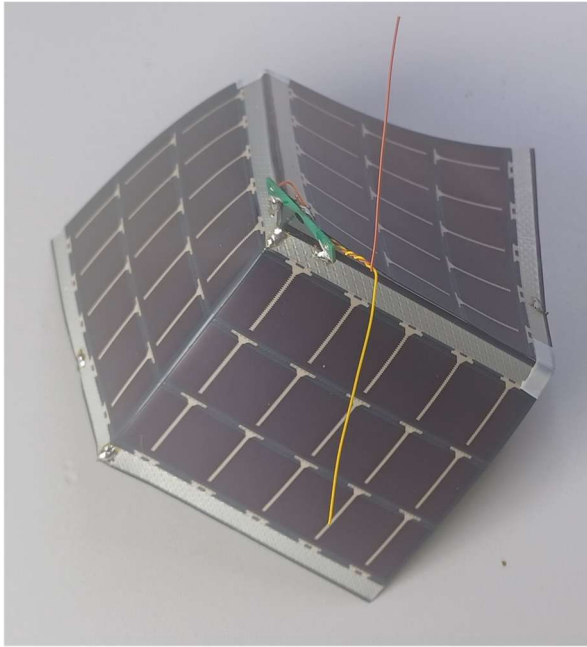




PICO-TRACKER

Teepee Assembly Manual

ABSTRACT

Illustrated assembly instructions for the Pico-Tracker teepee payload module.

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Pico-Tracker

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Part 1 - Required Tools

Ruler

Soldering Iron

Edge Cutter / Wire Stripper

Tweezers

USB serial Adapter

Mini USB cable

Empty plastic water bottles (2)

Part 2 - List of Materials

Solder

30 AWG wire wrap wire

36 AWG magnet wire

8lb braided fishing line

Contact adhesive

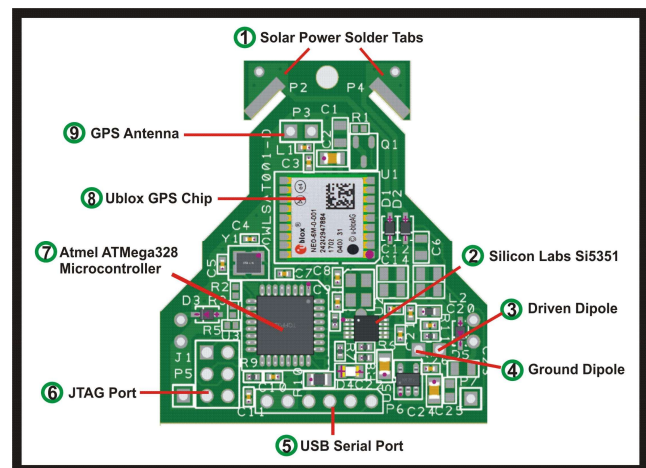
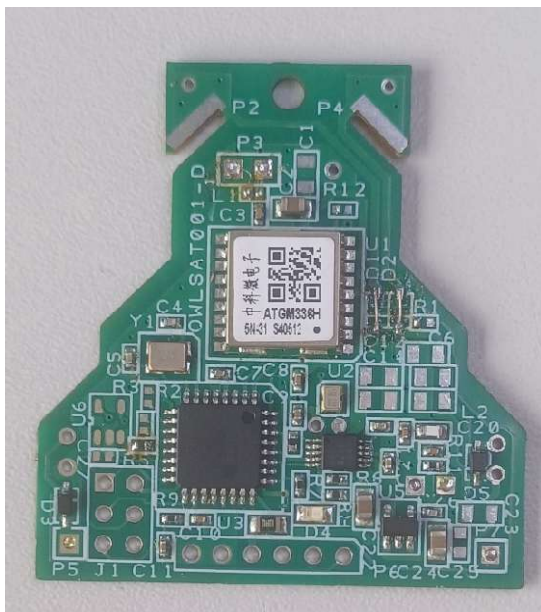
Tyvek Tape

Painters or masking tape

1uF Super Capacitors (2)

