Radio Jove
Antenna Manual Supplement

READ BEFORE ASSEMBLING ANTENNA

January 2006

Introduction
Now that your receiver is built, you need to choose the best antenna system to fit your needs. Your antenna kit contains materials for 2 dipoles. You have a couple of options as to how to proceed.

Single Dipole You can construct a single dipole, for observing the sun. It can be quickly setup at reduced expense and takes half the space of the dual dipole array (10 ft x 32 ft vs. 30ft x 45ft). You can observe the sun during daylight hours and with patience you will capture solar bursts. You can run drift scans of the galaxy and observe various effects of the earth's ionosphere. The downside of the single dipole is that, since it has low gain you will see only the stronger solar bursts and rarely any Jupiter activity.

Dual Dipole Array The full RJ1.2 dual dipole phased array will allow monitoring of both Jupiter and the Sun. Its larger size and increased sensitivity mean better reception of Jupiter and solar bursts. Galactic drift scans will be more detailed. The dual dipole array will require a greater expense for supporting masts as well as more real-estate than the single dipole. Some student groups may have difficulty making Jupiter observations as these occur in the late night or early morning hours.

Picking a Site
There are many sources of interference that can completely mask the signals that you are trying to hear. Arcing insulators on power lines are one of the worst. There are many others including light dimmers, electric fences, automobile ignition systems, electrical machinery, computers, arc welding equipment, bad fluorescent light starters, etc, etc.

Keep these potential radio noise sources in mind when you choose an observing site. As a general rule it is a good idea to get as far away as possible from power lines, busy highways, buildings full of computers, or industrial sites with electrical machinery. The middle of an athletic field may be a good choice, or a residential area with underground power, or perhaps a rural setting. However, we have had some good successes with Radio JOVE antennas near buildings; local conditions are extremely variable and trial-and-error may give you good results.

Choosing an Antenna
The Jove antenna kit contains wire, insulators, coaxial cable, connectors and a power combiner – all the materials necessary to assemble the electrical parts of the dual dipole array – or the single dipole antenna. If you decide to start with the single dipole you can complete the second dipole later.

All of the information you need to assemble the dual dipole array is found in the accompanying RJ1.2 Assembly manual. The single dipole Sun antenna is described in the remainder of this supplemental document. Construction time for this single dipole will run approximately 3 hours.

Radio Jove
Single Dipole Antenna for the Sun

Getting Ready to Build the Single Dipole Antenna
Please read sections 1.1 - 1.4, 2.3, and 2.4 in the RJ1.2 antenna manual before continuing.

What Parts are Needed?
The following list identifies all the materials supplied with the Jove RJ1.2 antenna kit. Materials which you will use for the single dipole are identified in the right hand column.

For Dual Dipole Array	Parts included in the Radio JOVE Antenna Kit	For Single Dipole	
	Description		
50 ft	50 ft. (15.24 m) #14 Gauge Stranded Copper Wire	25 ft	
95 ft	95 ft. (29 m) RG59U Coaxial Cable (Belden 8241)	95 ft	
4	PVC End Insulators (cylinders)	2	
2	Plastic Center (dogbone) insulators	1	
6	Twist-on F-connectors	3	
1	Coaxial cable coupler	1	
1	Power combiner / splitter (2-to-1)	NA	
6	Ferrite toroid cores	3	

