The Octopus Antenna - Construction Plans

What is it?

The Octopus antenna is a multi-band, somewhat directional dipole antenna array. It consists of 4 dipoles constructed from HamStick vertical antenna elements arranged horizontally around a central hub. Each dipole uses 2 HamSticks of the same band that are positioned 180 degrees apart (opposite each other). Four adjacent elements are electrically isolated from ground and wired together and connected to the coax connector center lead. The remaining four are grounded to the hub and the coax connector shield lead. No band switching is required because the dipole designed for the frequency of operation is the only one radiating. The antenna is about 14 feet in diameter.

Disclaimer

The original article on this design appeared in the December 2007 QST Magazine. It was authored by Geoff Haines, N1GY and appears on pages 36-38. I make no claims or guarantees whatsoever about this antenna, although I have been very pleased with results I have obtained. You may need to make design changes to suit your needs or due to using different parts. I also don't guarantee that these plans are complete or even sufficient for you to construct this antenna. In other words: Build it at your own risk. You're On Your Own!

Configurations

Several configurations are possible. A 4-band HF configuration is shown above. This configuration uses 8 elements, hence the name Octopus. These plans assume a 4-band, 8-element antenna centered on 2 electrical junction boxes, one atop the other. These 2 boxes require less drilling and adjusting to make the antenna mounting hardware fit properly than if you used one junction box as the hub. My first hub was constructed from one box but required a lot of extra drilling and fitting. Suit yourself.

Parts List				
Item #	Qty	P/N	Item	Source
1	8	Band dependent	HamSticks, 2 for each band of operation.	Direct from Lakeview Company, AES, HRO or other ham supply outlet.
2	2		Electrical junction boxes – round metal wet location outdoor type with 4 threaded ½" conduit holes (4" diameter by 1 5/8" deep)	hardware store
3	1		Upper flat cover with waterproof gasket for the junction box	hardware store
4	1		Lower cover with one centered conduit hole and waterproof gasket – outdoor lamp type.	hardware store
5	1		½" closure plug to close 3rd hole in lower cover	hardware store
6	1		SO-239 chassis mount coax connector	radio/electronics supply store
7	4		#4-40 hardware (nuts, bolts, washers and 1 solder lug) to mount SO-239 socket to lower cover	
8	8		Rod Coupling nuts with 3/8-24 threads (stainless steel preferred)	Fasteners, Inc. or hardware store
9	4		3/8-24 x 1" hex head bolts (stainless preferred)	hardware store
10	4		3/8-24 x ¾" hex head bolts (stainless steel preferred)	hardware store
11	8		3/8" solder lugs	hardware store
12	8		3/8" x 1 ½" diameter stainless steel fender washers	hardware store
13	8		3/8" x 1 ½" diameter x 1/8" thick nylon fender washers	hardware store
14	10	WNS-3/8-25	3/8" X ¾" diameter nylon shoulder washers (See note 1 below)	Small Parts, Inc. (800) 220-4242
15	4		#10-24 x ½" bolts (domed Phillips head or equivalent)	hardware store
16	4		#10 lock washers	hardware store
17	2		#10-24 nuts	hardware store
18			½" & ¾" thick-walled IMC conduit pipe for mast assembly	hardware store

Note 1: if you cannot locate nylon shoulder washers you can use short pieces of ½" outer diameter nylon rod that has a 3/8" hole in the center. The only purpose of these nylon pieces is to center and insulate the 3/8-24 bolts.

Hub Assembly

Figure 1

Attach the hubs together with 2 bolts as shown in Figure 1. The bolts are located on either side of the central conduit hole and far enough away from the outer edge so as not to interfere with installing the element mounting assemblies. The hubs must be positioned so the ½" conduit holes on the outside of the upper hub are located exactly between the ½" conduit holes on the lower hub (see Figure 3 on following page). This gives an even distribution of elements around 360-degrees (each 45-degrees apart) when the HamSticks are attached. You may find it necessary to hold the hubs in proper position by inserting a mandrel or other round object in the center conduit hole before drilling the 2 bolt holes. Use hardware from items 15, 16 and 17 in the parts list. I use one lock washer under the bolt head and one under the nut.

Locate and drill a ½" hole as shown in the picture above. The drill shown is a tapered Drill Master bit available from Harbor Freight. This hole is where the 2 insulated elements in one box to connect to the 2 insulated elements in the other box. I chose a ½" hole because this is the clearance diameter of the shoulder on the washers specified in item 14 of the parts list. To provide insulation and protection to the connecting wire I glued 2 shoulder washers together (one from each side) forming a feed-through insulator. You could use a grommet for the same purpose.