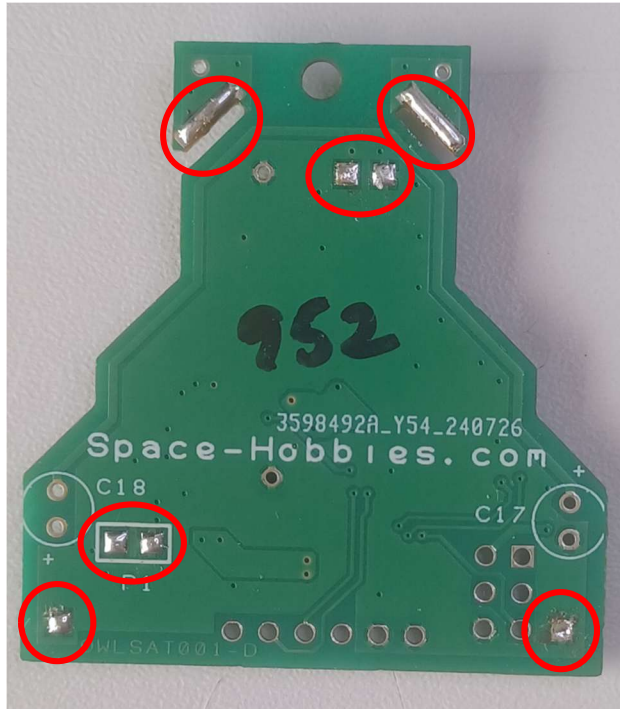
Power Film Solar Panels (2)

Pico-Tracker PCB



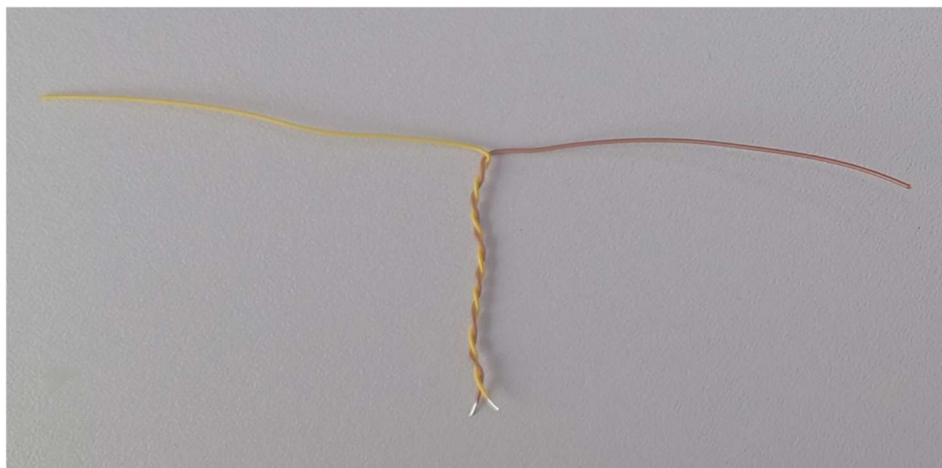
Part 3 – Solder Selected PCB Pads

Place solder to fill the highlighted pads on the Pico-Tracker PCB



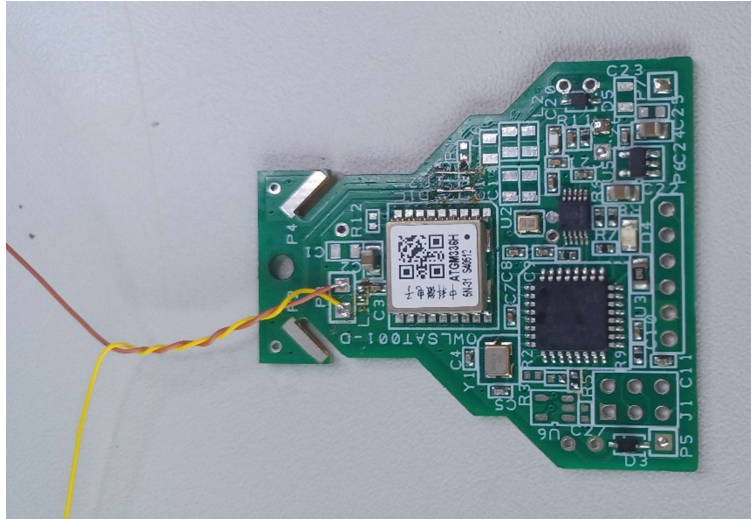
Part 4 – Build GPS Dipole Antenna

Cut two 3" pieces of 30AWG wire wrap wire. Twist the two wires together, leaving 1.9" untwisted as shown below:



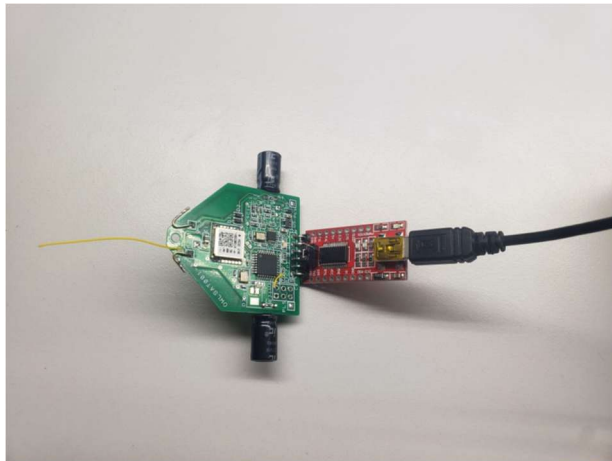
Part 5 – Install GPS antenna

Strip off 1/16 inch of insulation from the twisted end of both wires. Solder the wires into the antenna pads as shown below:



