Construction and maintenance of your SID Monitor’s Antenna
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DOCUMENT STATUS

Version 2.0:
Updates

Version 1.0: This document is still in the process of being reviewed.
To do:
  Edit content
  Brainstorm ideas on antenna solutions
    -- Do we want alternative designs here? E.g. PVC pipes versions
  Verify the materials list for complete and accurate parts specified
  Build another antenna and get photos of construction phases.
  Beta test the document with a school to verify the document it clear & complete.
Antenna Construction Hints

Here is one example of how to build a SID antenna; it is by no means the only way to construct an antenna. The good news is that the SID antenna does not need to be built to precise dimensional specifications nor its wire wound to exact tolerances nor does it have to be assembled / constructed exactly as shown in this document. In other words, you are welcome to experiment and/or adjust the construction of antenna for the parts and supplies you have on hand and can acquire easily.

Overview: We have three parts to the SID antenna: The Antenna, mast and base.

Antenna:
50 turns of #26-#28 wire. Magnet wire will work, but be more fragile. The X (or cross) frame is notched in the ends to hold the wire and is joined in the center where it can be attached to the mast. A terminal block is used to connect the wires to the coax cable.

Mast:
This raises the antenna portion above the base; it does not have to be very high. Remember: the antenna receives a VLF signal which submarines deep in the oceans can pick up… so it’s not like television antennas that need to be high up in the air.

Base:
The basic idea is to build a sturdy base that has some weight to it so it won’t blow over. Our experience is that antennas cannot be placed in the classroom because of electrical interference -- so it gets placed on top of the roof or some out of the way location.
Constructing the Base

The purpose of the base is to give stability to the antenna to prevent it from falling over. You could just as easily put a wood pole or 2”x2” in a bucket and fill it with rocks and/or concrete. The one built in this document is made from wood.

Starting with a 12” x 12”x 4” (header) scrap piece purchased at a local building supply store. It could just as well have been several 2x4s with pieces of plywood stacked on top and bottom. It should be painted to resist the elements. For a “nice” touch, underneath the base are screwed four rubber feet on the four corners to prevent scratching surfaces.

To attach the two 6-inch “L” brackets you need to get the spacing correct. Be sure that the mast will be centered on the base. Place the “L” bracket on the edge of the base and make sure to allow for the ¼” nut and metal plate as seen in this photograph.

One suggestion is that you thread the two U-bolts in place with a nut on one side and a wing nut on the other side.

Attaching the L the “L” bracket will line up and be construction you

Use a carpenter’s straight by the holes with a of 6 wood screws base.

At this point I lined up the mast and put a 2-inch hole about 1” deep in the base to accommodate the mast; this is optional.
The mast is a wooden 1 ½” to 2” round stock and should be long enough to hold the antenna up. This is not critical: 3 or 4 feet is sufficient, longer is okay too. The mast does not have to be tall like a television antenna because the VLF signal is ground (and ocean) penetrating. PVC pipe, or even driftwood could be used for the structure of the antenna.

To attach the antenna a bracket is bolted to the top of the mast. A 3” to 4” 1/4x20 threaded bolt is double “nutted“ to hold the bolt in place and provide the spacing away from the mast (this is for mechanical rather than electrical reasons). A wing nut is used to attach the antenna to this assembly. Additional washers and/or star / lock washers may be advisable to use as well to keep the frame from spinning in the wind.
Constructing the Antenna Frame

The antenna is a cross shape that I cut from 1”x2” boards; one continuous length of 30” and two 14 ¼” boards. These should be sanded and painted to resist weather.

The idea is to make the cross equal lengths in each direction.

The shorter boards are attached and held together by four mending plates: two per side held by four screws per plate. Again it is good practice to pre-drill pilot holes to prevent wood from splitting. After the plates are installed, drill a ¼” hole through the center as a means to connect the antenna to the mast. (Hint: to find the center use a straight edge and draw diagonal lines from the corners of the mending plates. ‘X’ marks the center position.)

Attach a two position terminal block below the mending plates as shown in the photograph.

