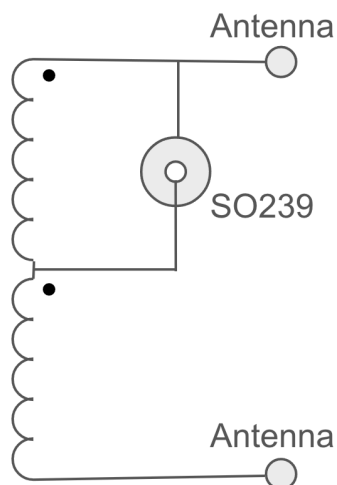


Matching Transformer construction

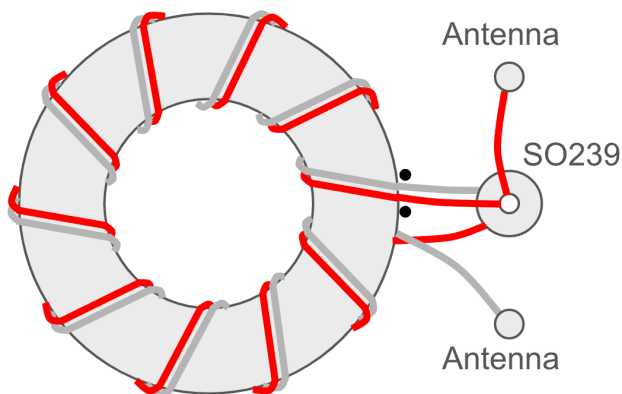
The Dual Beam Pro and I-Pro Home use 4:1 Ruthroff voltage transformers to bring the native antenna impedance of around 200 Ohms down to around 50 Ohms for a broad impedance match to the feeder, ATU and transceiver.

The transformer winding is shown below in a schematic and a representation of the physical configuration. Note: the number of turns in the diagrams is indicative and the actual number depends on the version.

Winding connection schematic



Winding configuration diagram



Construction

There are 2 versions available rated at 400W PEP and 1000W Peak Envelope Power (PEP). They both use the same design principles but the construction is quite different. The 400W version uses a T200-2 powdered iron Toroid core with 18 turns whilst the 1000W version uses 2 stacked FT240-31 (Ferrite mix 31) cores with 6 turns. The construction process is the same for both although the orientation of the parts within the box is different.

Winding the core

Parts list

| Description | Spec | 400W | 1000W |
|-----------------------|---------------------|---------------|-----------------|
| Powdered iron toroid | T200-2 | 1 | - |
| Ferrite mix 31 toroid | FT240-31 | - | 2 |
| PTFE insulated wire | 14 AWG multi strand | 2 x approx 1m | 2 x approx 0.6m |
| Core assembly kit | 3D printed ASA | 1 set | 1 set |

The core assembly kit comprises custom designed 3D printed parts to make the winding process easier, hold the wires in the correct positions and facilitate the mounting of the core in the enclosure. These parts are not essential but I have made the design available online for anyone with access to a suitable 3D printer. Please ask if you require more information.

For the 1000W version I use 25mm fibreglass tape wrapped around the outside to hold the 2 toroids together.

Both wires are wrapped tightly around the core in parallel, as shown in the winding configuration diagram above. The number of turns is measured by the number of times that the wires pass through the centre of the core. The core inner and clamp from the core assembly kit hold the wires in place but if these are not used, the turns can be spaced by hand and small cable ties can be used to hold the wires in place at the start and finish.

Assembling the enclosure

Parts list

| | | |
|---------------------------------|---------------------|---|
| ABS enclosure with screw on lid | L100 x W76 x H40 mm | 1 |
| Panel mount UHF socket | SO239 | 1 |
| M3 x 10mm socket head screws | A2 Stainless steel | 4 |
| M3 full nuts | A2 Stainless steel | 6 |
| M3 serrated washers | A2 Stainless steel | 4 |
| M6 solder terminal | Tinned brass | 2 |
| M6 x 20mm flanged hex bolts | A2 Stainless steel | 2 |
| M6 x half nuts | A2 Stainless steel | 2 |
| M6 dome nuts | A2 Stainless steel | 2 |
| M6 flat washers | A2 Stainless steel | 4 |
| M6 serrated washers | A2 Stainless steel | 4 |
| M6 nut retaining plate | 3D printed ABA | 2 |
| M6 solder terminal | Tinned brass | 2 |

The enclosure design is not critical and alternative parts can be used if required. For the Dual Beam Pro and I-Pro Home I use 6mm bolts for connecting to the antenna elements and UHF connectors (PL359/SO239) for connection to the feeder.