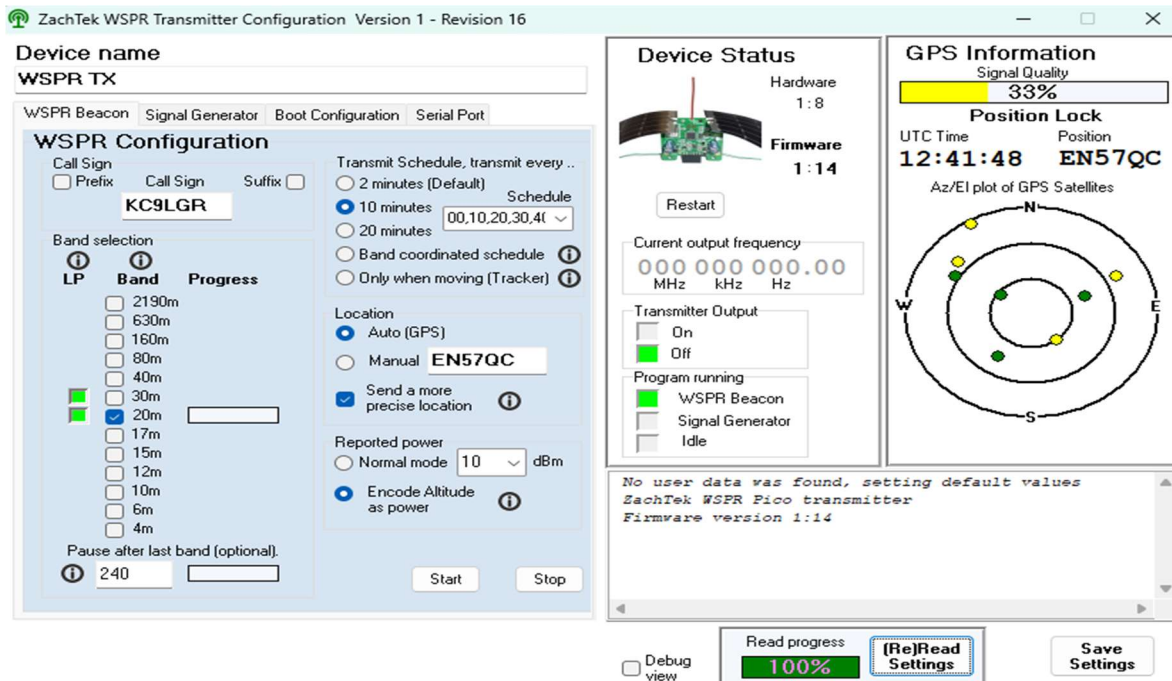
Part 6 – Configure the Tracker

Set the power jumper on the USB serial adapter to 5V and connect the USB serial adapter to the tracker as shown below. In a few seconds, the tracker's LED will start flashing.



Download the configuration software from <https://Zachtek.com/download>. Launch the Zachtek Configuration Software and select the serial port number of your USB serial adapter from the

“Serial Port” tab. Then go to the “WSPR Beacon” tab and click the “Read Settings” button. Enter your amateur call sign and click the “Save Settings” button twice.

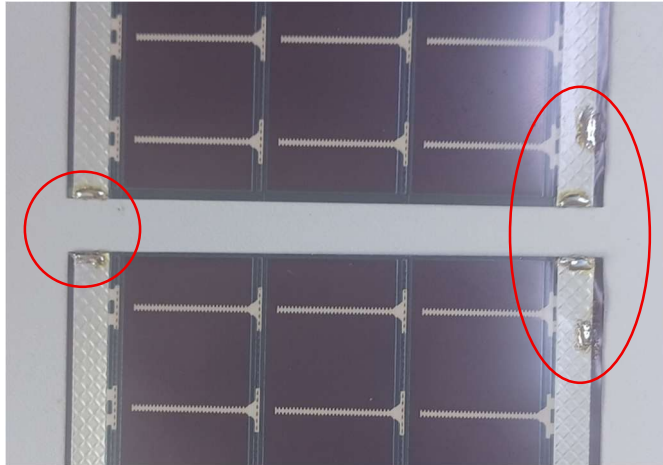


Part 7 – Install Solar Panels

The teepee solar panel configuration uses three square panels in a half-cube configuration for maximum solar coverage and to power the tracker at low sun angles.

