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Portable Seismograph Hut

Assembly instructions and system overview

The Seismology Research Centre division of ES&S has designed a portable seismic monitoring solution that acts as an equipment storage and carry case, which doubles as a semi-secure seismograph hut and solar panel mounting frame. This document describes the recommended method of operation based on the system design.

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Hardware

The case was designed to store all of the equipment required to quickly deploy a seismograph in the field without the need for addition tools. The standard kit comprises:

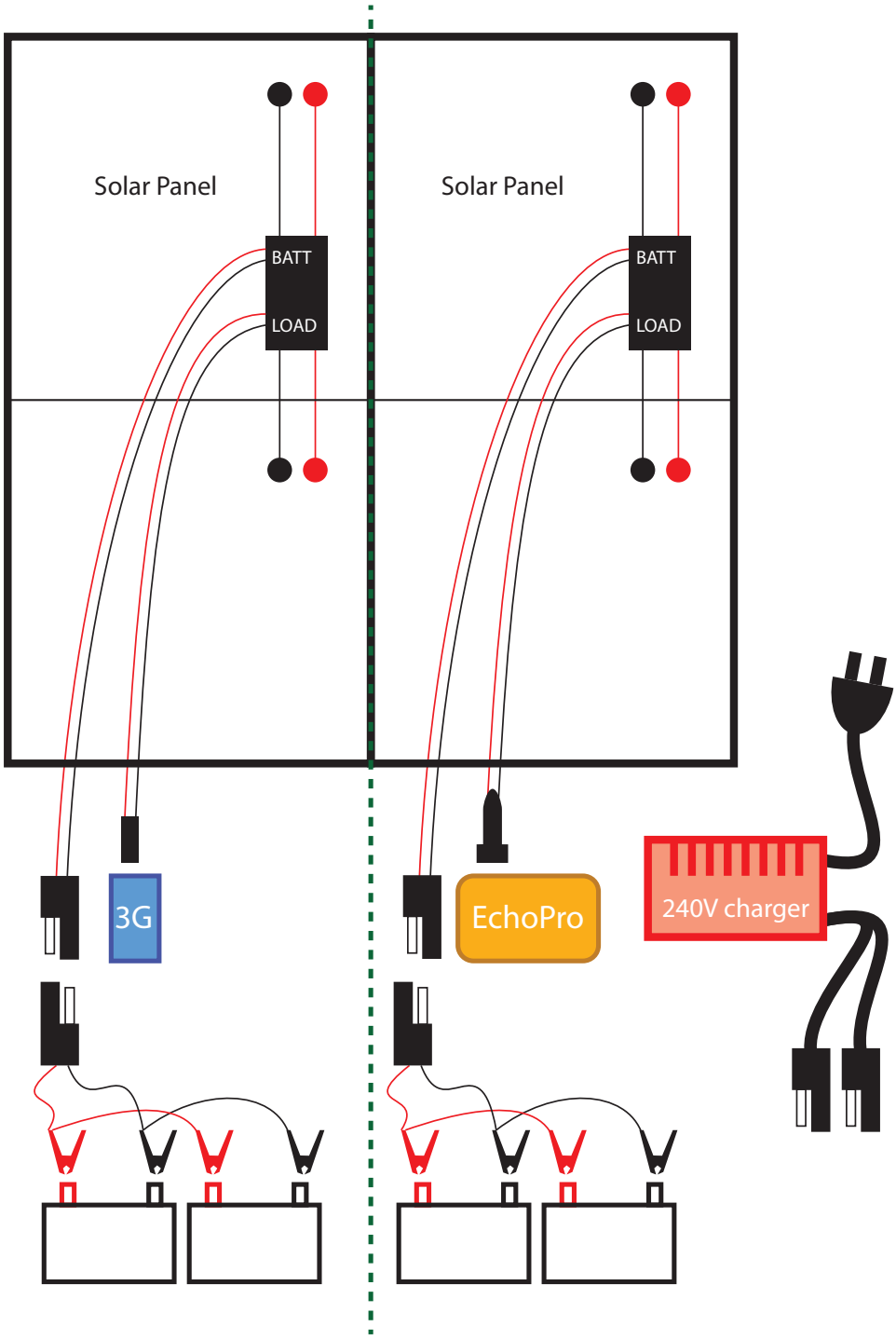
- 1x Kelunji EchoPro 6-channel seismic recorder
  - includes internal NiMH battery pack, 5m GPS aerial and 4GB memory
- 1x Guralp CMG-6TC seismometer with 5 metre cable
- 1x Guralp CMG-5TC accelerometer with 5 metre cable
- 2x 80W foldable solar panel with integrated charge regulator
- 1x 3G modem with high gain aerial and cable
- 2x battery cables (each cable clips to two batteries, charged by one solar panel)
- 1x set of solar panel framing parts

