Homebrew your Omnidirectional INMARSAT-C Antenna

In this short article we are going to look into the construction details of an old commercial INMARSAT-C Antenna. The purpose of this document is to serve as a base for satellite enthusiasts to be able to reconstruct a similar antenna for use in an own sat monitoring application, e.g. connected to an own SDR receiver.

The Antenna analyzed here is a commercial unit made by Thrane & Thrane in Denmark. The model is a TT-3002 which was obtained as surplus equipment after being used 15 years on a large commercial ship.

The antenna helix element sits under a plastic radome. The cast metal base is the housing for the build in electronics (Combiner, Diplexer, Low-Noise RX Preamp and Uplink Power Amplifier). The base also serves as the ground plane for the helix antenna element.

The antenna uses an N-Connector inside the mounting tube bracket and the electronics are fed with the supply voltage via the coaxial cable (12V on RX and 28V on TX).

The Antenna is very heavy and rugged for outdoor use under the harsh conditions of the open seas.

Rubber gaskets are used throughout the construction to make the antenna moisture proof and the electronics compartment of the antenna is backfilled with a dry inert gas via a valve at the time of building to prevent condensation problems occurring by changing environment conditions around the antenna.

Construction Details:

The antenna element itself consists out of a N-Type connector at its bottom followed by a short tube for the purpose of diameter reduction, followed by the main centre tube.

The centre tube represents a solid type of air dielectric coaxial line for feeding the helix assembly on the top side of the antenna structure.

The chosen diameters of the coaxial line components (inner conductor and outer conductor diameter ratio) result in a line impedance of approx. 35Ω.

The length of this coaxial line is critical and dimensions need to be kept exactly as in the drawings, since it has an impedance matching function.

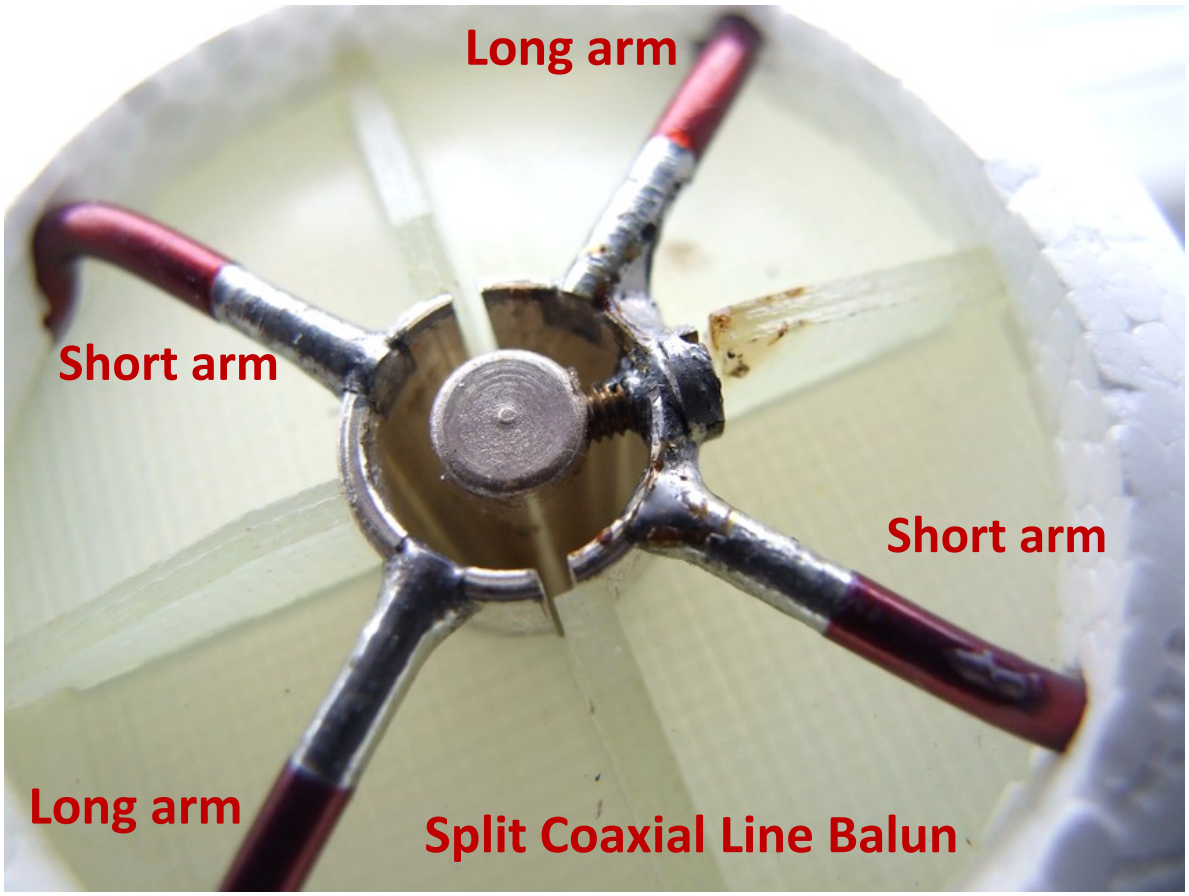
The outer tube has two slots at each opposite side of the tube. The slots are 1mm wide and 48mm long (which represents roughly a quarter wavelengths on 1545 MHz). This acts as a split coaxial line balun to connect the balanced helix feed point to the unbalanced coax line.