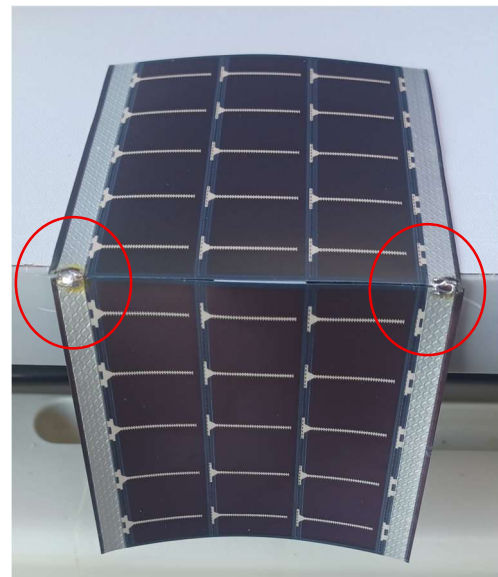
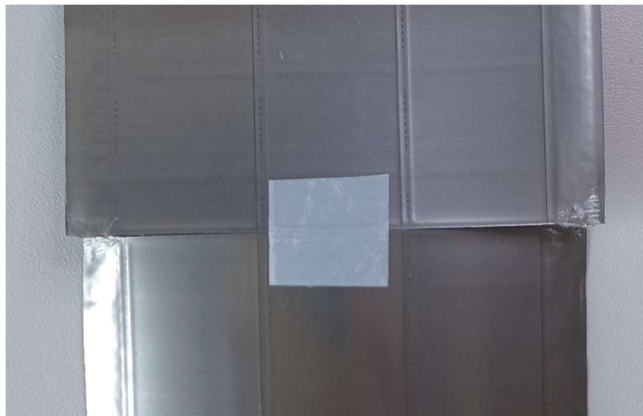
7.a Tin Solar Panels

Use solder to tin two of the solar panels at one end of the solder strips so they can be joined together. Do this by heating the end of the conductive strip with the soldering iron and solder to melt off the protective coating and tin the strip at the very end. Tin the two panels at opposite ends. The picture below shows the two panels oriented in the same direction with the ends of the solder strips tinned. The unseen ends of the panels are not tinned. Set the soldering iron to about 700°F. Be careful, prolonged heating can melt the solar panel.



7.b Solder the Panels Together

Lay the two tinned panels upside down on a flat surface with the tinned ends touching. Align the panels and tape them together with a ½ inch square piece of Tyvex tape. Flip the taped panels over and place them at the edge of your workbench with one panel hanging down at a right angle. Next, add solder to bridge the tinned sections of the panels at the corner and create the electrical connection.



7.c Prepare and Attach the Third Panel

The small triangles on the panels identify the polarity of the solder strips (electrodes) at the edges of the panels. The arrow inside the red circle in the picture below points away from the positive

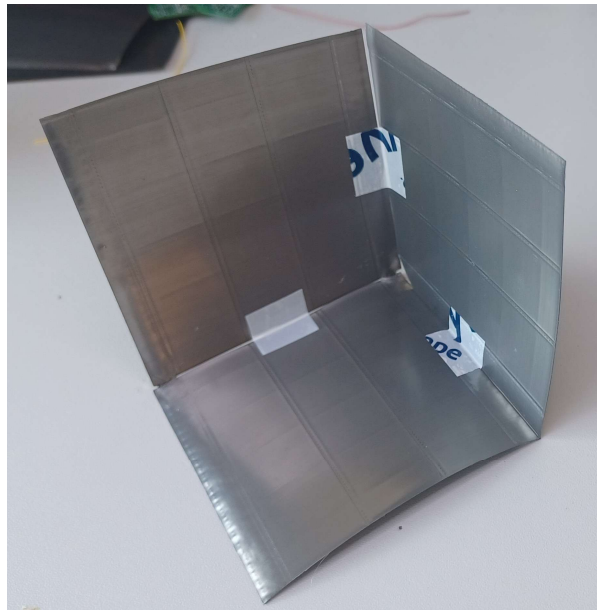
panel electrode. Start by cutting off one corner of the positive electrode on the third panel, as shown below. Do not cut into the central purple area of the panel.



