A Dual-Band
Ferrite Sleeve Loop (FSL) Antenna

This is a summary design for a weather-resistant FSL with a 12-inch “contra” wound coil that allows full coverage between 150 and 1700 khz in two overlapping bands. The actual coil of the antenna is approximately 12.5 inches in diameter, and it is housed in a large plastic box which, other than two holes for the variable capacitors, provides a weather-tight enclosure for the delicate Litz wire inside.

This is intended to be more an illustration of how to design and build an FSL such as this, rather than a detailed explanation giving exact dimensions and construction & wiring directions. For one thing, the ferrites I used are no longer available, and you may find it preferable to substitute for other construction elements as well.

The parts I eventually used are:

- 108 ferrite rods, each 160 mm long and 8 mm in diameter. These were ex-Soviet surplus, obtained from an eBay seller, which are unfortunately no longer available.
- Approximately 105 feet of 660-44 Litz wire, available from a couple eBay sellers.
- An 8-inch PVC coupler, typically only available via mail order.
- Two 2x342 pf variable capacitors, available from eBay seller zLowe7, who also sells the necessary shafts and knobs that go with the capacitors.
- Half-inch thick foam wrap. You can use 1/4” foam wrap (more widely available) and use two layers.
- A “19 Litre XL” container from Really Useful Boxes, available through mail order in North America. The non-XL 19 litre box that is also sold wasn't quite big enough.
- One DPDT switch, big enough to be secured to the PVC coupler.
- Some small wood blocks, tape, etc. as discussed below.

A few design notes:

- The “contra” method of winding the coils allows for dual-band operation with the flip of a switch. A good discussion of this winding method is presented by Dave Schmarder at http://makearadio.com/coils/contracoils.php. I ended up with two 16-turn coils. In series, they have about 1,000 uH of inductance, and in parallel 250 uH.
- A basic schematic of the circuit is shown on the last page. Using a DPDT, in one switch position the coils are in parallel and use just one section of one of the variable capacitors. This is for the MW band, and it tunes **530-1700 kHz**. Yes, I got very lucky here :-)
- In the other switch position, the coils are in series, and all four variable capacitor sections are engaged. This tunes from **149 to 850 kHz**, covering the entire LW broadcast band, NDB band and a good chunk of the MW band.

First up is to provide the rather large and heavy FSL with a place to rest inside the enclosure. This picture shows 6 blocks, held in place with double-stick foam tape, which provide a suitable foundation.

The bottom two blocks are high enough to provide about 1/4" space between the FSL's coil and the bottom of the plastic box. The side blocks provide about the same clearance to the side walls.

This rather blurry picture shows the 8" PVC coupler sitting in the enclosure. As you can see, the side blocks should be up higher a couple inches (I eventually fixed that).

The blocks should be sized such that the PVC coupler rests fairly snugly, with minimal rocking or other movement. Note that the PVC coupler sticks up above the top edge of the box, which is fine since the lid is about 2 inches high.

The next step was to wrap one layer of half-inch thick foam around the coupler, providing a foundation for the ferrites. Note that the foam stops about one inch from the edges of the PVC coupler in order to provide a place for the supporting blocks to contact the PVC coupler.

I used double-sided tape underneath the foam to hold it in place on the PVC coupler, and strapping tape around the outside to secure the foam.

I next placed the ferrites onto the foam wrap. I first put two strips of 2” white first aid adhesive tape down, with the adhesive side out, in order to provide a sticky, permanent bed for the ferrites. For one of the ferrites, I used two short pieces of ferrite that allowed a gap in the center and each end for the wire to pass through (see next step). Two strips of strapping tape went around the ferrites to securely hold them in place.