In addition to the items stored in the hut, ES&S will also normally supply the following:

- 4x 85Ah 12V DC VRLA batteries with connection cables
- 1x 10-cell NiMH battery charger
- 1x 8A 240V mains-powered VRLA battery charger

Power Systems – Storage & Deployment

To ensure that more than enough power is provided to operate the equipment indefinitely in the field, two VRLA batteries are supplied for the seismograph system, and two VRLA batteries are supplied for the communication system. While in storage, these sets of batteries should be connected to the mains-powered charger so that they are ready for deployment at a moment's notice. The chargers will automatically keep the batteries topped up, and although they are VRLA batteries, they should still be charged in a ventilated environment as a small amount of hydrogen is produced during charging.



Similarly, when the EchoPro recorders are in storage, their internal NiMH batteries should be connected to their chargers so that they are available for immediate operation upon deployment. In cases where taking the external VRLA batteries is impractical, the recorder can operate from the internal battery for between one and two days, giving the deployment team enough time to source external VRLA or flooded batteries that could be used with the solar panels in the longer term.

Although the NiMH charger has a DC input, it is not possible to charge the internal battery using external batteries and/or solar panels, as the input voltage is not sufficiently stable for reliable operation. The internal batteries are intended for use in emergency deployments only, when it is critical to start recording data as soon as possible after a main event. At all other times it is recommended that an external battery system is used.

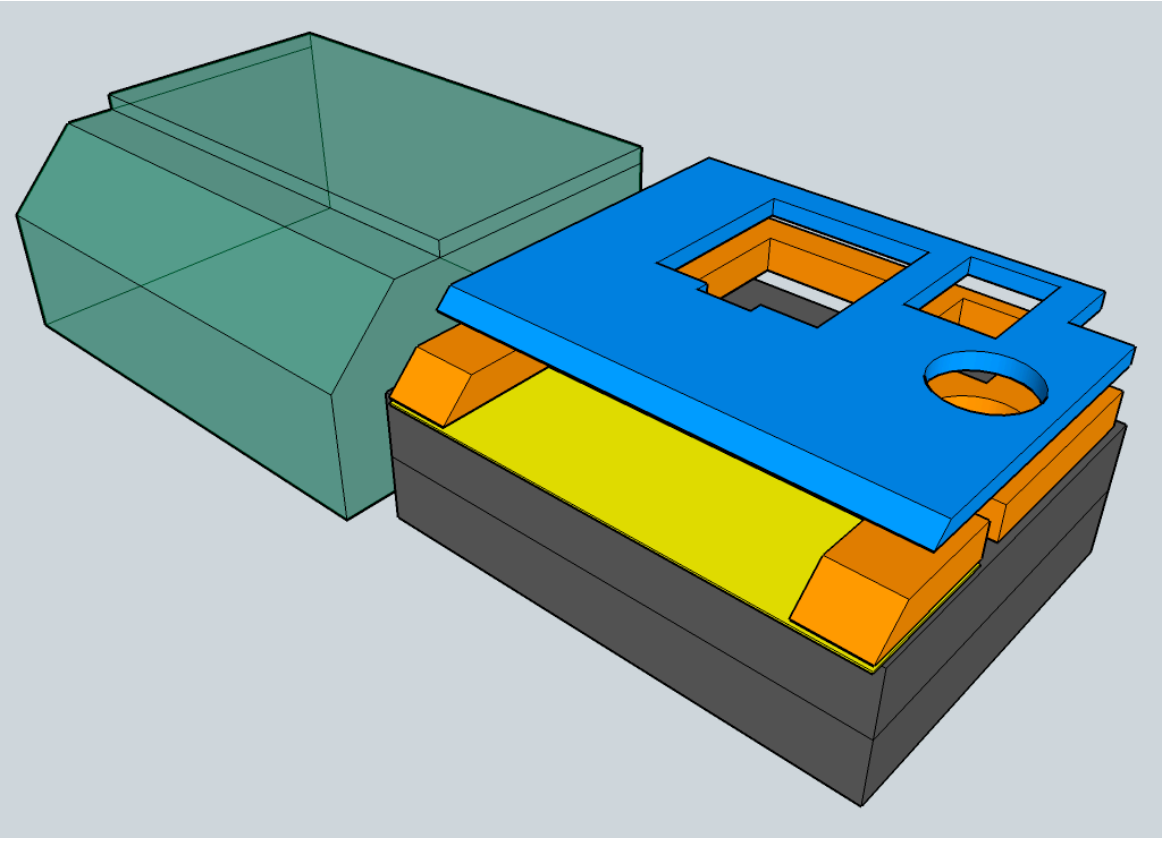
Warning! **Do not charge NiMH batteries with the VRLA charger, or vice versa**