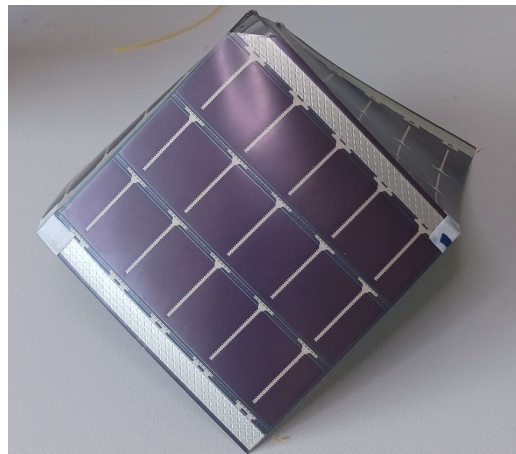
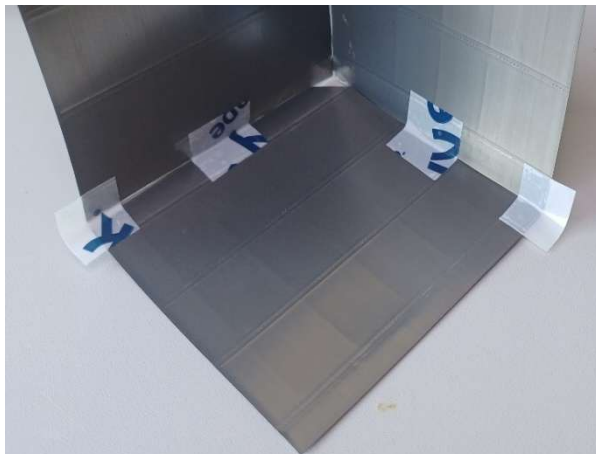
Attach this panel to the two soldered panels with the cut-off corner aligned with the positive junction on the soldered panels. Align and center the edge of the third panel with the edge of one of the joined panels and attach with a ½" square piece of Tyvex tape, as shown below.



Orient the newly taped panel vertically with the second soldered panel flat on the work surface, as shown below. Add another piece of Tyvex tape at the center edge of the panel and hold the adhesive side back as shown below. Rotate the newly taped third panel to form the half-cube, then allow the adhesive side of the tape to touch the very edge of the third panel and attach the remaining section of tape to the third panel to form the half-cube.

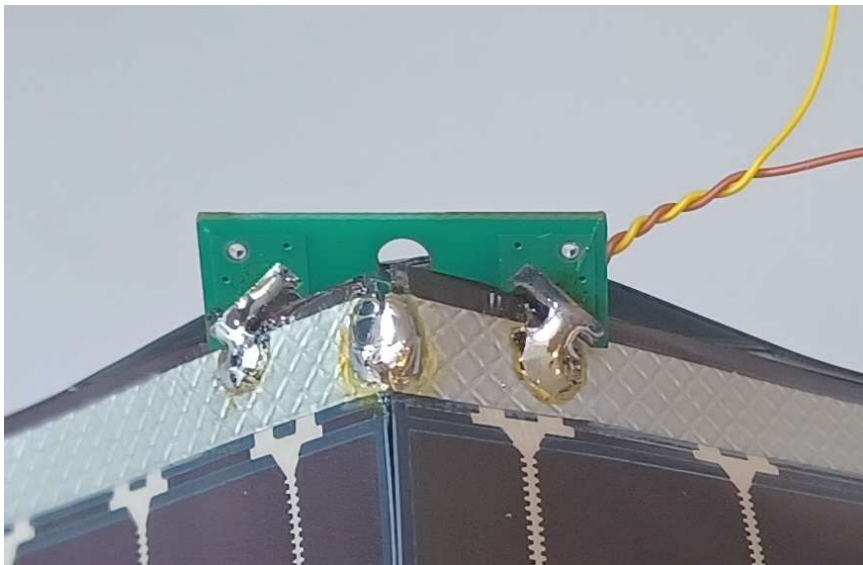
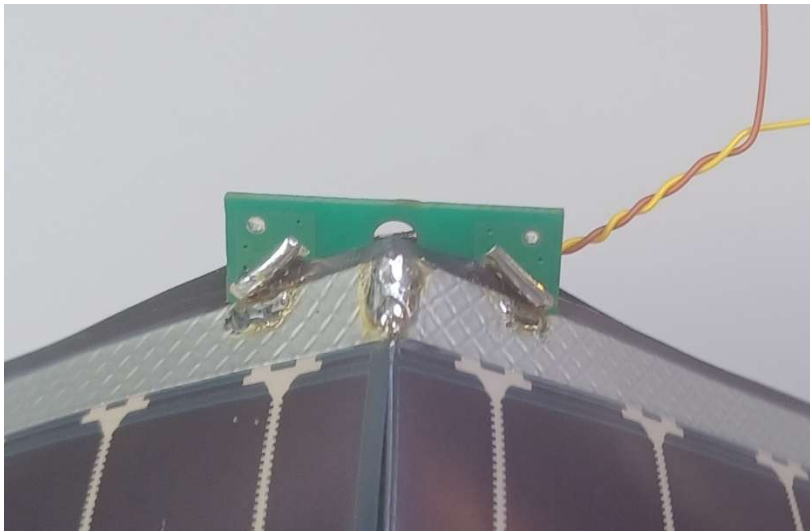