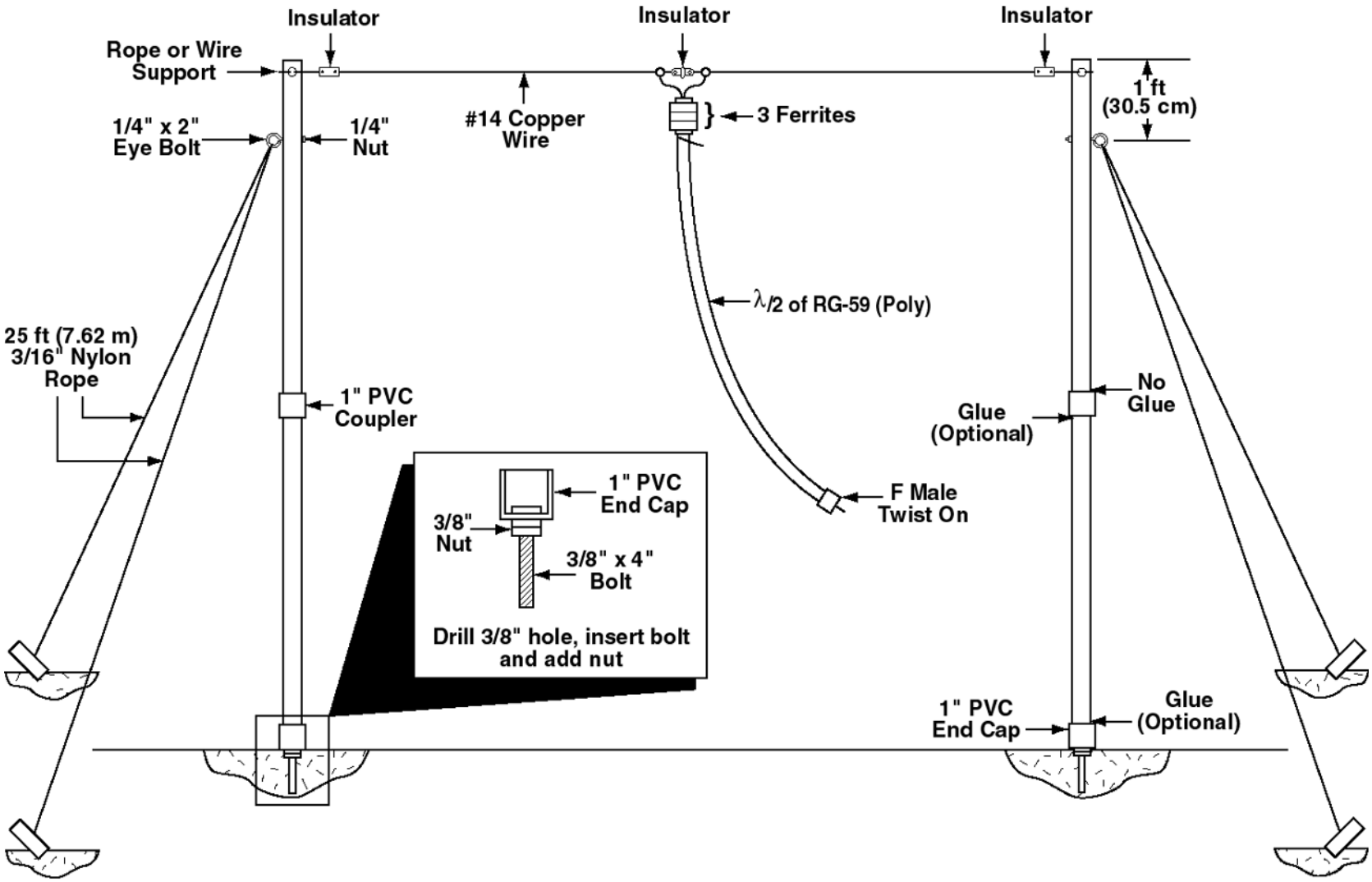
You will need to purchase the following materials to complete the single dipole antenna.

Parts necessary but NOT included with the Radio JOVE Antenna Kit		
1 60 ft. (15.24 m) x 3/16 in. Nylon Rope		
2 10 ft. (3.048 m) x 1 in. PVC pipes (Sch 40)		
2 1 in. PVC End Caps		
2 1 in. PVC Couplers (Optional for portable use)		
2 4 in. x 3/8 in. Bolts		
2 3/8 in. Nuts		
2 3/8 in. Flat Washers and Lock Washers		
4 4 in. x 1/4 in. Eye Bolts		
4 1/4 in. Nuts, lock-washers and flat-washers		
1 Small can of PVC Cement (optional)		
3 Tie wraps (optional)		
4 Tent stakes		

Building the Single Dipole Antenna

Take a few minutes to study the following diagram. This is the dipole antenna that you will be building. The antenna will be installed, with the wire running E-W, on a site approximately 32 ft E-W by 10 ft N-S.

