub and secure with a velcro strap.
- Now lift the outer spreader sections into the upright position and secure them to the center post with another strap.
- Secure the floating wires and cords at the very bottom with a velcro strap.
- Turn the antenna upside down and secure the wires and cords with another strap. Omit wires or cords flipping to the wrong side over the fiberglass tubing, otherwise you have to lift the antenna during the next installation to get the wire or cord back to the right side.



Antenna setup is proceeded in reverse order, of course. Remove the velcro straps step by step, carefully unfold the spreaders and get the wires and cords sorted. Do not tighten the locking swivel joints until all wires and cords are in place.

Attention: The dark coloured wires and cords near the ground are substantially dangerous, you may easily trap over them. In your own interest, take down or set up the antenna during bright daylight only, and be extremely careful stepping over antenna parts!

11. Additional advice

- For a permanent installation or frequent portable use, I recommend to prevent the wire clips from slipping with a drop of super glue (cyanoacrylate adhesive).

The M6 x 40 wing screw and wing nut supplied for portable use are intended for fixing the antenna on a portable mast with 1" or 26 mm inner diameter. For instance, I use a push up mast with a top section of 30 mm and 2 mm wall thickness, which makes 26 mm inner diameter.

- Drill a 6.5 mm (1/4") hole across the top section of the mast, 90 mm (3.54") from the top. Remove filings and razor edges. Insert the fiberglass base of the antenna and align holes. Secure with the wing screw and wing nut supplied.

If you intend to mount the antenna in a different way (e.g. rotator), prevent the fiberglass tubing from mechanical stresses.

- Push the fiberglass tube into a firmly fitting and thick walled protective metal tubing. Then clamp both into your rotator and carefully and equally tighten the brackets until you can feel a slight clamping effect on the fiberglass tubing. Stop tightening and secure with a cross bolt through all brackets, protective tubing and the fiberglass tube.

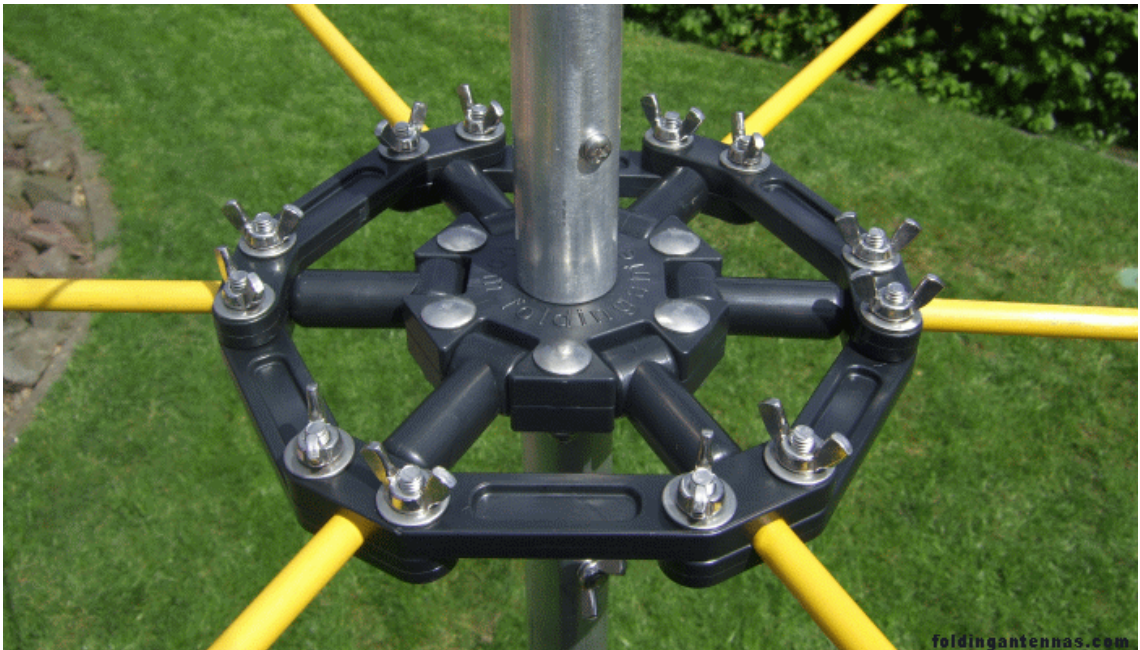
Though the fiberglass spreaders are designed for exterior use, in regions with extreme uv radiation (low humidity locations up to 40 degrees latitude) a certain degradation of the epoxy resin may appear over the years which can result in cracks or spreader breaks in high winds or when covered with ice. A preventive coat of uv protective paint can help to extend antenna life in those cases.

12. Optional storm brackets

In windy areas and for a permanent installation, additional storm brackets are recommended. They prevent the spreaders from flipping upwards during strong wind gusts and reduce lateral spreader movement.

Assembly and installation of the storm brackets:

- Get 3 brackets and drive 4 carriage bolts M6 x 30 in each bracket. Lay the brackets on a hard surface (work bench) and use a hammer to drive in the bolts. Stop a few millimeters before the end and verify the orientation of the square flanges under the bolt heads. Align with the square hole in the brackets if required and hammer in completely.
- Enlarge the holes of the 3 remaining brackets with a 6.5 mm (1/4") drill.
- Install the brackets on the ready-made antenna as shown in the picture: Hold one bracket equipped with bolts under 2 spreaders and put on a bracket without bolts from the top, and with an offset of one spreader. Secure with washers M6 x 16 and wing nuts M6 (or nylock nuts if ordered for permanent installation).
- Install all other brackets the same way.



Remove all brackets before collapsing the antenna!

13. Accessories

The following accessories are available for your folding antenna:

- Transportation and protection bag with large shoulder straps, perfect for portable use. Enough room for antenna cable, storm brackets, ferrite choke etc.



- Large clamp-on ferrite core (Fair-Rite® Nr. 0431177081). This core has a 1" opening and is ideally suited for a K9YC style common mode choke. Route the coax 3 times through the core and separate the loops. No need to cut the connector.



In addition, this core is great as a line isolator for RFI fighting on your neighbour's tv or radio. It easily takes the thickest wires without touching them and is installed in a few seconds.

14. Specifications

Impedance	50 Ohms
Connector	UHF socket (SO-239), N type socket on request
Gain	max. 5-6 dBi in free space (3-4 dB over dipole)
F/B ratio	peak >20 dB (varies by band)
SWR	<2 over the entire band (20/17/15/12m), 10m band: 28-29.3 MHz
Rated power	1500 Watt
Elements	high strength and flexible tinned stranded copper wire 1.0 mm ² (AWG 18), black PVC insulation
Spreaders	flexible and sturdy fiberglass rods, UV resistant, 10 mm (~0.4") diameter
Support cords	1.5 mm Dyneema® rope, UV resistant
Center post	high quality aluminium tubing 30 x 2 mm (~1.2" x 0.08")
Mounting hardware	all stainless steel A2
Other plastic parts	injection molded from PBT (polybutylenterephthalate) black, high impact, UV resistant
Turn radius	approx. 3.20 m (10.6 ft.)
Weight	approx. 6 kg (13 lbs)
Wind load area	approx. 0.25 m ² (2.7 sqft.)
size when collapsed	approx. 1.15 m (45") x 15 cm (6") x 15 cm (6")
Antenna fixture	fiberglass rod 5" x 1" O.D., e.g. fits into telescope masts with top section of 26 mm (1") I.D.

Changelog:

V1.03 - 1st version published

V1.04 - element lengths reviewed, some smaller changes

V1.05 - construction hints added

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