Packing/Unpacking & Assembly of Seismograph Hut

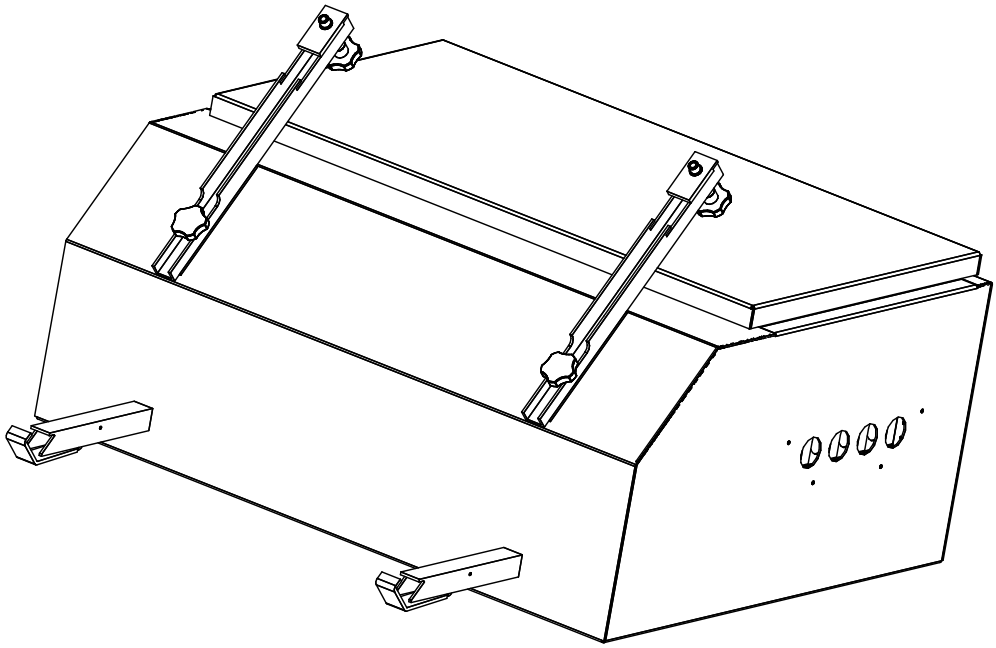
The seismograph huts have been designed to be used with one or two solar panels. Huts can be supplied with a single solar panel, which is then supplied with a foam insert to help brace the items packed in the hut. An expanded view of the packaging components is shown below. The order that the components are placed into the hut is discussed below.

The two foldable solar panels are zipped inside their individual bags and placed in the bottom on the case. The accessory tray is then placed on top of the panels and slid to the front (towards the handles) of the case. The thicker foam insert is then placed behind the tray, and then the thinner foam insert is placed atop the tray and lower insert, forming a lid for the tray and the small holes in the lower insert.