BASIC DIPOLE



Wire and Coaxial Cable (Use the ○ markers to check off each step as you complete it.)

Cutting the Wire, Coax, and Rope

1. ○ Cut 2 pieces of copper wire each to a length of 12 ft. 4 in. (3.76 m). This length includes 5 inches extra on each end for attaching to the insulators.
2. ○ Cut 1 length of coaxial cable 32 ft. 4 in. Referred to as the 1 λ (lambda) cable. The remaining cable (about 60 ft) can be used to connect the antenna to the receiver.
3. ○ Cut two lengths of rope, each 2 ft. (0.61m). Melt the ends with a lighter to keep from fraying.

Wrapping the Insulators

1. ○ Attach an end insulator to each wire. Thread 5 in. (12.7 cm) of copper wire through the hole in the end insulator and wrap it back on itself as seen in figure 3.1a.
2. ○ Thread each rope through an end insulator (fig 2a). Tie using 6 in. of rope for each knot).
3. ○ Attach the pair of wires to the center insulator (fig 2b). Thread 5 in. (12.7 cm) of copper wire through the hole in the center insulator and wrap the wire back on itself as seen in Figure 3.1b.
4. ○ The total length of the dipole wires (from one end insulator to the other end insulator) should be 23 ft. 3 in. (7.09 m). Ropes should extend about 1.5 ft (45 cm) from each end insulator.

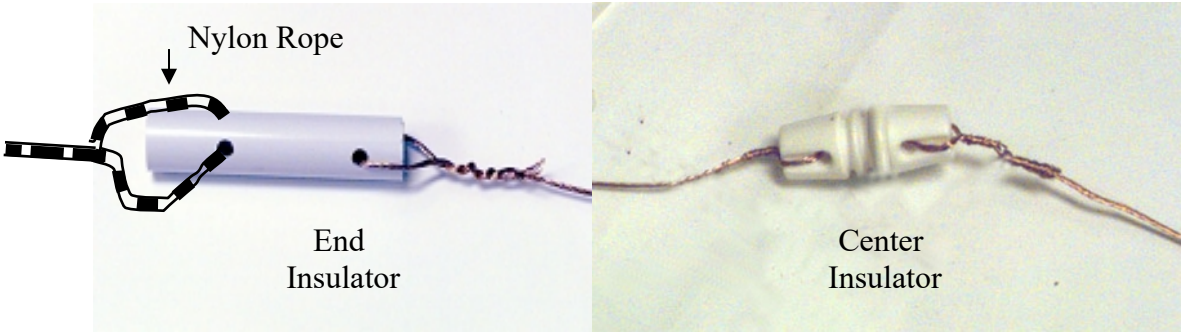


Figure 2a and 2b. Wrap the end and center insulators with the antenna wire.

Preparing and Soldering the 1 λ Coax lines

1. ○ Remove 5 inches (12 cm) of the outer insulation from ***one end only*** of the 1λ cable. Be careful not to cut the braided copper wires underneath.
2. ○ Unweave the braided copper shielding using a small screwdriver or the tip of a pen or pencil. Start at the end of the wire and carefully unbraid all of the exposed copper shielding (Figure 3a and 3b). A few broken strands of braid are normal.

Figure 3a and 3b. Unbraid and twist copper shielding.

4. ○ Strip off the insulation around the center conductor approximately 1 inch (2.5 cm). This is polyethylene and is fairly tough, so use a sharp knife with caution. **WARNING: *Be careful not to nick the center conductor when cutting and stripping off the insulation around it.*** Nicking the center conductor will weaken it and most likely cause it to break after swinging in the wind.

5. ○ Loop the coaxial cable over the center insulator and tie wrap or tape it (Figure 4) just below the section of stripped coax. This will provide strain relief so the solder joints will not break.

6. ○ Wrap the bare center conductor around the end of one of the copper wires attached to the center insulator. Wrap the twisted shielding around the other copper wire attached to the center conductor.

7. ○ If necessary, clean the ends of the wire with sand paper. Solder the coax center conductor and shield to the copper wires (we recommend using a soldering gun). Use plenty of solder and heat the wires until you see the solder seep into the wires.