Cut two 3/8" square pieces of Tyvex tape to secure the outer corners of the cube. Lay the unsoldered corner flat on the table with the silver side up and place a piece of tape across the seam with half of the tape protruding beyond the edge of the panel, as shown below. Fold the protruding tape over to the front of the panel to completely secure the corner. Do the same for the second corner.

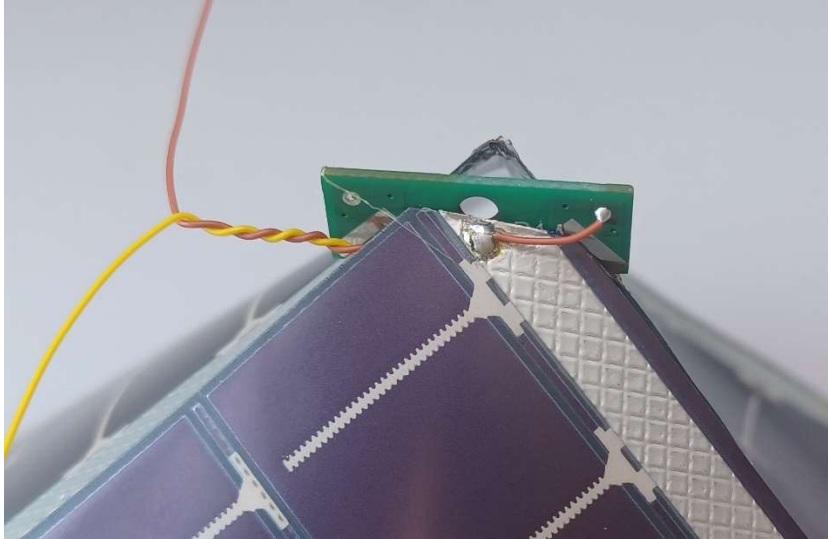


7.d Solder Tracker to the Solar Panels

Feed the GPS antenna and tracker through the open top corner of the solar panel teepee with the component side of the tracker facing the cut-off corner of the third solar panel. Slide the edges of the other two panels into the two slots at the top of the tracker. With the large hole in the tracker aligned with the apex of the panels, solder tin the panel electrodes where they meet the tracker solder pads and solder the tracker to the panel electrodes while keeping the tracker aligned with the center of the teepee.

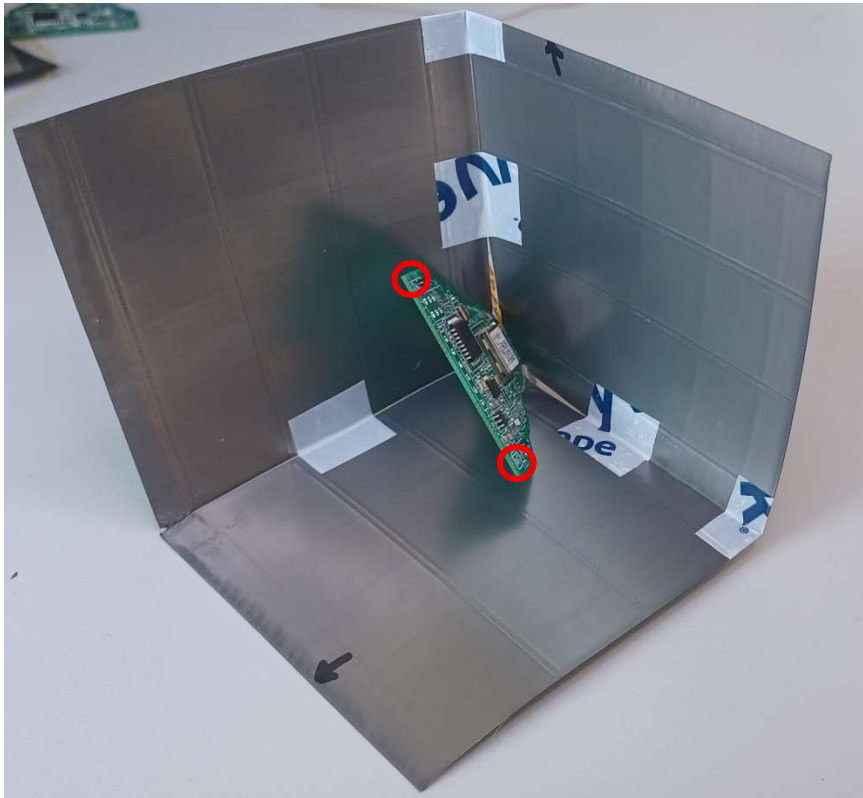


Next, connect the positive electrode of the third panel to the tracker with a short piece of wire-wrap wire as shown below:



