

Building a SID Antenna

A SID antenna is called a “**wire-loop antenna**” and is nothing more than a frame that holds up “wraps” or loops of wire. There is no “standard size” or even shape of antenna for a SID monitor. The 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. You are encouraged to experiment and adjust the construction of your antenna for the parts and supplies you can acquire easily.

You can either build a **small (< 1 meter wide)** antenna with lots of wraps of wire, or a **large antenna (2 or more meters wide)** with fewer wraps. Larger antennas are more sensitive, but they are difficult to carry around and mount outside because of wind, rain, and space requirements. Smaller antennas are easier to build but require more wire to pick up the signal and are not as sensitive as big antennas. The larger in diameter, the better your antenna will be, e.g. 25 turns on a 2 meter frame is better than 50 turns on a 1 meter frame. Your antenna does not need to use the designs or materials we demonstrate. The antenna can be made out of crossed broom sticks or spare wood, anything that is not metal (conductive) is fine. The design schemes we suggest are merely examples of antenna frames that we found to be easy to construct and wind while being sturdy. Pictures of existing SID antenna designs can be found at:

http://solar-center.stanford.edu/SID/antenna_designs.html

Antenna Wire

To wind either the small or large antenna you will need about 120 meters (400 feet) of **insulated** wire. Solid wire makes it easier to wind an antenna than stranded. Magnet wire will work, but be more fragile. You can use anything from #18 AWG (**1.02362mm**) to #26 AWG (**0.40386 mm**) size wire depending on the size of your antenna. The small antenna will require about 50 turns/winds of the smaller diameter wire, the larger one about 25 of the larger diameter wire. We have placed a conversion chart for AWG in the appendix.



Making a Large Antenna:

Here is a design for a simple large antenna. This design does not require a mast and stands up on its own. It can be placed indoors in an out of the way place (e.g. up against a back wall) or outdoors. If placed outdoors in an area where it will be subjected to the elements (like wind or rain) you may need to anchor it to something sturdy.

We have included another antenna design using a mast in an appendix. Once again these design examples are only suggestions to get you started, they are not necessarily the best or only options for your site.

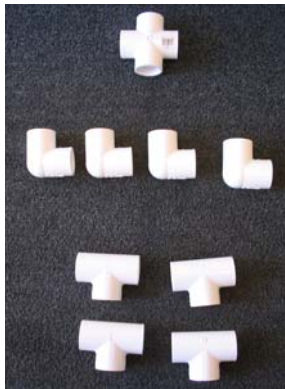
The requirements for an antenna are:

- A wound loop on a frame (although it does not have to be round)
- The wire loop cannot touch the ground
- The wire must be insulated
- The antenna must be upright
- It must be sturdy to resist whatever elements it may be subjected too (wind, rain, clumsy neighbors)

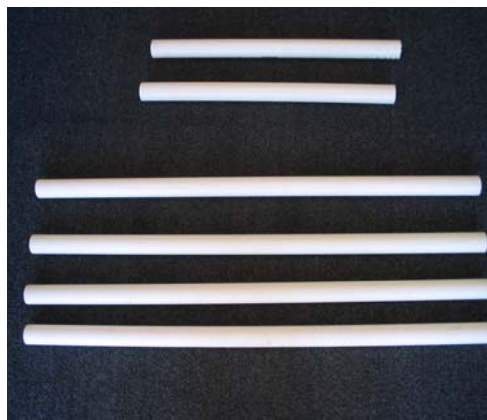
Materials used in this design:

- **PVC pipe:** one inch diameter pipe, cut into **4** pieces of length 2.5 feet and **4** pieces of length 1ft. These lengths do not have to be exact.
- **PVC connectors:** **1** four way connector, **4** elbow connectors, **4** T connectors. *If you cannot locate a 4 way connector, try taking two elbow connectors and duct-taping them together. Just make sure it is secure!*
- **Tape and/or zip ties:** To make sure the antenna wire stays wound.
- **Antenna wire:** See our section on choosing antenna wire on the previous page.

Step 1: Gather your materials

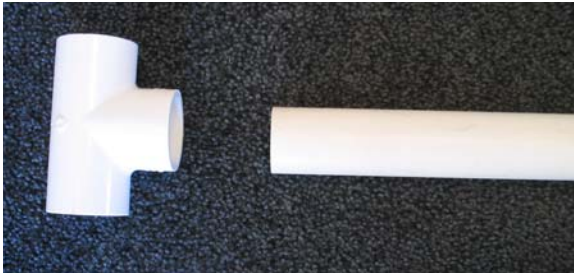


PVC connectors



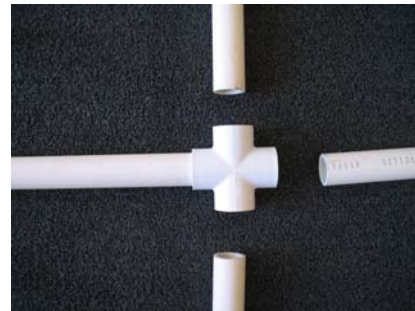
PVC Pipe (should be 4 small pipes)