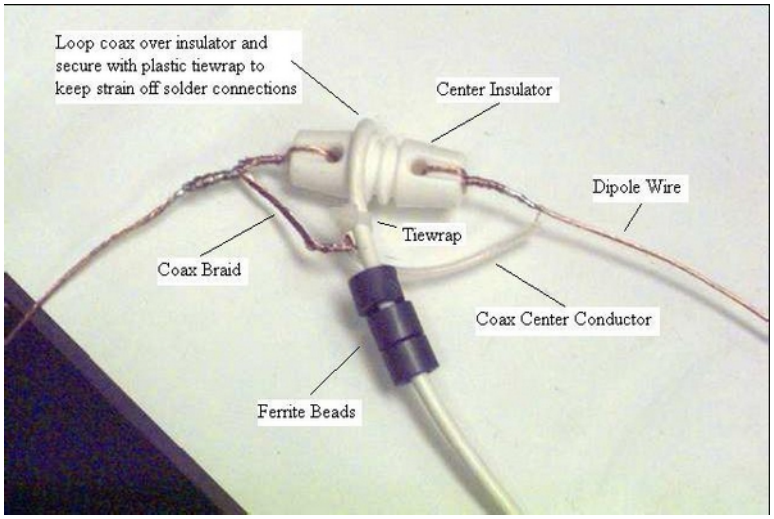


Figure 4. Attach the 1 λ coax to the center insulator

Installing the Ferrite Beads

1. ○ Slide 3 ferrite beads up the cable to the very top of the coax near the dipole. Secure them all in a row with tape and a tie wrap.

Installing the F-Connectors

1. ○ Remove 1 inch (2.5 cm) of the coax outer insulation (fig 5a).
2. ○ Unbraid about half of the exposed shielding and fold it back over the other half of the copper shielding and over the outer casing (fig. 5b)
3. ○ Remove the insulation around the center conductor leaving about 1/2 inch (1.3 cm) of bare center conductor (Figure 5c, 5d).
4. ○ Push the F-connector over the end of the coax and twist on as tightly as possible. About 1/8 inch (0.3cm) of center conductor should stick out of the end of the F-connector (Figure 5e).
5. ○ Repeat this connector installation procedure for each end of the long cable which will run to the receiver.