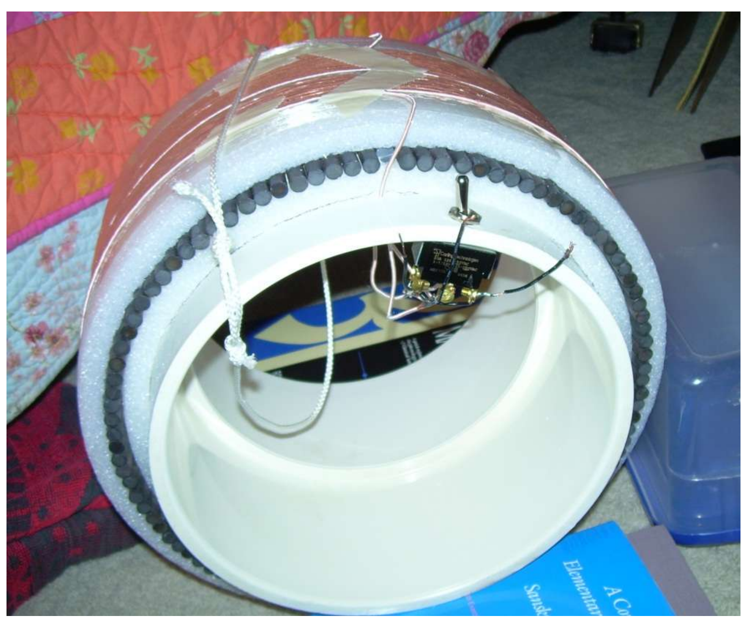
Then, around the ferrite sleeve went another layer of half-inch foam wrap, which provides the separation between the ferrite sleeve and the coil of Litz wire.

Next, I would the Litz wire in “contra” orientation, leaving about 1/4” between the two coils. After the coils were wound, and secured with adhesive tape, I threaded the four wire end through the ferrite sleeve and into the center of the PVC coupler, in order that they could be secured to the band switch.

I also soldered short lengths of 18-gauge stranded wire onto the ends of the Litz wire in order to more easily secure the wire to the band switch screw terminals.

I drilled a hole and mounted the band switch onto the PVC coupler. By placing the switch here, I had to use a fairly large switch with a long neck, since the PVC coupler is very thick and is also slightly curved. I connected the Litz wire ends to the appropriate places on the switch, and attached short lengths of wire that the variable capacitors would eventually attach to.

I next mounted the two variable capacitors onto the box, drilling two holes and using good double-sided foam tape to secure them. The variable capacitors also have 2.5 mm screw holes.



In order to lower the FSL into the enclosure, the FSL must be first partially lowered in to clear the variable capacitors. Once the capacitors and the switch are close enough together, the connections can be made, and the FSL can be lowered all the way in. This can be tricky – you might want to have someone holding onto the FSL while you make the connections!

I affixed alligator clips to the variable capacitors, rather than soldering things together with the FSL hovering in the container. This allows easy access for maintenance and alteration, but may slightly decrease tuning sharpness, so it is a trade-off.

Once the FSL is lowered all the way in, it stays in place, although putting some sort of non-skid pads on the wooden support blocks helps prevent the FSL from rotating, since this could place strain on the connecting wires between the switch and variable capacitors.

As seen at right, I tied a length of poly rope around the FSL, and leave it there in order to be able to easily hoist the FSL out of the box if need be.