Step 2: Connect the T connectors

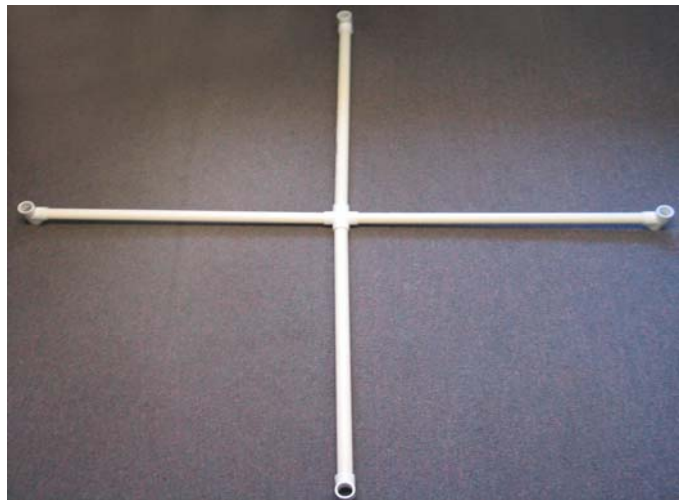
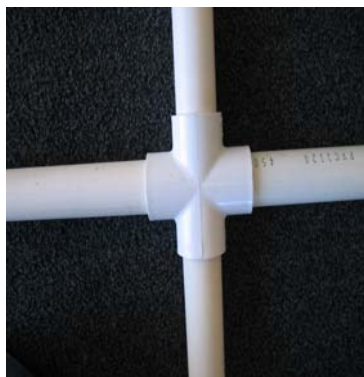


Attach the T connectors to each long length of pipe.

Step 3: Create your frame with the 4 way connector as a hub

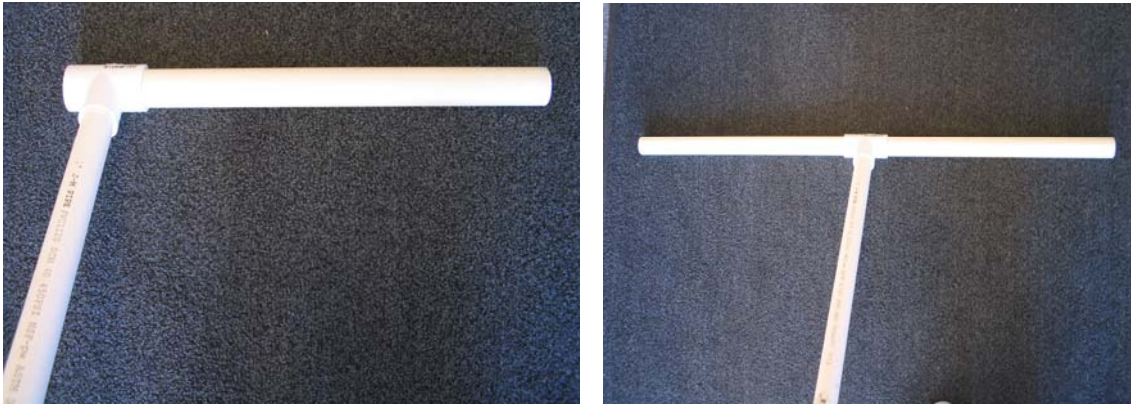


Attach the completed T connected lengths of pipe to the 4 way connector (this will be the hub of your antenna frame).



Turn your end connectors so the openings are perpendicular to the 4 way hub (as shown). This is the completed frame, you can work with this design to create “feet” as we did, or affix it to a mast. Mast design examples can be seen in appendix E and also on our website: http://solar-center.stanford.edu/SID/antenna_designs.html

Step 4: Create a base so that your antenna will stand upright. This (and the following) step can be omitted if you are building a mast.



*Standing your antenna up, place one of the smaller lengths of PVC pipe in each end of the T connector. **Repeat** this on the other side of the frame that touches the ground.*

Step 5: Create “feet” on the base so your antenna is more stable.



Place the 4 elbow connectors on the open ends of the base you created. Now your antenna will stand upright and off the ground.

Now you should have an antenna that looks like a large X with a base. This style of antenna will work best indoors where it won't get knocked over by wind. If you would like to use this design outdoors, make sure it is up against a wall or in a sheltered area. Feel free to make adaptations for stability and safety, just make sure you don't connect it to anything metal.

The completed frame



This antenna was designed by Phil Scherrer and built by Sean Liu and Shannon Lee (photos by Shannon Lee)

Here are some photos of a completed antenna of this design. These photos include the antenna wire and terminal to monitor connections. These steps are explained in detail in later sections.



Note the use of zip ties to make sure the wire windings stay together.



This design and antenna was created and photographed by Phil and Debbie Scherrer.

Winding the Antenna

Step 1: Plan how you will be winding your antenna; this will depend on the style you built.