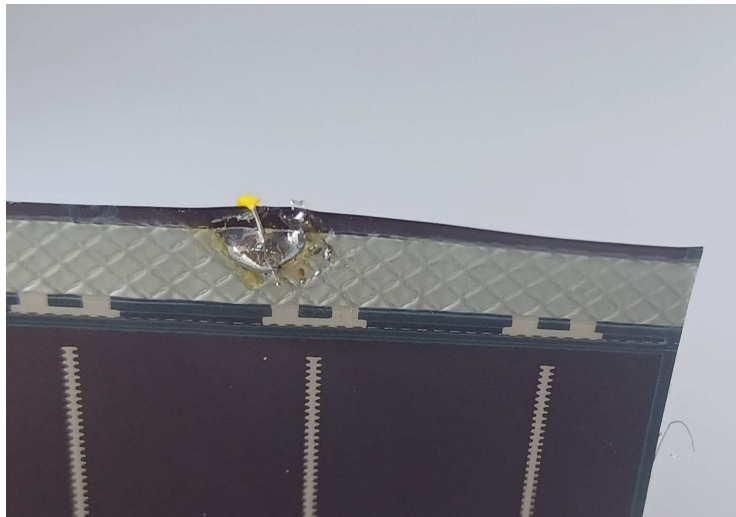
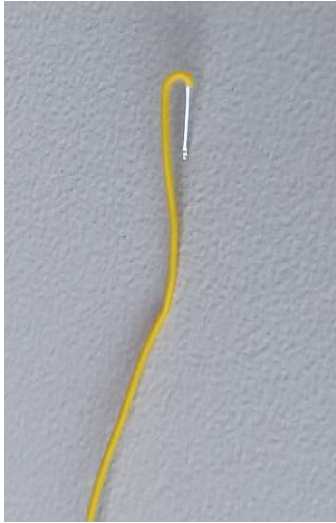
7.e Solder Ground Wires to the Solar Panels

Determine the ground wire attachment points by flipping the assembly upside down and locating the ground wire pads on the tracker, as shown below by the red circles. Wires should be attached to the closest negative solar panel electrode. One wire goes to the third panel, and the other must attach to one of the first two panels. The black arrows mark the closest points in the picture below:



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Cut two 2-inch lengths of wire-wrap wire and strip 1/16 inch of insulation from both ends. Bend one end over about 1/8 inch from the end to make a hook and solder it to the tined solar panel as shown below:



7.e Solder ground wires to the PCB

Solder the other end of the wire to the ground holes in the PCB as shown below:



Part 8 – Testing the Tracker

Place the tracker in direct sunlight with the sun at least 30 degrees above the horizon. After 30 seconds, the green LED should light and then start flashing about once a second. If the LED does not light in direct sunlight, check the orientation of your solar panels and verify your solder connections to the panels. If the LED stays on but does not flash, there is not enough solar power. After a few minutes, the LED should start double flashing every second. This indicates GPS lock and valid GPS data. If this does not happen, verify the GPS antenna solder connection.

Part 9 – HF Antenna Wires

9.a Making and Managing the Antenna Wires

Ground wire:

Find a clear area 17.5 feet long on a workbench or the floor and mark two points that are 17.5 feet apart. Using painter's tape, tape the end of the 36AWG magnet wire onto one mark on your work surface. Then unspool the wire to the other mark. Cut the magnet wire at the mark and tape the loose end to the side of an empty water bottle. Spool the cut wire onto the water bottle and tape the second end to the bottle. Identify this end with a mark on the tape.

Driven wire:

Repeat the procedure for the second wire, but do not cut the wire. Leave the spool lying at the second mark. Now, tape the loose end of the braided fishing line on top of the taped end of the magnet wire and unspool the fishing line on top of the magnet wire. Do not cut the fishing line yet.

Starting from the taped end of the two lines, hold the lines together between your thumb and index finger. Using a dab of contact cement between your other thumb and index finger, glue a 10-12 inch section of the two lines together by running the two lines through the glue between your fingers. Repeat this process about every 4 feet along the two lines. Make sure the magnet wire is slightly slack between glued sections so the fishing line will be holding the load. The last glued section should be at the 17.5-foot mark. Cut the magnet wire at the mark, but leave two feet of additional line when you cut the fishing line. Now, tape and wrap the loose ends onto the second water bottle. Tape the far end of the wires to the bottle and mark this end on the tape.