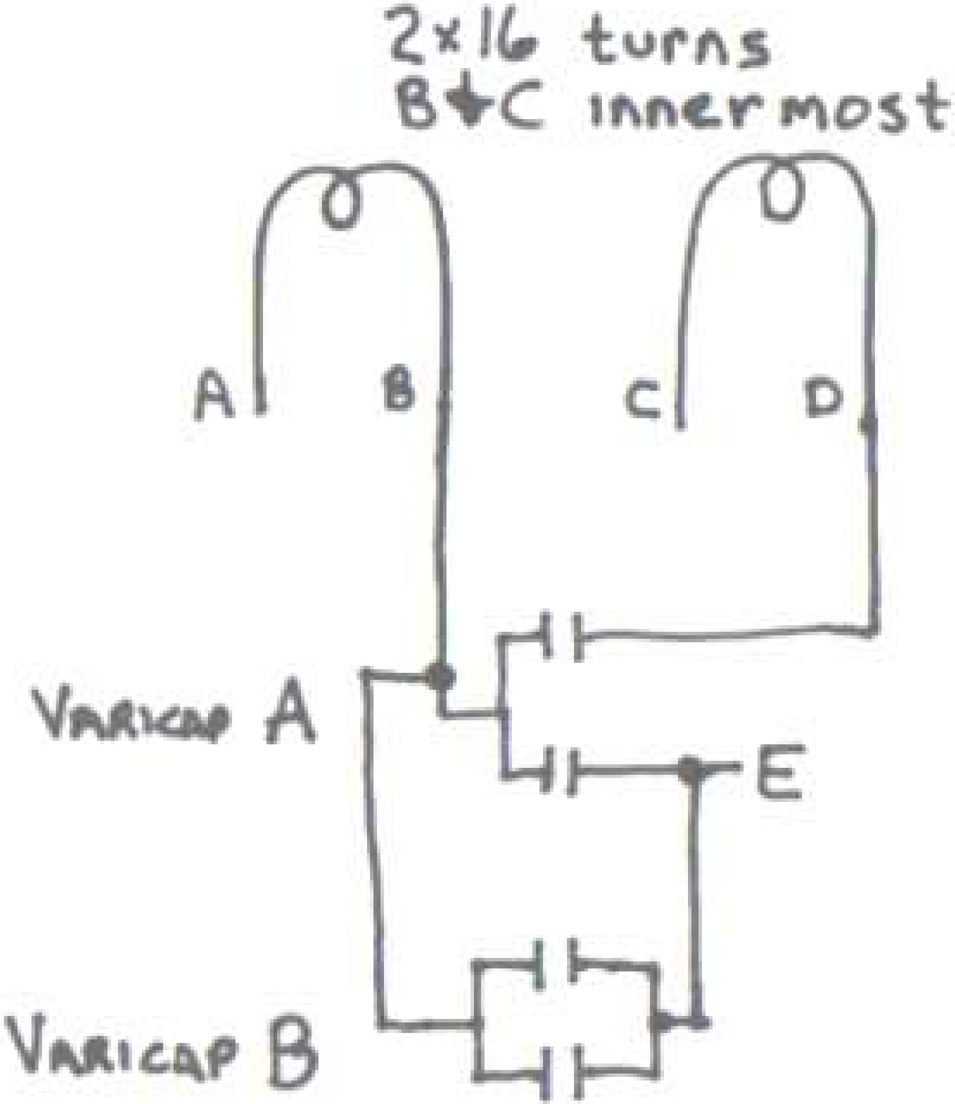
To use the finished FSL, simply select which band you want using the DPDT, and tune the antenna to the resonant frequency. I purposely put the band switch inside in order to make the FSL more weather-resistant (and to allow the PVC to fit inside the box), and it is a simple matter of momentarily lifting the lid to switch bands.

With a radio such as the Tecsun PL-380, which is rather insensitive on LW, the radio is best placed right on the lid, as close to the Litz coils as possible. However, in the upper LW band and especially in the MW band, the radio must be held several inches away in order to maintain sufficient tuning sharpness.

A peculiar feature of FSLs is their extreme sensitivity to surrounding metal objects. You also need to get it a fair distance off the ground in order to not ground the FSL. As above, I place it on two office crates, one of which I transport the FSL in and the other holds my radios and other gear.

Many thanks to Graham Maynard, Steve Ratzlaff and Gary DeBock for their generous support and insights into the construction and use of this and other FSL antennas!

Kevin S, Bainbridge Island, WA



MW: A-D
B-C

LW: A-C
D-E

DPDT

A	o	o	E
C	o	o	D
B	o	o	A