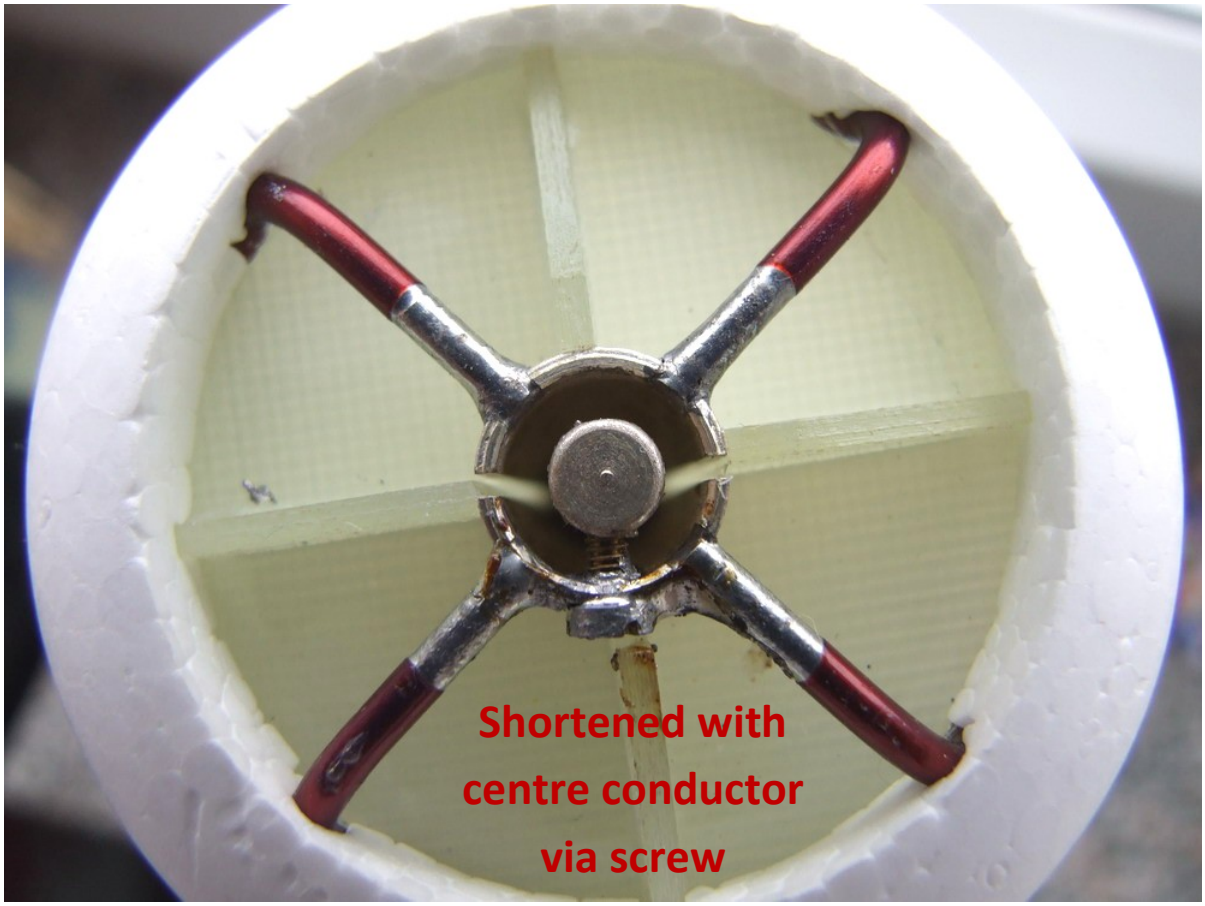
The Antenna itself is basically composed out of two bifilar helix elements mounted 90° perpendicular to each other. One bifilar pair is slightly longer (resonant on the 1.5 GHz downlink frequency range) and the other bifilar pair is slightly shorter (resonant on the 1.6 GHz uplink frequency range). Since the Helix is operated in back-fire mode and is required to operate with RHCP polarization it is important to note that the helix elements are wound anti-clockwise. (Backfire helix radiation is always of opposite sense to the helical winding)