I start by drilling the required holes in the box using a jig and a 2.5mm pilot drill. The panel mount socket hole is then opened up to 14mm and the antenna connection bolt holes are opened up to 6mm.

This enclosure comes with internal ribs for holding PCBs in place. For the 400W version it is necessary to remove a couple of the ribs from either side of the SO239 connector to provide a flat surface for the nuts on the retaining screws.

I use the actual SO239 connector to position the 3mm holes for the retaining bolts as the tolerance on the holes can vary slightly between each connector. I also add a couple of 3mm drain holes in the lower side of the box to avoid water build up if the enclosure should leak.

The 3mm terminals can then be soldered to the wires for connection to the ground plate of the SO239 connector and the 6mm terminals soldered to the wires for connection to the

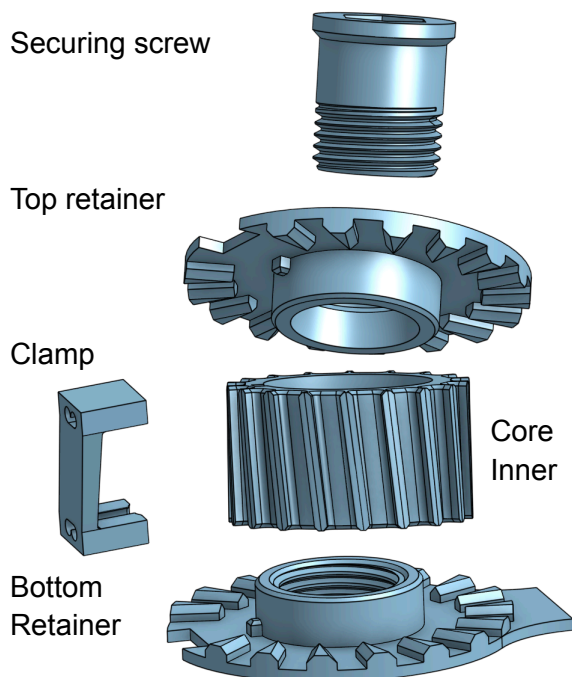
antenna connection bolts. The connectivity is shown in the winding configuration diagram and in the final assembly photos. The winding tails should be trimmed to avoid excessive lengths of wire in the enclosure but not so short that the solder connections are stressed.

The exact sequence of soldering and assembly depends on the configuration. Points to note are:

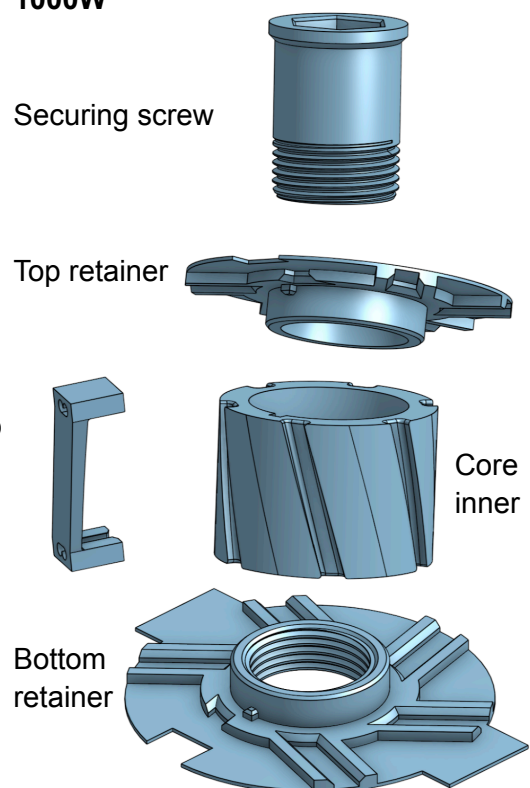
- It may be easier to solder the SO239 central pin wires outside the box by loosely placing the core in the box and passing the wires through the connector hole before fitting the connector.
- It may be necessary to fit the antenna connection bolts before the core in which case the 6mm solder terminals can be soldered after installation.
- To prevent the antenna connection bolts from turning (and possibly stressing the wires) I use a 3D printed plate with a hex hole to keep the bolt in position.
- Fitting the 3mm nuts to the SO239 connector retaining bolts is fiddly. I use a 3D printed nut holder to simplify the process.
- Potting compound can be used to hold everything in place but this makes it difficult to repair any faults and can have a slight effect on the impedance.