To unpack the case the items should be removed in the reverse order.



The seismograph hut is designed to be theft resistant by securing the solar panels to the frame from inside, and relying on the mass of the batteries inside the locked hut to discourage theft of the entire system. The components of the hut have been designed for assembly without tools, with minimum complexity, maximum strength, and moderate security in mind. Once the hut/carry-case has been emptied of all packing materials and equipment, assembly can begin.

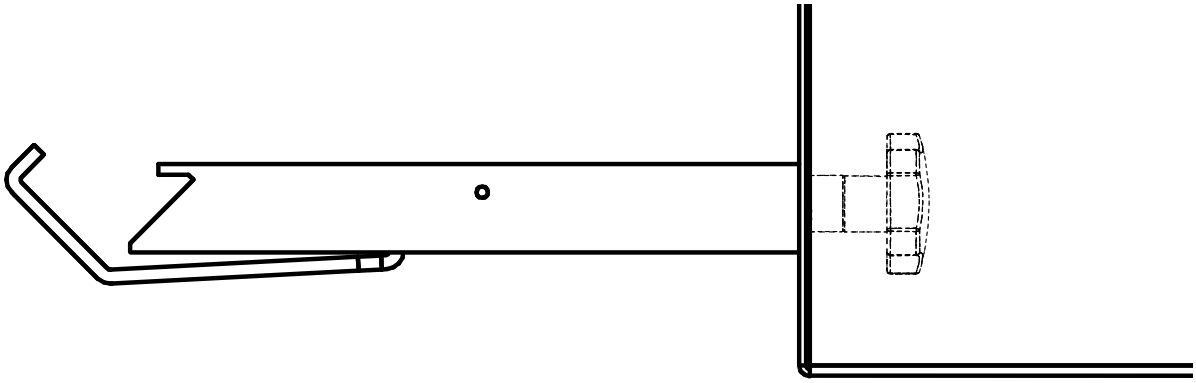


It is recommended that the hut be placed in its final position before beginning the solar panel frame is assembled. Due to the size and weight of the batteries, they should be installed while the lid can open to 90 degrees, as once the solar panel frame is installed the lid can only open to 45 degrees, making battery installation difficult.

Step 1: Fit the solar panel security struts

The part below is described as the "security strut" as it is the part that clamps the solar panels so that they cannot be removed without opening the locked hut and releasing them.

Insert the strut's threaded rod into the hole at the front of the hut, then spin on the knob from inside by just a few turns, leaving the clamp loose so that you can fit the solar panel later. Fit both security struts in the same way, whether using one or two solar panels.



Step 2: Unfold and brace the solar panel(s)

Unfold the solar panels and use the bracing channels to make the panel rigid. If you are using two solar panels, unfold them both and connect them together by locating the lugs on one side of one solar with the holes on the opposite side of the other solar panel. Place a bracing channel on the left and right sides of the panel(s). If you are using a double panel, also fit a bracing channel to the top and bottom of the panels across the panel gap.