One side of the slotted tube is soldered to one short and one perpendicular mounted long element. On the other side of the slotted tube their “counterparts” is mounted.

The centre conductor is “shortened” at the top end with one side of the slotted tube.
(the side of the tube does not matter, since mounting is symmetrical)

Since pictures speak more than a thousand words see photo on the next page.

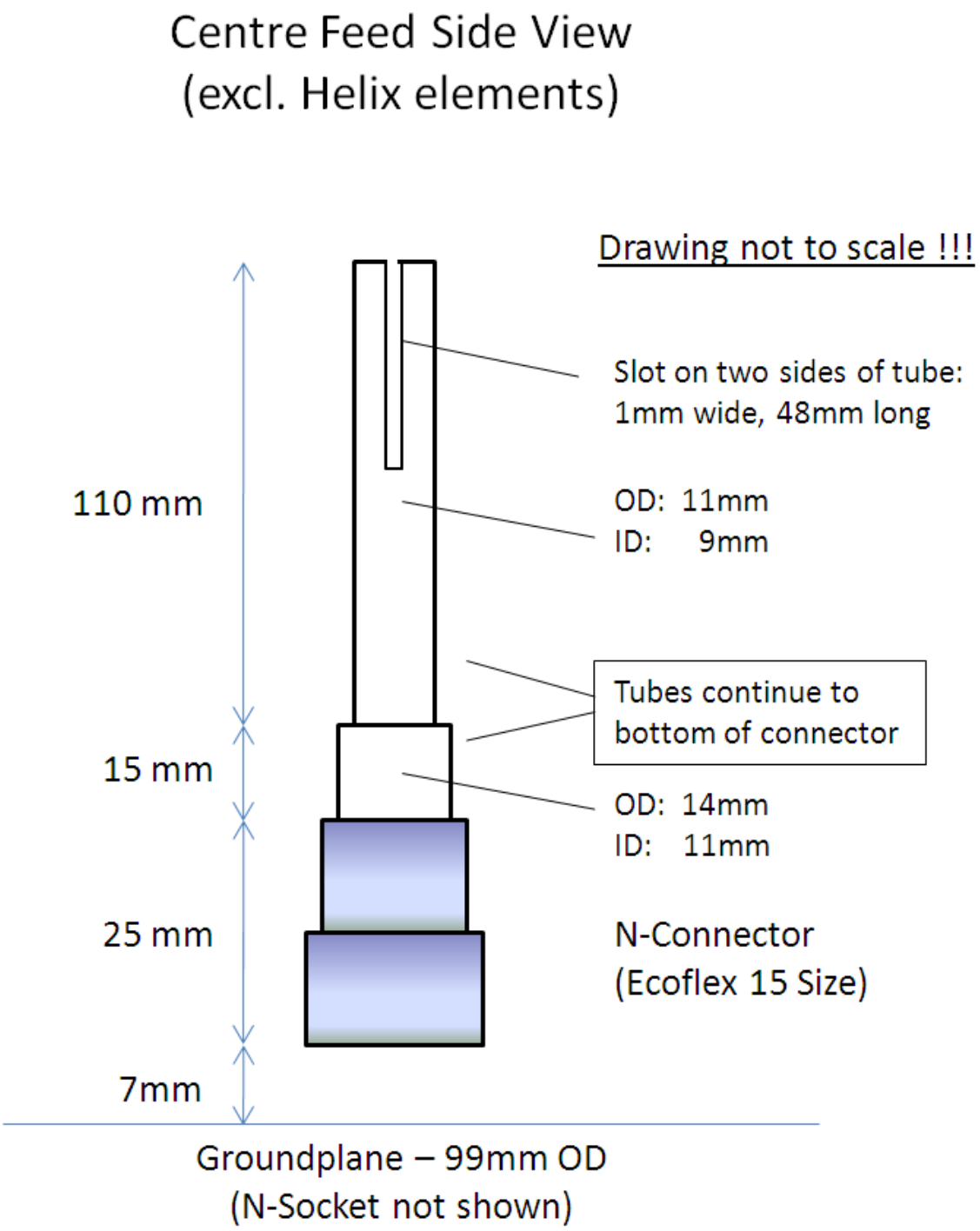

Long arm
Short arm
Short arm
Long arm