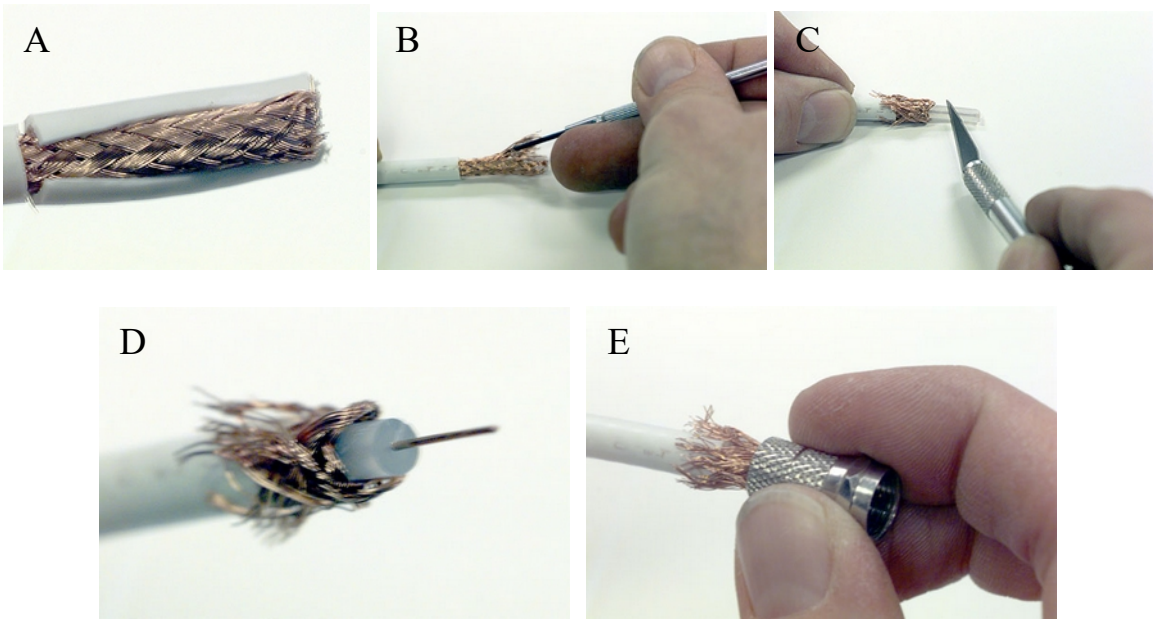


Figure 5a –e. Prepare the coax and install the F-connector.

MAST PREPARATION (refer to figure 1)

Start with one 10-foot PVC pipe and pick one end as the dipole end.

A. Dipole End

1. Drill a ¼" hole, two inches from the end of the mast (hole A). Drill another ¼" hole (hole B) twelve inches from the end of the mast (and parallel to hole A).

2. Install one 4”x ¼” eye-bolt in hole A with the eye inward for the dipole. Use a flat washer, lock washer and nut to secure the eyebolt. Install and secure an eyebolt in hole B with the eye outward for the guy rope.

B. Ground End Cap

1. Drill a 3/8” hole directly in the center of the PVC end cap.
2. Install and secure a 3/8 x 4” bolt into the cap hole (see figure 1).
3. Glue the end-cap with protruding bolt to the ground end of the mast.

This completes the first mast. Prepare the other identical mast.
If you plan to cut the masts in half for portability do so now. Install and glue a coupler onto the top of the bottom section of each mast.

PREPARING the SITE

Before the antenna can be assembled and raised, you must layout the antenna field. Study Figure 6, noting that the antenna wires run in an East-West direction. Proceed as follows.

1. A magnetic compass, a 50-foot measuring tape, and a couple of helpers will make quick work of laying out the site.
2. Determine the mast and guy stake locations on the antenna field. Use one of the guy stakes to create a small hole at each mast mounting point. (Then remove the stake – these holes are where you will insert the spikes on the bottom of the PVC masts. Hammer in the guy stakes (with the top of each stake tilted outward from its mast at about a 45 degree angle). The antenna field is now ready for installation of the masts and dipole

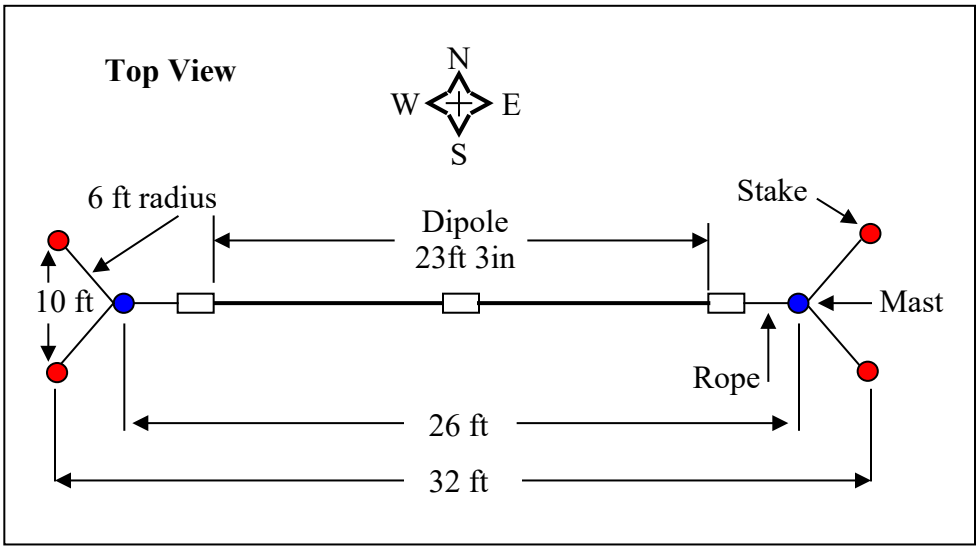


Figure 6. The antenna site showing the location of stakes and masts. The minimum site size required to erect the dipole is 10 by 32 ft. The dipole should be at least 10 to 15 ft from the nearest parallel metal fence or sizable metal object. Exercise caution erecting the dipole. Stay well away from power lines – **warning** – electrocution hazard.