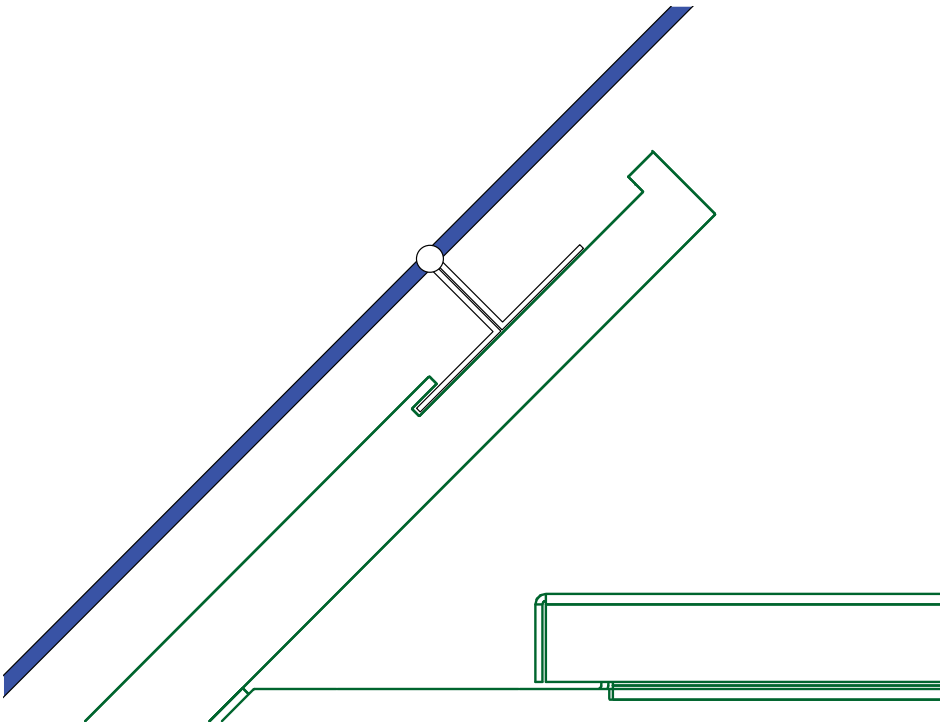
It is recommended that the batteries are placed inside the hut at this stage as the lid opening will be restricted after this point.

Step 3: Raise and secure the solar panel support arms

The arms that support the solar panel will be folded down into the angled recess of the hut. Loosen the knobs that are holding the arms, then rotate the arms up and locate them on the lug located above the pivot point, then tighten the knob down again.

Step 4: Hang the solar panel(s) on the support arms

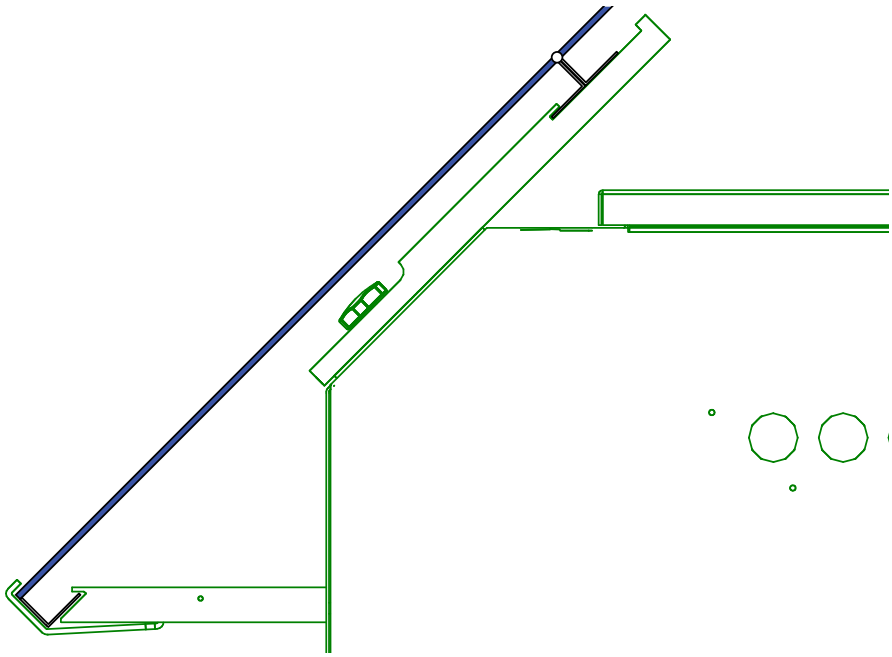
With the solar panel oriented so that the regulators (the black boxes on the back of the panels) are on the upper half on the panel(s), hook the top part of the lower panel frame into the slot on the support arm. This is shown at right, with the solar panel in cross-section.



Check that the panel assembly is centrally located between the arms so that the lower struts grab the panels evenly.