Element Mounting Assembly

Figure 2

Assemble the element mounting hardware as follows. Each element's mounting hardware should be centered in the conduit hole. I use one nylon *shoulder* washer per hole. On the elements where the assembly is grounded the nylon washer simply centers the mounting bolt. On the insulated elements the nylon washer centers the bolt and thus prevents it from touching the metal box.

Insulated Elements

In each box the 2 elements connected to the coax center lead must be insulated from the hub. The hardware at the bottom of

Figure 2 shows this assembly using nylon fender washers.

Select any hole in either hub. Insert the solder lug on a 1"hex head bolt (Item 9), then a nylon fender washer (Item 13). Place a nylon shoulder washer (Item 14) into the conduit hole (the direction of the shoulder is unimportant) and from inside the box pass the bolt through the hole and through the shoulder washer. On the outside of the box insert a second nylon fender washer over the bolt and then spin on a rod coupling nut (Item 8). Position the solder lug so it is approximately horizontal in the box. If the

lug is pointed up it may hit the top cover when installed. Gently tighten the rod coupling nut.
Note: there is no really good way to prevent the rod coupling nut from turning when mounting or removing the HamStick element because the nylon washer has little friction against the junction box. For this reason I always use an open-end wrench on the rod coupling nut to prevent it from turning as I mount or remove the element.

Repeat the above assembly procedure on an adjacent hole in the same box.

Turn the hub over and install 2 more insulated mounting assemblies on 2 adjacent holes which are also adjacent to the assemblies you just completed. Stated another way, when you look at the hub from the top or bottom, the 4 insulated element mounting assemblies must all be contiguous, occupying the same half-circle.

Figure 3 shows how the element mountings are positioned. Note that the solder lugs should be rotated 90-degrees from the position shown so as to not interfere when the top cover is attached. Wiring will be easier if the solder lugs on the 2 insulated mountings face each other and the same with the 2 grounded mountings.

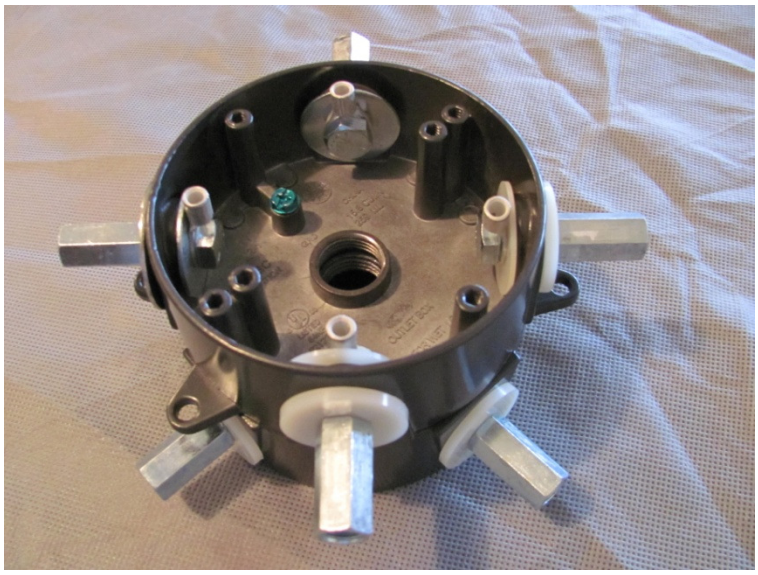

Figure 3 – Showing how junction boxes are positioned before connecting them together and how the insulated elements are adjacent to each other.

<u>Grounded Elements</u>

Now repeat this procedure for the 4 grounded mounting assemblies (2 per box) using the hardware shown in the upper part of the previous picture. This time use the ¾”long hex head bolts (Item 10) and the steel fender washers (Item 12). These rod coupling nuts can be tightened more because the steel fender washers are stronger than the nylon fender washers.

Mounting the SO-239 Coax Connector

Mount the SO-239 coax connector to the lower junction box cover as shown in Figure 4. It should easily fit into one of the off-center conduit holes. You may have to remove some metal from the inside of the cover in order to attach the lock washers and nuts. I used a Dremel tool to remove enough to mount a #4 solder lug under one of the nuts.