WEATHERPROOFING THE ANTENNA
It is important to weatherproof the coaxial cable connections at the antenna feedpoint and the cable coupler, particularly if the antenna will be subject to moisture. Simply wrapping them in electrical tape will help, but a better solution is to use Radio Shack Coax Sealing tape. The rubberized plastic compound sold at hardware stores to insulate tool handles makes a great outer coating on top of the tape and will help ensure complete protection from moisture penetration.

MAST and ANTENNA INSTALLATION

Read all installation instructions before starting. Do not attempt installation of antenna masts with fewer than 3 people.

DO NOT INSTALL NEAR POWER LINES

ITEMS NECESSARY ON HAND:
2 masts, dipole assembly (includes the soldered one-wavelength coax and ferrites), all coax cable with F-connectors attached, rope, sharp knife, lighter (After cutting the rope, melt the ends with the lighter to keep the end from unraveling).

Step 1. Lay out the masts, with the base of each mast near its hole. Stretch out the dipole. Attach one end of the dipole rope to its mast using the top eyebolt. Do not connect the other end of the dipole to its mast yet.

Step 2. Cut two 26 ft long guy ropes, one for each mast Pass each guy rope thru its eyebolt, and then loop back thru the eyebolt so the center of the rope is secured by the double loop at its midpoint. You should end up with two equal lengths of rope coming from the lower eyebolt on each mast.

Figure 7. Setting up the mast. Lay out the dipole on the ground and set up one pole at a time.

Step 3. Insert the mast with the dipole wire attached into its hole in the ground and erect it to the vertical position. Tie guy ropes to their stakes so that the mast is approximately vertical.

Step 4. Attach the dangling end of the dipole to its mast. Stick the second mast into its hole, and secure the guy ropes so that the mast is approximately vertical. The antenna should be fairly taut with both masts near vertical. If it is not, move one mast as needed along the E-W line, reinsert in ground, and retie the guy ropes.

USE CAUTION – BE SURE THAT GUY ROPES ARE SECURE.

Step 5. Adjust all guy ropes to make the antenna masts vertical. Do not expect perfectly straight masts, as the PVC pipes will flex one direction or another.

Connecting Cables to the Radio JOVE Antenna and Receiver

You can connect the receiver directly to the 1λ cable coming from the feedpoint or you can extend that cable by attaching the additional 60 ft section of coax. Use the female/female F-adapter (enclosed with the kit) to connect the two cables. Make sure that all F-connectors are snug. You can listen with headphones or an amplified speaker or using the audio system of a computer sound card. The computer option is described below. Connect all cables to the receiver as shown in Figure 8.