Using the core assembly kit

400W



1000W



The bottom retainer is glued to the inside of the enclosure using plastic weld adhesive. The lug(s) align with the internal ribs of the enclosure to locate it in the correct place. The assembled core fits onto the bottom retainer and there is a locating notch to ensure that the core inner is in the correct orientation so that the wires engage in the guide slots.

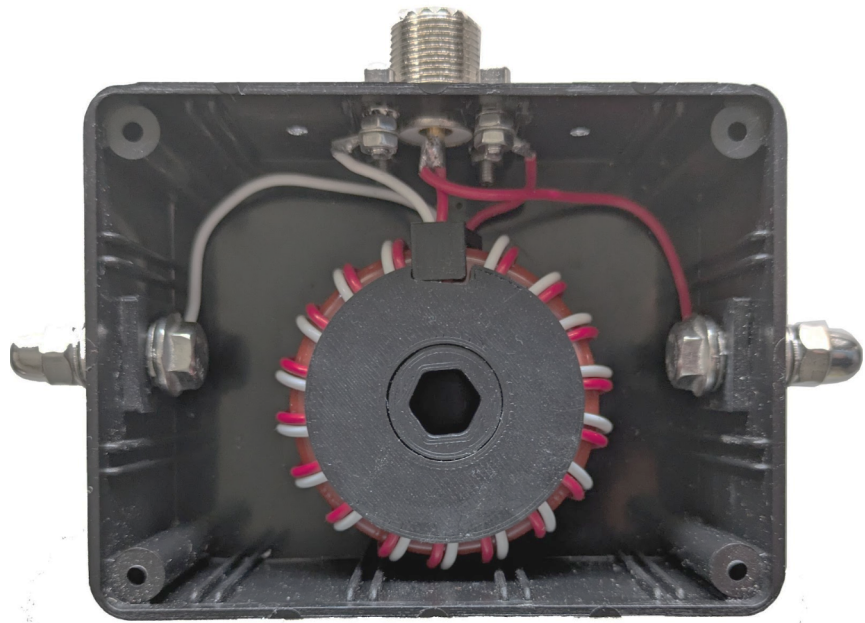
Note: when winding the core, the clamp should be aligned with the notch in the core inner.

The top retainer fits onto the core inner using the same alignment and the securing screw holds the parts together.

Final assembly

These photos show the inside of the assembled matching 400W (top) and 1000W (bottom) matching transformers.

Inside the box you can see the antenna connection bolts where the 6mm terminal is held onto the bolt with a serrated washer and a half nut. The half nut is hidden in the 3D printed plate that is glued to the box to stop the bolt assembly rotating.



On the outside is a flat washer, another half nut, a serrated washer, another flat washer and a dome nut.

The SO239 held in place with 4 x M3 socket head screws and, inside the box, M3 serrated washers and nuts. The terminals are attached to two of these screws with an additional nut.

2 red wires are soldered to the centre of the SO239 socket to complete the connections.

The matching transformers are completed by screwing on the lid to which I attach a V-block mount so that it can be easily attached to a mast or pole. This mounting block is also a custom 3D printed part that can be replaced by alternative mounting arrangements as required.