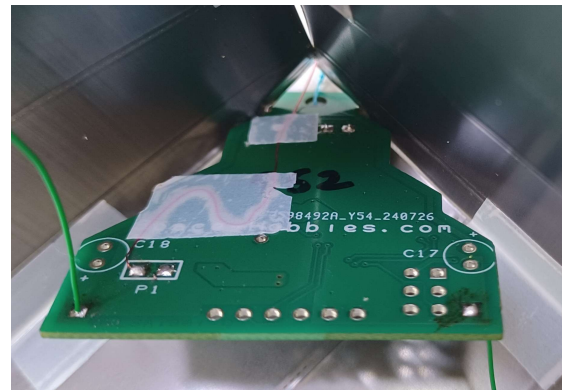
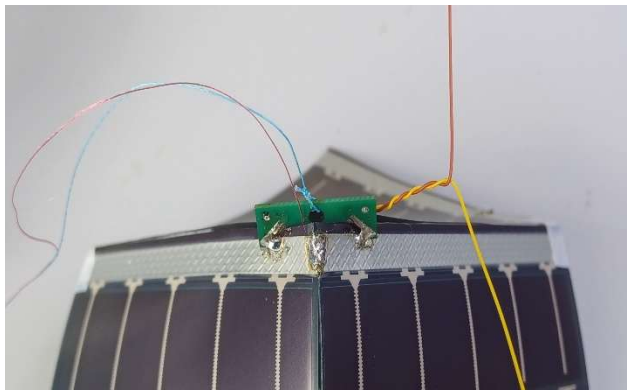
9.b Attaching Antenna Wires to the Tracker

Attaching the balloon wire:

Place the tracker and the two water bottles near your soldering iron. Remove the tape from the marked end of the fishing line-wire and unspool two or three feet of line. Then reapply the tape to

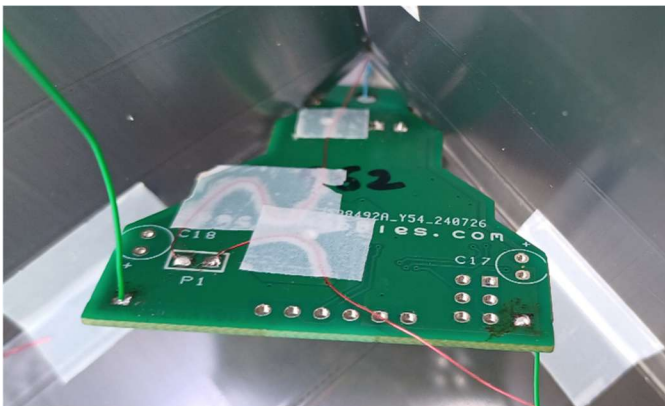
prevent any further unspooling. Separate the first 6 inches of fishing line from the antenna wire and tie the fishing line to the large hole at the top of the tracker. Try to get the tie point about 2-3 inches from where the two lines are still glued together. Cut the tag end of the fishing line and feed the loose antenna wire between the solar panels on the back side of the tracker PCB. Dangling the tracker from the fishing line, pull the antenna wire tight and cut it 0.5 inches below the bottom edge of the tracker PCB.

Using a soldering iron and solder, heat the end of the magnet wire until 1/8 inch of insulation is removed. Solder this wire into the outside antenna pad as shown below. Leaving some slack in the antenna wire connection to the fishing line, form the antenna wire into an “S” shape as shown and tape it down with two small pieces of Tyvek tape.



Attaching Antenna Ground Wire:

Remove the tape from the marked end of the single antenna wire and unspool two feet of wire. Then reapply the tape to prevent any further unspooling. Using a soldering iron and solder, heat the end of the magnet wire until 1/8 inch of insulation is removed. Solder this wire into the inside antenna pad as shown below. Tape the wire to the PCB with Tyvek tape as shown below. Place the completed tracker and antenna bottles into a box or tub for testing.



Part 10 – Testing the Transmitter

Place the tracker in direct sunlight or under a high-intensity LED sunlamp. After about 30 seconds, the tracker LED should start flashing once a second. After a few minutes, it will start double-flashing once a second to indicate GPS lock. Then every 10 minutes on the zero minute, the LED will flash continuously while transmitting. You should be able to hear the 20m FSK transmission tones at 14.0596MHz on any HF receiver and decode the WSPR packets using the WSJT-X Windows Application.