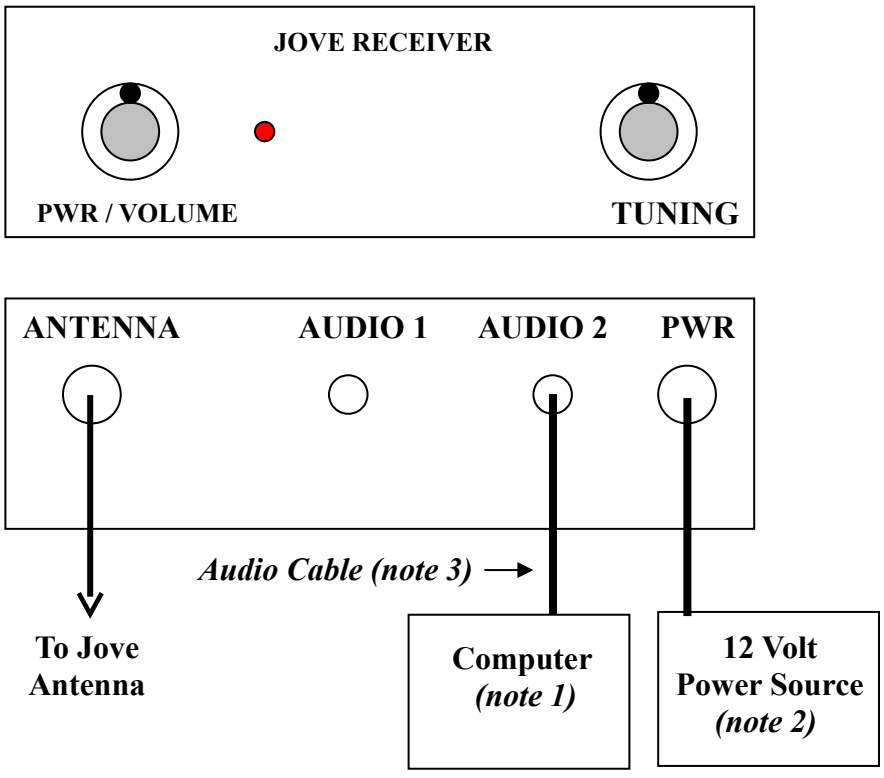


Figure 8. Connections to the Jove receiver for testing with a computer.

Note 1. The computer can be a notebook or desktop running SkyPipe software. SkyPipe has been tested to run on Windows machines using Win 98 or later and some Macintosh computers running Windows emulation software

Note 2. The12V DC power source can be a lantern battery (EverReady 732, Radio Shack part # 23-007), or a regulated power supply such as the Jameco 162996. If you use battery power, test the battery voltage every few hours to make sure it has not dropped below 11 volts. The Jove radio should be turned on for this measurement.

Note 3. The Jove receiver has two identical stereo audio output jacks (Audio 1 and 2). Each jack provides the same receiver signal to both stereo channels (left and right channel). An audio cable connects the Jove receiver (either Audio 1 or 2) to the computer sound card input. Desktop computers have *line* and *mic* inputs while laptops usually have only a *mic* input. The *mic* input is much more sensitive with mic boost enabled on your sound card control panel. The *line* input is stereo – supporting both left and right channels. The *mic* input is often monaural, supporting only a single channel (left). Your Windows audio volume control panel selects either *line* or *mic* inputs to your sound card and SkyPipe (Options>Source) selects between left and right channels. You can use either mono or stereo audio cables, but be sure to check both your Windows Volume Control Panel and SkyPipe Options to connect the receiver audio to SkyPipe.

Set your receiver volume control to the 12 o'clock position. Adjust your software volume controls in Windows for a baseline signal around 1000 on SkyPipe with the antenna connected. You should hear a significant increase in noise level when the antenna is connected to the receiver as compared to listening to the receiver with no antenna (Figure 9). If you do not see and hear this noise increase, then there is something wrong with either the antenna or the receiver. Check all connections, wires and cables of the antenna and see the troubleshooting section of the receiver manual if necessary.