Split Coaxial Line Balun


Shortened with
centre conductor
via screw

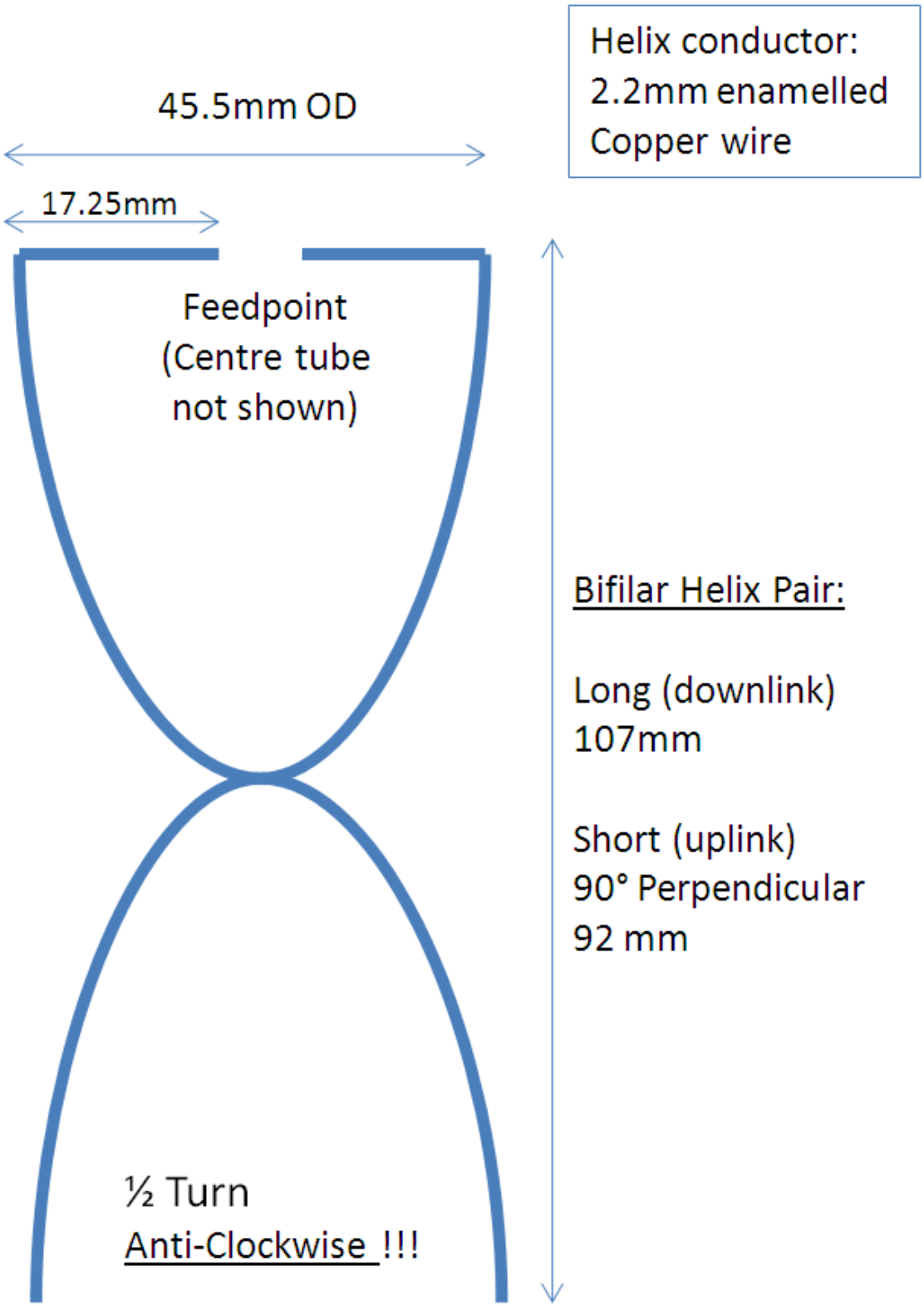
For the construction of the split coaxial line balun it is important to keep the same inner diameter of the central tube till the bottom of the N-Connector case. This means that the tube and the short diameter reduction tube should be pushed all the way down into the N-Connector. The 5mm centre conductor needs to be connected to the centre pin of the N-Connector.