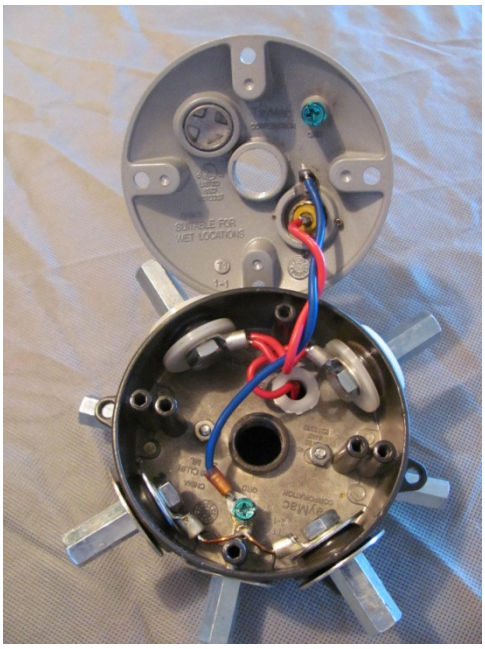

Figure 4 – Bottom junction box

Wiring the Hub

Figure 4 shows the bottom conduit box wiring and Figure 5 shows the top conduit box wiring. I used 18-AWG insulated wire for the insulated element wiring (red wire) and the same size (blue wire) for connecting the bottom cover to the hub's green ground bolt.

Note that the 4 grounded elements connect to the hub via the wiring of their solder lugs to the junction box green ground bolt. The two junction boxes are electrically connected via the two #10 bolts.

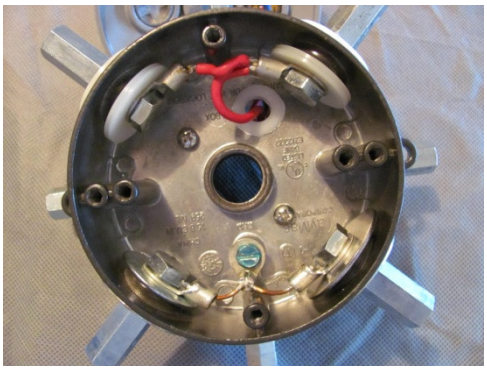

Figure 5 – Top junction box

Complete the Assembly

Attach both upper and lower covers using the supplied gaskets and bolts. I decided to drill 2 extra holes to mount the bottom cover as they come drilled for only 2 holes and the junction box has mountings for 4 holes. Detents were provided on the underside to position the holes for drilling. Use two #10-24 bolts in the extra holes (Item 15 & 16).

The completed assembly is shown in Figure 6.

Figure 6 – Completed Hub

Mounting the HamStick Elements

Consideration should be given to optimal placement when mounting the elements. Of course the pair of elements for one band must be mounted 180-degrees apart; one element grounded the other insulated.

You should try to mount elements adjacent to each other which will have minimum interference. It is a good idea to mount dipoles that

share common harmonics at right-angles or 90-degrees apart from each other. For instance, 20 meter and 40 meter dipoles should be

90-degrees apart. I used the following arrangement viewed clockwise from above the top cover: 40, 15, 20 and 10 meters.

Connecting to a Mast

The center threaded conduit hole on the bottom cover is where you attach the hub to a mast. The threads are straight and not tapered as with normal ½" NPT pipe threads. However, I have found that a pipe with ½" tapered threads will attach just fine. You can use a ½" Rigid Compression Connector (Halex #26351) to attach to non-threaded conduit pipe. Home Depot sells ½" IMC thick walled tubing that has the proper non-tapered threads which should be rigid enough to hold the hub. The next larger size (3/4" OD) will fit over the ½" pipe so you can easily construct a telescoping mast. With two 10' pieces and an overlap of about 2-3 feet you should be able to get the antenna up about 17' to 18'. You may need to guy the mast depending on your conditions.

To keep antenna weight and wind load to a minimum, I mounted a rotator at the bottom of the mast rather than the top. This will obviously cause problems if you need to guy the mast.

Adjusting Element Length for Minimum SWR

There are several ways to adjust each HamStick element for optimum length (minimum SWR). I used an MFJ HF/VHF SWR Analyzer model MFJ-259B on a short coax connected directly to the bottom of the hub with all elements installed as dsicussed above. I tuned both elements of one dipole before moving on to the next dipole. There is some interaction between the 2 dipole elements as you change the adjustable rod length. When you have one adjusted, adjusting the other will change the first, etc. I went through this sequence twice before I noticed the interaction was minimal. I was able to obtain nearly 1:1 SWR on each band at the center frequency where I normally operate. With such small elements the bandwidth may be quite narrow so I use an antenna tuner.

A second method is to install one dipole at a time and tune it with the others removed. This would be very time consuming and I doubt it would provide as good results as tuning each in the presence of the others.

73 and good luck.

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