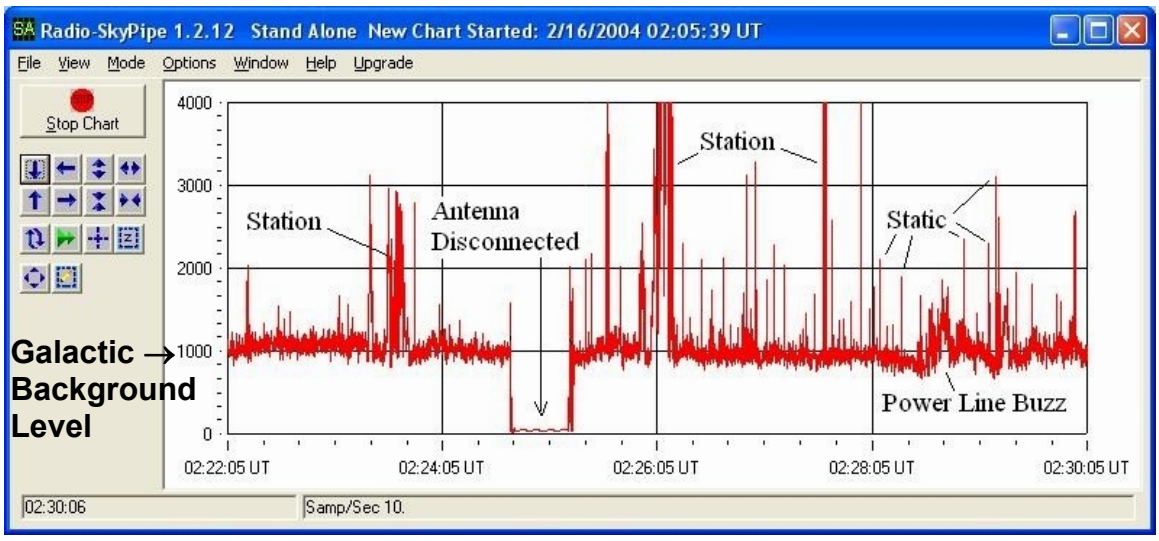


Figure 9. Typical SkyPipe trace showing effect of connecting and disconnecting antenna.

Congratulations on completing your radio telescope. To monitor the Sun set the receiver gain to the 12 o'clock position and tune the receiver to a quiet frequency between stations. Figure 10 depicts three weak to moderate solar bursts. Each burst typically lasts less than a minute and often has a rapid onset and then a slow decay in intensity.

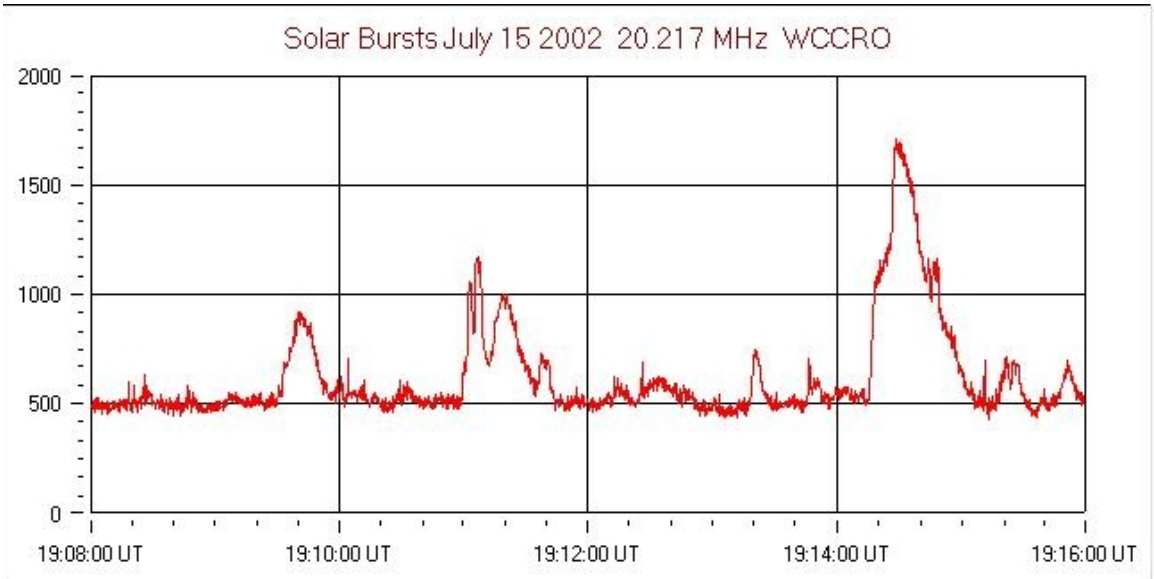


Figure 10. Typical solar bursts – each burst usually lasts less than a minute. Bursts may come singly or in groups. Usually there is more activity when there are visible sunspots on the Sun.

Always Observe Safely

1. Avoid Lightning (always disconnect the antenna when not in use, and always disconnect the antenna before a lightning storm is present, and preferably well before the storm arrives.)
2. Never assemble the antenna under overhead power lines. The antenna should be located as far from overhead power lines as is practical – several hundred feet if possible.
3. Mark your guy ropes with reflective high visibility tape

Share Your Data
The Jove team maintains a data archive on the Jove website. You are invited to submit your records to this archive.

If you need help or advice – contact a Jove team member – see the website for details.