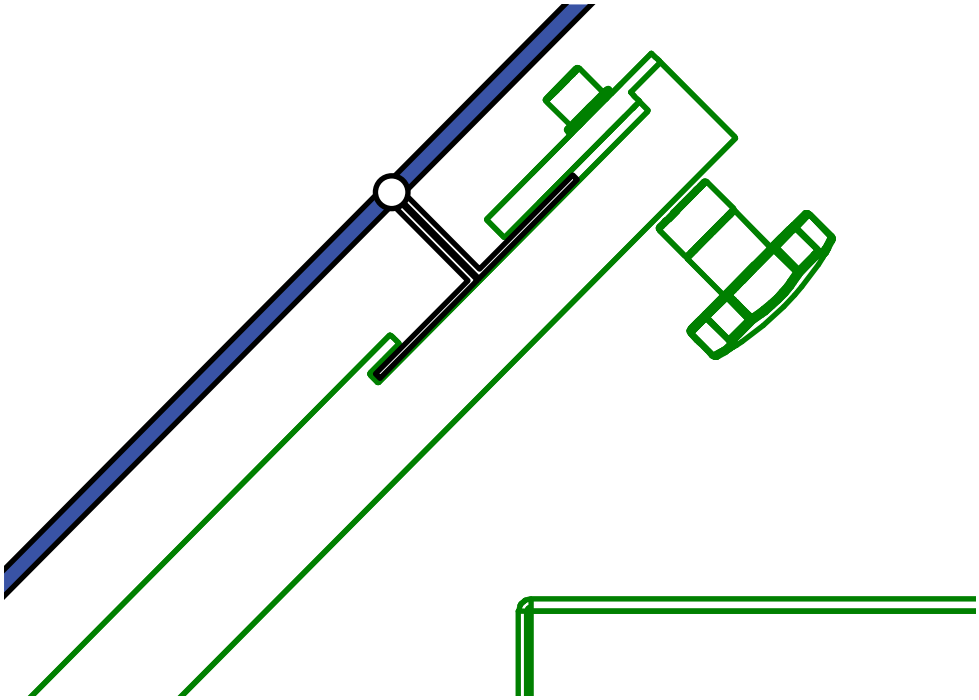
Step 5: Lock the solar panel(s) in place with the security struts

Once the solar panel is hung, the security clamps can be fitted and tightened. The panel should first be hooked under the lip of the strut (as shown in the diagram below). The clamp of the security strut is then placed over the bottom end of the panel. Once in place, tighten the internal knob to pull the clamp in against the panel. Once tight, the solar panel cannot be removed without opening the hut and loosening the knob to release the clamp.



Step 6: Clamp the solar panel(s) to the support arms

To reduce movement in the solar panel, the final step is to add a small clamp to each support arm.



Place the loosened clamp over the solar panel frame at the top of the support arm with the narrow step at the top, as shown at left.

Tighten the knob until the solar panel frame is being held rigidly in place. When the lid opens it will rest against these plastic knobs at about 45°.

Step 7: GPS and wireless modem aerial mount

The final step is to attach the GPS and wireless modem aerial mounting plate. Simply screw the mounting plate into one of the spare threaded nuts at the top of one of the panels.

The GPS aerial is magnetic and the mounting plate is made from a ferrous metal (as opposed to aluminium as used in all other components) so the aerial will stick to the plate.

The plate also has a mounting hole to suit the supplied high-gain 3G modem aerials.

Now that the seismograph hut is assembled, the components can be placed inside, connected together, and set for operation.

Wiring through the Cable Clamp

As shown earlier, there are two cables coming from each solar panel, which need to pass into the hut through the cable clamp. There is also the GPS aerial and a 3G modem aerial, both of which also need to pass through the cable clamp. Finally, the sensor cables need to pass through the cable clamp as the sensors will be buried up to 5m away from the hut. The holes in the cable clamp are large enough for the mil-spec cable plug that is connected to the recorder to pass through. There are four cable clamp holes, and we suggest using one for each sensor, one for the power cables, and one for the aerials.

From inside the hut, undo the clips on either side of the clamp frame and pull out the top half of the clamp along with the top half of the foam seal. Pass the cables into the hut from outside by manually squashing down the lower half of the foam, then replace the top half of the foam and frame, then clamp it down into place. Although this does not form a perfect seal it will provide a reasonably effective barrier against the entry of dust, moisture, insects, and small animals.

It is recommended that all cables should be looping up from below the entry point so that any moisture collecting on the cable cannot run down along the cable into the hut.