A fitting size N-Connector is e.g. one designed for Ecoflex 15 coax cable.

See the following schematic drawings which should be self-explaining:

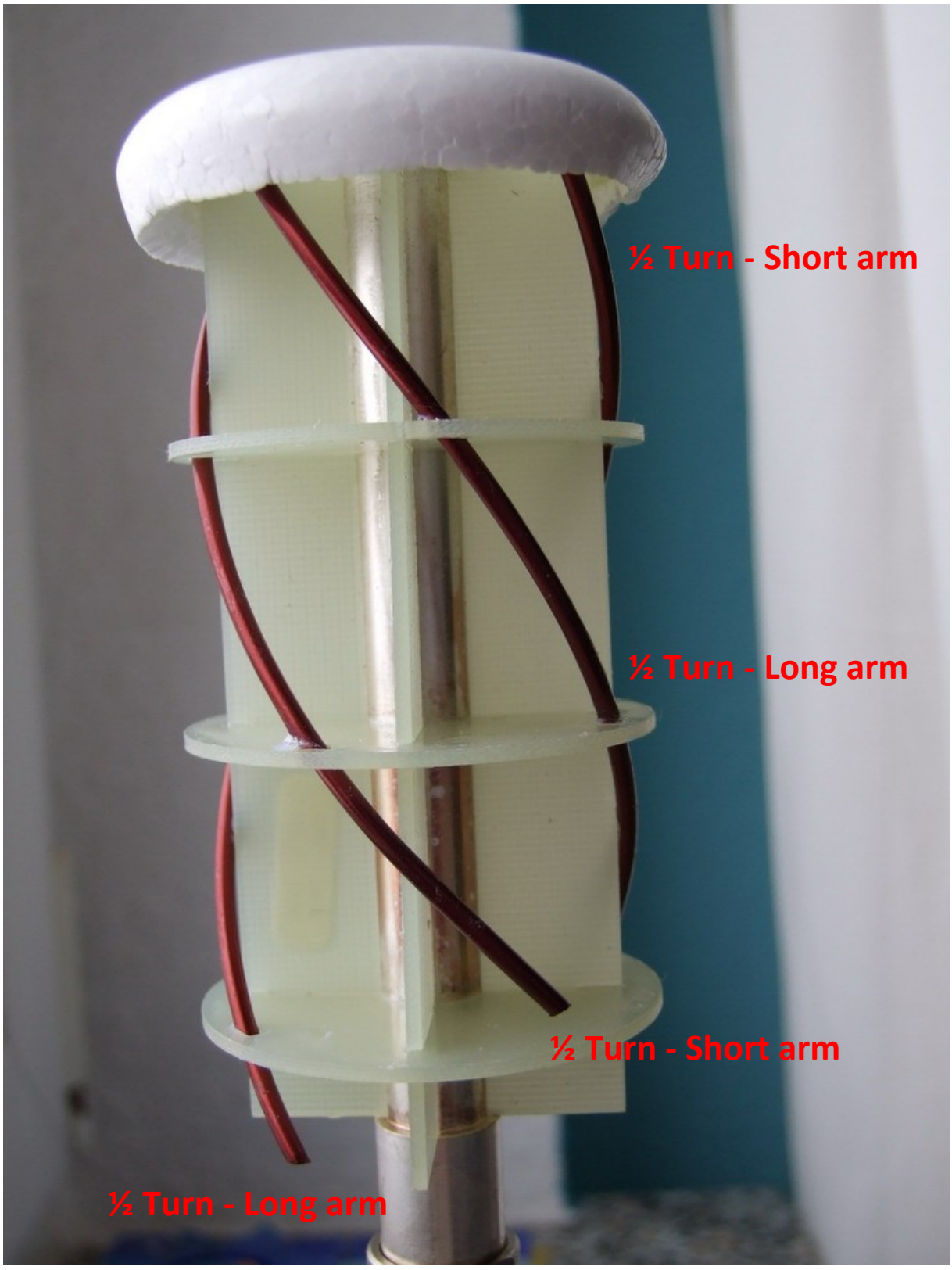


Helix Side View (only one bifilar pair shown):