The four ends of antenna are notched and shaped using a round wood rasp to form a “U” shape notch about 1/2” deep and secondly for the entry and exit edges are beveled to relieve any sharp corners and prevent the wire from breaking when being wound.

Take care on this step – the wood can break out on you if you aren’t careful.

[Why are these pictures so faint?]
Antenna Design #2.
Plastic PVC pipes

The base. NOTE: This is not heavy enough for outdoors; any amount of wind will knock it over. It can be tied down or weighted down to prevent it from moving in the wind.

Notice the notch at the end, it holds the wires
Winding the Antenna

Pictured: Left to Right: Sean Liu (Senior at Los Gatos High School), Ray Mitchell (Computer Science Instructor, Cal. State University, East Bay), and Eric Havel (Environmental Instructor, Chabot Space & Science Center)

This step requires at minimum two people, but three or four people are better. One person to make sure the wire gets wound correctly and the other to make sure the spool of wire is feeding properly. If three or four people are available, then one can feed the wire, the other turn the antenna frame and the third person make sure that the wire is taught (tightly tensioned) around the antenna frame. A fourth person should keep track of the number of winds of wire; about 50 winds (or turns) should be used.

Attach the antenna to the mast but do not to tighten the wing nut. Allow the antenna frame to spin while winding the wire. This nut may need tightening (or loosening) as you proceed.

The person holding the spool of wire should insert a screwdriver or rod through the center of the spool and make sure that it is controlled while winding is occurring.

TAKE YOUR TIME… a fast job will produce sloppy results and could break something. Expect that it will take about 20 - 40 minutes to complete this step.
Start on one side of the antenna string out the wire from the center out to one of the ends of the antenna frame. It might be helpful to use some transparent or masking tape to hold this wire in place. Be sure to leave enough slack on the end to attach it to the terminal block.

The wire is wound around the frame; about fifty turns should do it. Keep tension on the wire while you do this. It requires cooperation of both people; the person holding the spool to make sure the wire is feeding properly and the person winding the antenna to make sure that the wires are neatly going around in each of the slots.

On the final turn go just a little further and run the return wire on the opposite side of the arm where you started and to the other side of the terminal block. Leave some excess and snip the wire with some wire cutters.

Strip the two antenna wires about 3/8” back and use a screwdriver to attach the wires to the back the top two screws of the terminal block out about 1/2 way. Form a “J” hook in the antenna leads (the wire you just wound) with some needle nose pliers in a clockwise direction (the same direction that you are tightening the screw) then one at-a-time place the “J” hook wire onto the terminal screw and tighten down the screw.

A dab of glue might help keep the wires from loosening with time.

This completes the antenna assembly.
Installing the RG-58 Coax Cable

Now it is time to prep the coax cable for use. The term “coax” is short for coaxial, this means that the cable has two conductors in the same axis, one center connector and the ground shield around the center connector. The RG-58 is a standard cable used by ham radio people etc. and is available at radio shack or other such outlets. Be sure to allow yourself enough length to run from your antenna site to where you have your SID monitor – plus some slack. Remember to consider both the horizontal as well as vertical dimensions when performing your calculations.

[If RG/59 cannot be used, a warning should be included here that the 75a(?) RG59 that is commonly available cannot be used because of *****. RG58 is 50a(?) at high frequency.]

Carefully strip about 2 inches of the outer sheathing of the coax cable with a sharp pocketknife or Exacto knife. Cut only deep enough to pierce the sheathing but not any deeper or you will cut the ground wire.

Pull the center conductor and sheathing through the ground wire and twist the ground wire as shown in the photograph.

Next, strip the center conductor back about $\frac{1}{2}$”. I recommend using spade connectors and a crimp tool to make the attachment to the terminal block easy.

On the other end of the coax you need a TNC (Threaded N-Compact) connector to mate with your SID Monitor. Radio Shack sells two types, and even though either one would work, you really want the twist on type Catalog # 278-140 as pictured below:
A COAX stripping tool is available to strip the ends to make assembly easier, unless you plan on doing several of these antennas, the cost of the tool does not justify a purchase, it easy enough to strip the end according to the instructions on the back of the package.