Winding the Antenna requires at minimum two people, but three or four people are better. One person makes sure the wire gets wound correctly and the other feeds the spool of wire. If three or four people are available, then one can feed the wire, the second 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 for a small antenna and about 25 for a large antenna.

For the simple antenna design described previously, winding may be cumbersome. We found that if you place the frame on a spinning stool, with someone holding the center down so it doesn't slide off, it becomes easier to wind the wire. Also, we used two swiveling office chairs back to back in place of the stool and winding worked well.

If you are using a frame with a mast, here is another method to wind your wire:



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

This is the mast as described in appendix E. 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.

Step 2: Winding

To get started, on one side of the antenna, string out the wire from the center to one of the ends of the antenna frame. Use some transparent or masking tape to hold this wire in place. Be sure to leave enough slack on the end to eventually attach it to the terminal block.

The wire is wound around the frame; about fifty turns on a small size antenna, and 25 on a large antenna, should do. Keep tension on the wire while you do this: the person holding the spool has to make sure the wire is feeding properly and the person winding the antenna needs to assure 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 wire cutters.

Connecting your Antenna to the Terminal Block

Strip the two antenna wires about 3/8 inch back. 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) as shown in figure 1, then place the “J” hook wire onto the terminal

screw and tighten the screw as in figures 2-4. Connect the other antenna wire in the same fashion. Make sure they are connected to the same side of the terminal block. Some areas of the world do not allow exposed connections such as these, please be sure to check your local regulations for this equipment. A cover may need to be made or purchased for the terminal block in some situations.



Figure 1



Figure 2



Figure 3



Figure 4

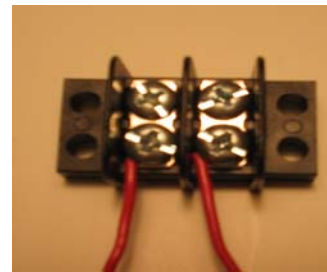


Figure 5

In these photos the terminal block is not permanently attached to the antenna. You will need to make sure your terminal is attached. If your antenna is wood, placing screws in the empty holes will suffice. For a PCV antenna you may need to use zip ties or tape. A dab of glue might help keep the wires from loosening with time.

This completes the antenna assembly. You are now ready to connect your antenna to your monitor.

Installing the RG-58 Coax Cable

Now it is time to prep the coax cable for use. “Coax” is short for coaxial, meaning the cable has two conductors in the same axis, one center conductor, and a ground shield around the center connector. The RG-58* is a standard cable used by ham radio people and is available at electronics outlets (similar to Radio Shack if you are in the U.S.). Determine the length of wire you will need to run from your antenna to your SID monitor, plus some slack. Remember to consider both the horizontal as well as vertical distances when performing your calculations.

* Note: RG-59 could be used as well, although different terminators are needed. The two types have similar electrical characteristics, but different impedance. The RG-59 is used in cable systems and has a 75 ohm impedance; RG-58 is 50 ohms. Again, each needs a specific terminator.

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



Figure 1



Figure 2



Figure 3

Pull the center conductor and sheathing through the ground wire and twist the ground wire as shown in figure 3. Next, strip the center conductor back about $\frac{1}{2}$ inch as shown in figure 3 and 4. We recommend using spade connectors (figure 4) and a crimp tool to make the attachment to the terminal block easy (figure 5).



Figure 4



Figure 5

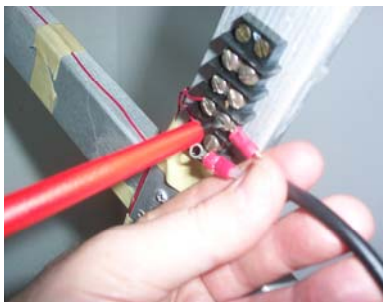


Figure 6



Figure 7

To attach the spade (ring) connected coax wires to the terminal block, unscrew the two screws on the opposite side of the connected antenna wires. Slip the ring over the screw and tighten back down (figure 6 and 7).

Connecting the Coax Cable to the Monitor

On the other end of the coax you need a TNC (Threaded N-Compact) connector to mate with your SID Monitor.

A COAX stripping tool is commercially available to strip the ends to make assembly easier. However, unless you plan on doing several of these antennas, the cost of the tool does not justify a purchase. It is easy enough

to strip the end according to the instructions on the back of the package. An example of such a tool is shown in figure 1.

Strip the coax about 21 mm from the end. Cut or scrunch the ground wire so that it sticks out about 6.35 mm from the covered coax as shown in figure 2. Next, strip the center conductor about 14.3mm this is also shown in figure 2. Now place the center conductor into the hole in the TNC connector (at the end of the shaft). Twist the shaft in a clockwise direction until screws are tight and covers any exposed ground wire as in figures 3 and 4. *If you are having trouble, cut a little bit off your center conductor and try again.*



Figure 1



Figure 2



Figure 3



figure 4



Figure 5

When your connector is finished it will connect to the monitor as shown above.