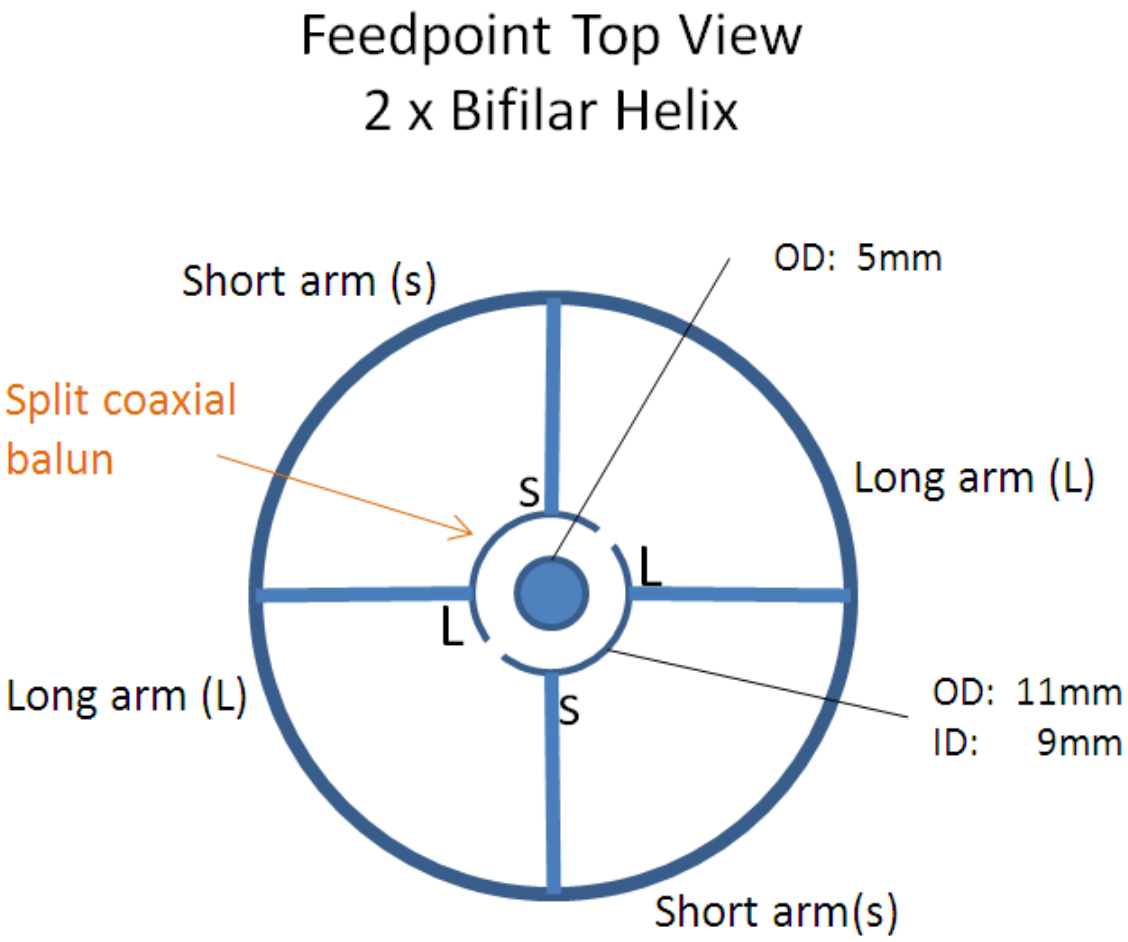


"Streight" Helix conductor lengths per ½ turn arm (before bending into helicoidal shape):

- Long arm (Downlink): approx. 127mm + horizontal section (see drawing above)
- Short arm (Uplink): approx. 114mm + horizontal section (see drawing above)



Helix structure is supported by epoxy plates (PCB like material). Given the small size a self-support might be possible in a homebrew project or a more simplified support structure.



DISCLAIMER: