



Supplement 7. The Indiana Monitoring Station Design



Station Set Up

- Much of the station can be pre-built indoors, and then attached to the pole when ready.
- Key elements:
 - Polycarbonate box with knock-outs
 - Microphone
 - Solar panels and solar arm
 - Post
- Miscellaneous elements:
 - Post pounder
 - Stickers (for the box)
 - Permatex anti-seize lubricant (for coating stainless steel screws).
 - MC4 assembly tool (for disconnecting MC4 connectors).
 - Zip ties
 - USB power monitor (testing panel power delivery)

Equipment needed (to do):

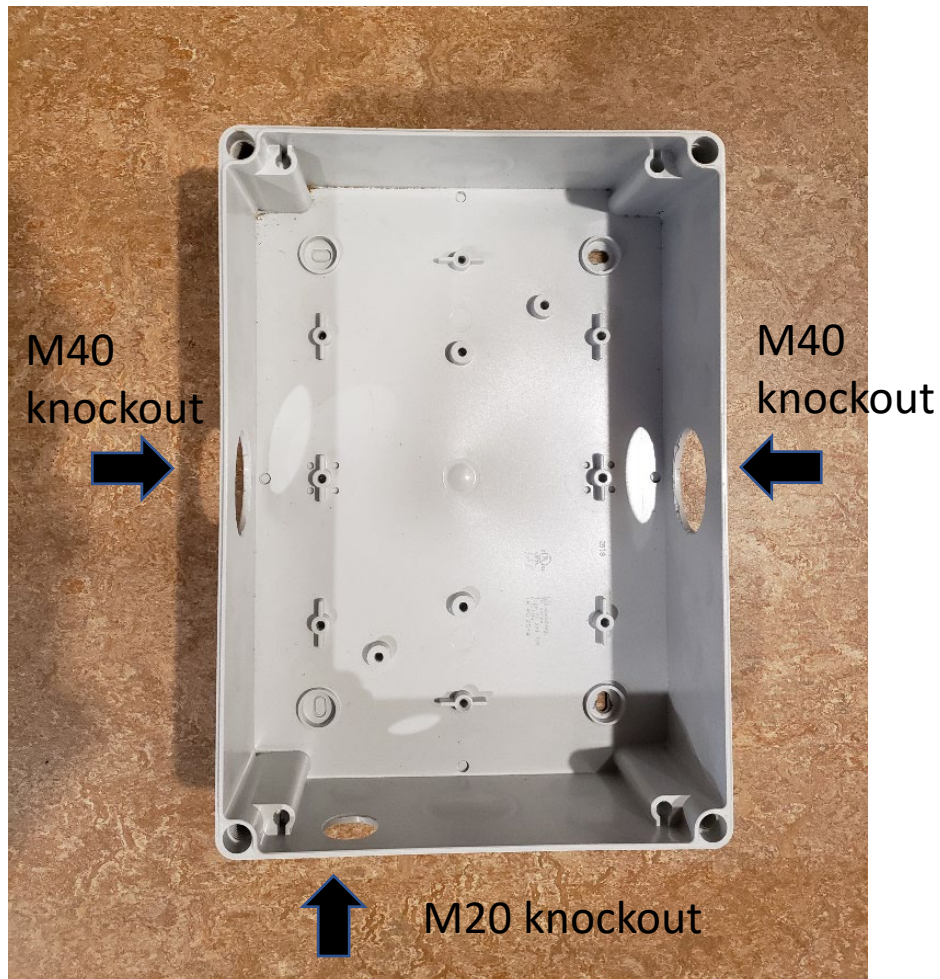
Item	Price per unit (\$ USD)	Product ID	Link
5V 1A Switching (Fixed) Regulator	15	DE-SW050	https://www.dimensionengineering.com/products/de-sw050
Short (6" A/MicroB) USB Cords (Phone to power cable)	1.85	N82E16812423068	https://www.sparkfun.com/products/13244
Long (3.00' /914.4mm) USB Cords (Power cable to solar conXall)	0.95		http://www.newegg.com/Product/Product.aspx?Item=N82E16812423068
ConXall Inline SKT (For connecting external mic on inside of box)	3.99		SC1203-ND http://www.digikey.com/product-search/en?vendor=0&keywords=SC1203-ND
ConXall PNL MNT PN (For connecting external mic on outside of box)	2.55		SC1206-ND http://www.digikey.com/product-search/en?vendor=0&keywords=SC1206-ND
ConXall PNL MNT SKT (For connecting power cable on outside of box)	3.24		SC1207-ND http://www.digikey.com/product-search/en?vendor=0&keywords=SC1207-ND
ConXall inline PN (for connecting power cable on inside of box)	3.46		SC1202-ND http://www.digikey.com/product-search/en?vendor=0&keywords=SC1202-ND
JLI microphones	1.9		http://www.jlielectronics.com/products/JLI%252d61A.html
Foam Windscreens (for microphones)	1.198		http://www.amazon.com/gp/product/B00B6KMDU8
1120 Pelican Case	21.95		https://www.pelican.com/us/en/product/cases/protector/1120
TRRS Audio Cable	1.85		https://www.sparkfun.com/products/11580
ALEKO 10W solar panel (mono) (14x11x1 in, 3.5 lb)	39.99		http://www.amazon.com/ALEKO%C2%AE-10W-10-Watt-Monocrystalline-Solar/dp/B007YT5XCA
Phones (Motorola Moto E 2nd Generation LTE XT1527)	100		
Equipment shared across phones, such as heat shrink tubing, wire, velcro, and zip ties	5		
Mounting mechanism (U-post)	30		
TOTAL PRICE PER UNIT (2015)	232.93		

Polycarbonate Box



- The directions here use a Polycase model SK-21 with a clear cover. This is a large box with metric sized knock-outs.
- Metric knockouts include 24 x M20, 4 x M25/32, 4 x M32/40.
- <https://www.polycase.com/sk-21>
- Other boxes can be used, depending on your monitoring needs.

Knock Out 3 holes



- Rotate the box vertically (if this is how you intend to attach it to the pole), and knock out three holes:
 - Two M40 holes (one on each side). These will feed in the solar panel cables.
 - One M20 hole (at the bottom of the box). This will feed in the microphone.

Microphone



- We used a YouMic Lavalier Lapel Microphone
- Higher quality microphones can certainly be explored.

Microphone Cord Grip

Plastic Submersible Cord Grip

Metric Threads, for 0.28"-0.51" Cord OD, M20 Knockout



Each

ADD TO ORDER

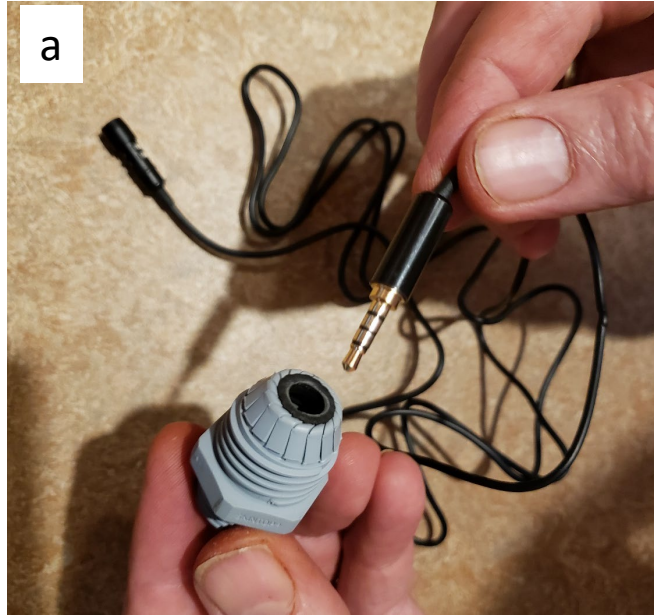
In stock
1-9 Each \$5.36
10 or more \$4.82
7310K33

Shape	Straight
For Cord OD	0.28"-0.51"
Mounting Location	Knockout
For Knockout Trade Size	M20
Knockout Connection Type	Threaded
Thread Size	M20
Thread Type	Metric
For Cord Shape	Round
Material	Gray Nylon Plastic
Cord Holding Type	Bushing
Bushing Material	Rubber

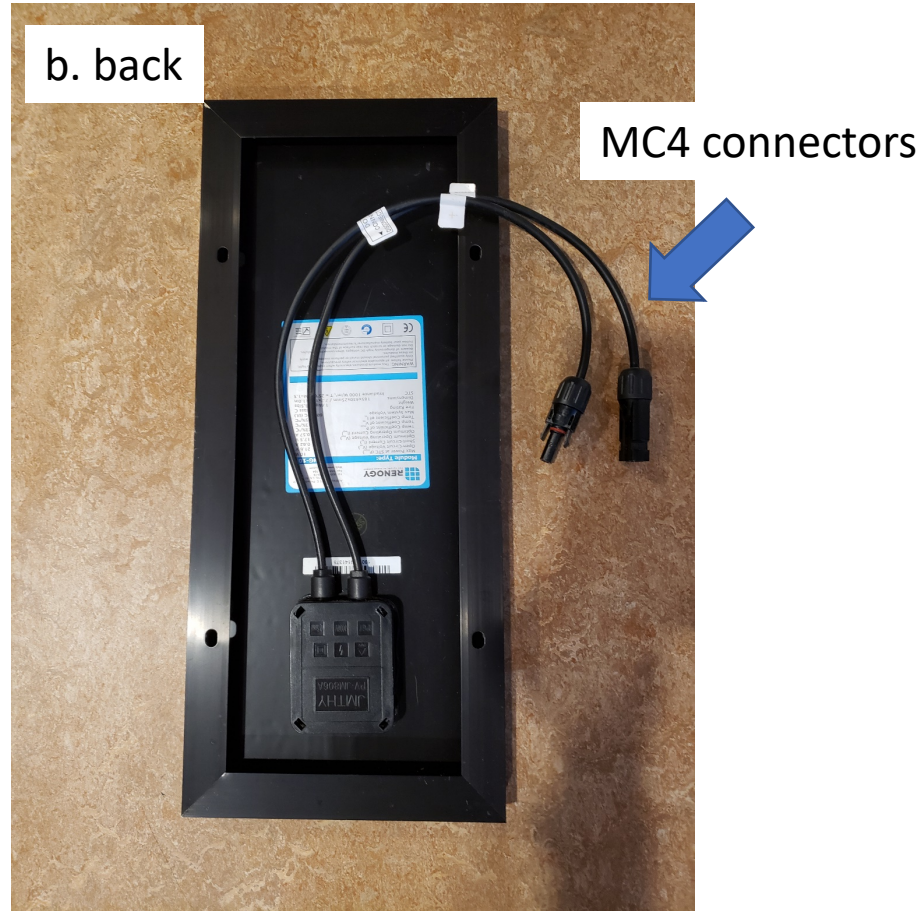
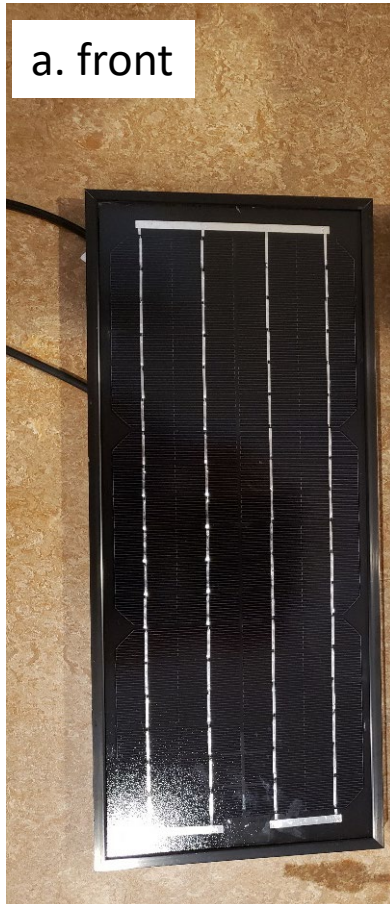
- The microphone is plugged directly to the phone, and threaded through the box by an M20 cord grip.
- We used a McMaster-Carr plastic submersible cord grip M20 (metric threads, 0.28" – 0.51" cord diameter).



Setting up the microphone



Solar Panels (1 or 2; directions are for 2)



- Renogy IOW 12V Mono Solar Panel
- Output Cables: 1.64ft
- Maximum Power: IOW
- Optimum Operating Voltage (V_{mp}): 17.50V
- Optimum Operating Current (I_{mp}): 0.57A
- Weight: 3.51bs
- Connectors: MC4 Connectors
- Maximum System Voltage: 600V DC (UL)
- Open-Circuit Voltage (V_{oc}): 21.6V
- Short-Circuit Current (I_{sc}): 0.62A
- Dimensions: 16.9 x 7.3 x 1.0 In

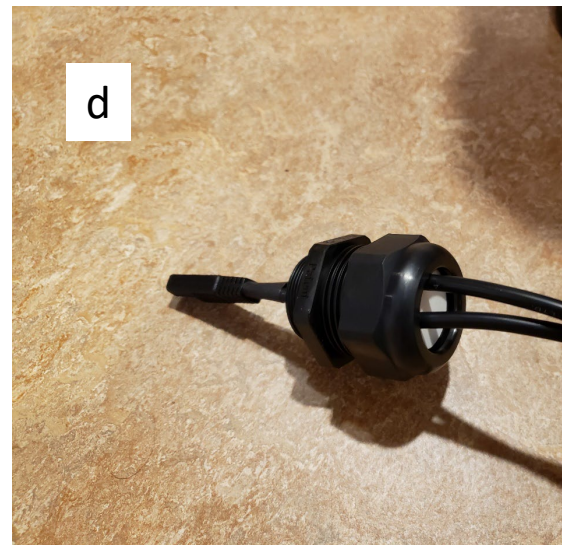
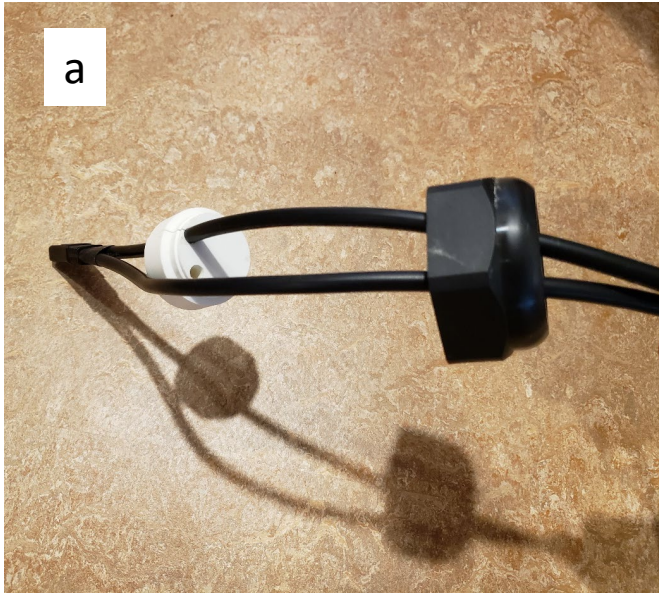
Ultimately, each panel will be connected to an SAE plug adapter; the SAE end will thread through the box, and the MC4 end will connect to the panel. For now, we will work with the connector cable, which should be long enough to comfortably reach from the panel to the box, with enough spare cable to allow for a drip.



The SAE plug adapter will feed into the box through a M40 cord grip with a cable gland.



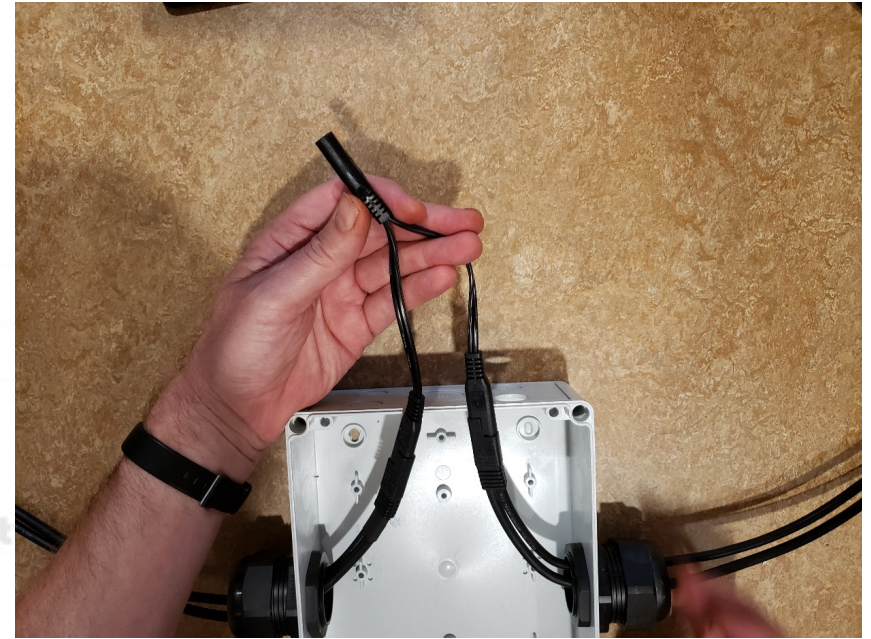
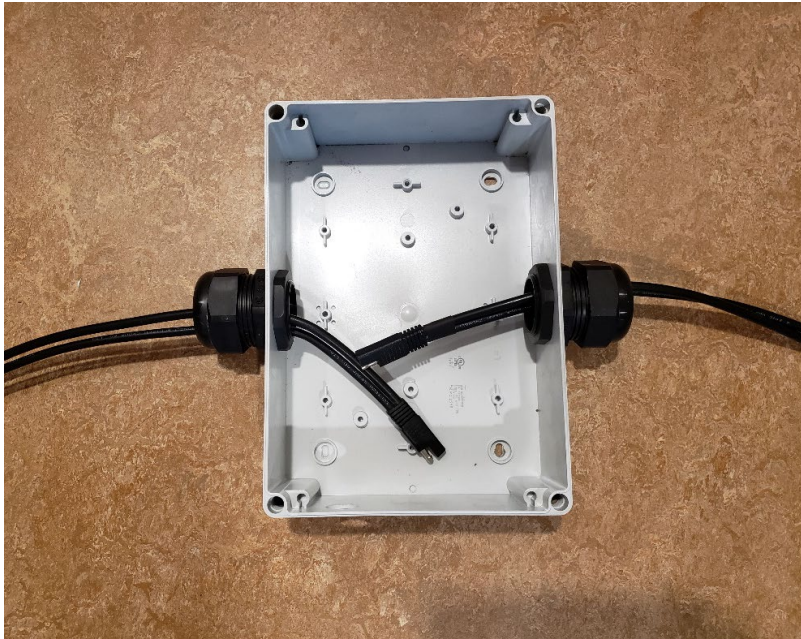
Fit the extender SAE cables to the gland.



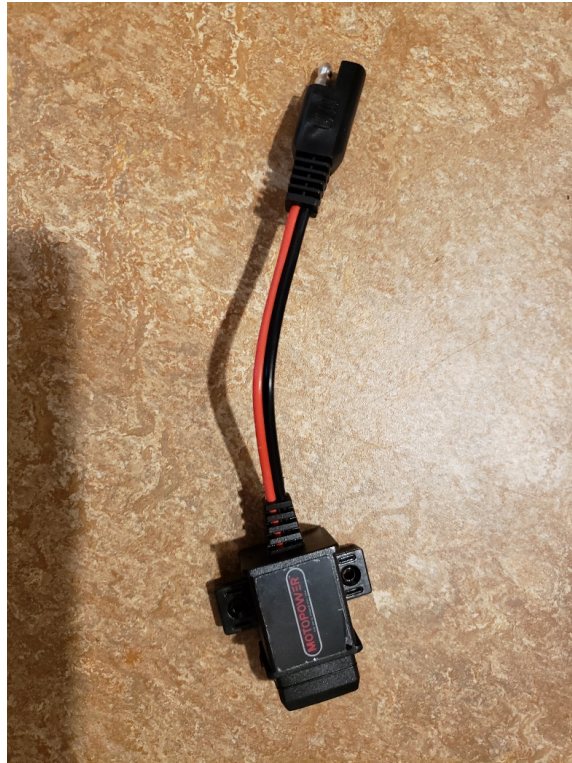
Thread the SAE end through the box, and tighten the cord grips. Repeat for second panel.



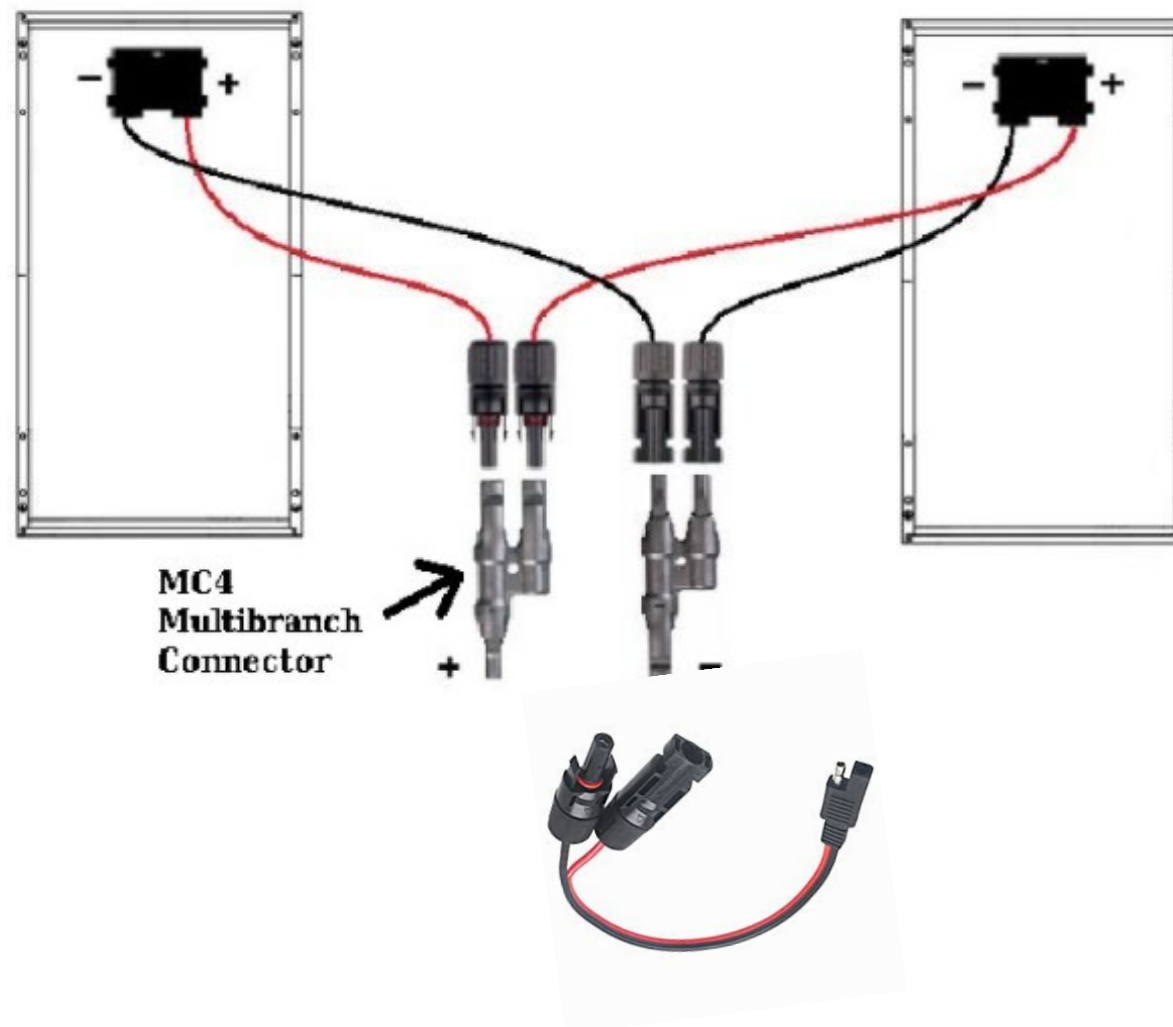
Connect a SAE Y-Cable to Dual SAE connector



Attach the SAE end to a stepdown USB converter.
Power from both panels run through this unit.



An alternative solar panel connection: Connect the two panels outside the box with a multibranch MC4 connector, and use a single SAE adapter cable to enter the box (one box hole only).



External Battery

- We used Voltaic Systems V44 Always On External Battery Pack with Dual USB Ports - 12,000mAh
- It is important to use a battery pack that does not automatically shut off, otherwise the phone battery will drain.



- a) Plug the battery into the stepdown USB port.
- b) Plug the smartphone into the battery.



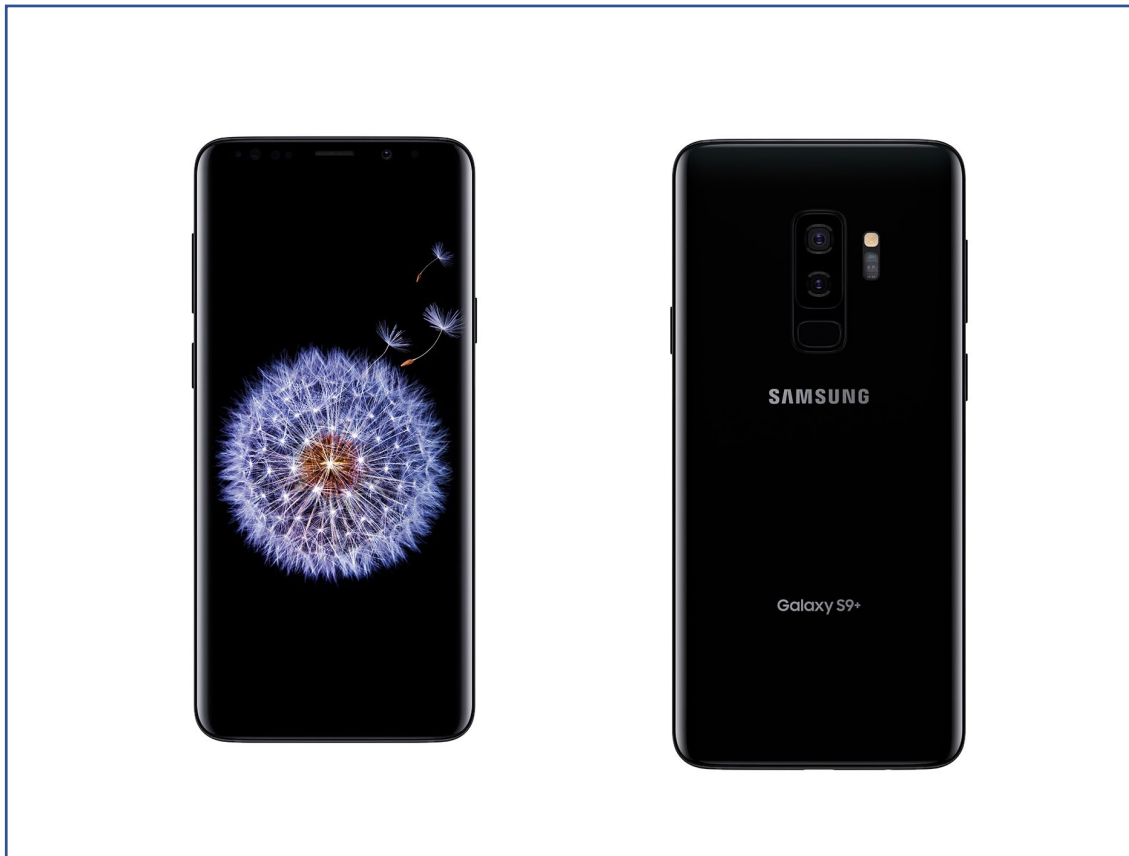
1. Solar power enters box via a SAE-MC4 cable.
2. The two cables are connected with Y-cable.
3. A SAE to USB stepdown is connected.
4. The external battery is plugged into the USB stepdown.
5. The smartphone is plugged into the external battery.
6. The microphone is plugged into the smartphone (not shown).
7. Items can be fastened to the box with zip-ties or Velcro.

The box connected to two solar panels.

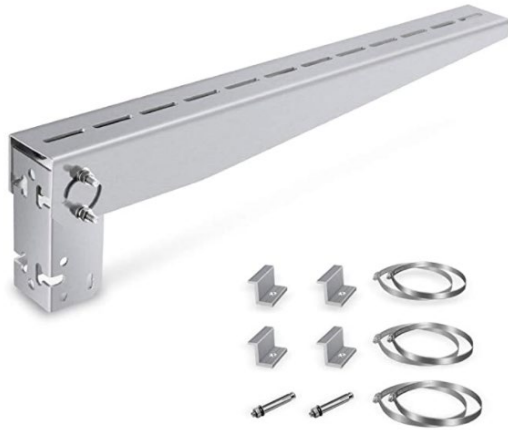




Attach the smartphone to the lid with wide Velcro, with the camera pointing outwards against the clear lid. We used Samsung Galaxy S9, though certainly cheaper phones would work.



Solar Panel Arm



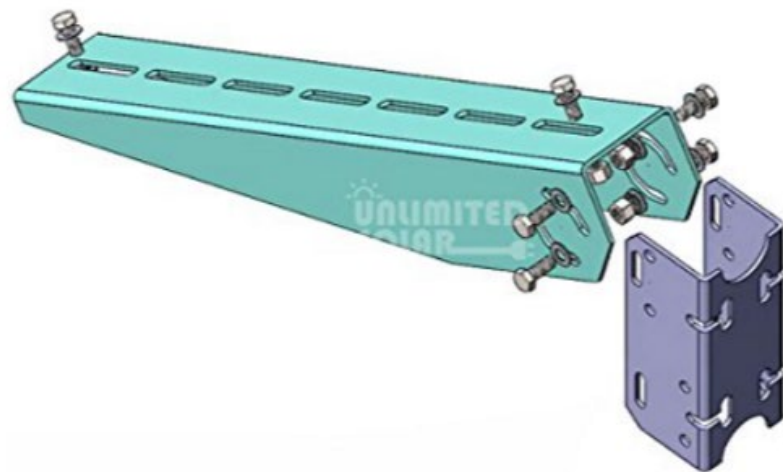
- This is a wall mount. It can be mounted to the pole with either U bolts or with pipe clamps. The direction of the bracket depends on which method is used:
- The left image below shows a U bolt fastener; the right shows hose clamps. Both come with the arms.

Deployment - Poles

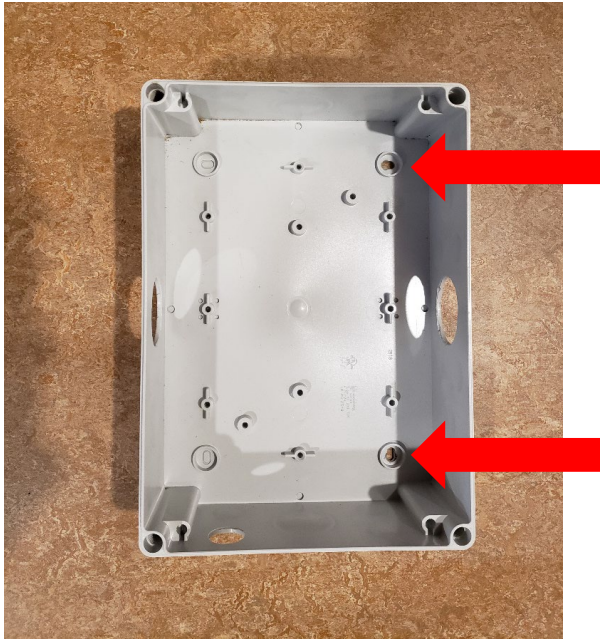


- Choose a pole. It could be as cheap as a 8' wooden fence post (~ \$7) or as expensive as a 8' Galvanized 1.75 inch Square Sign Post (~ \$40)

Mount the solar arm to the post.

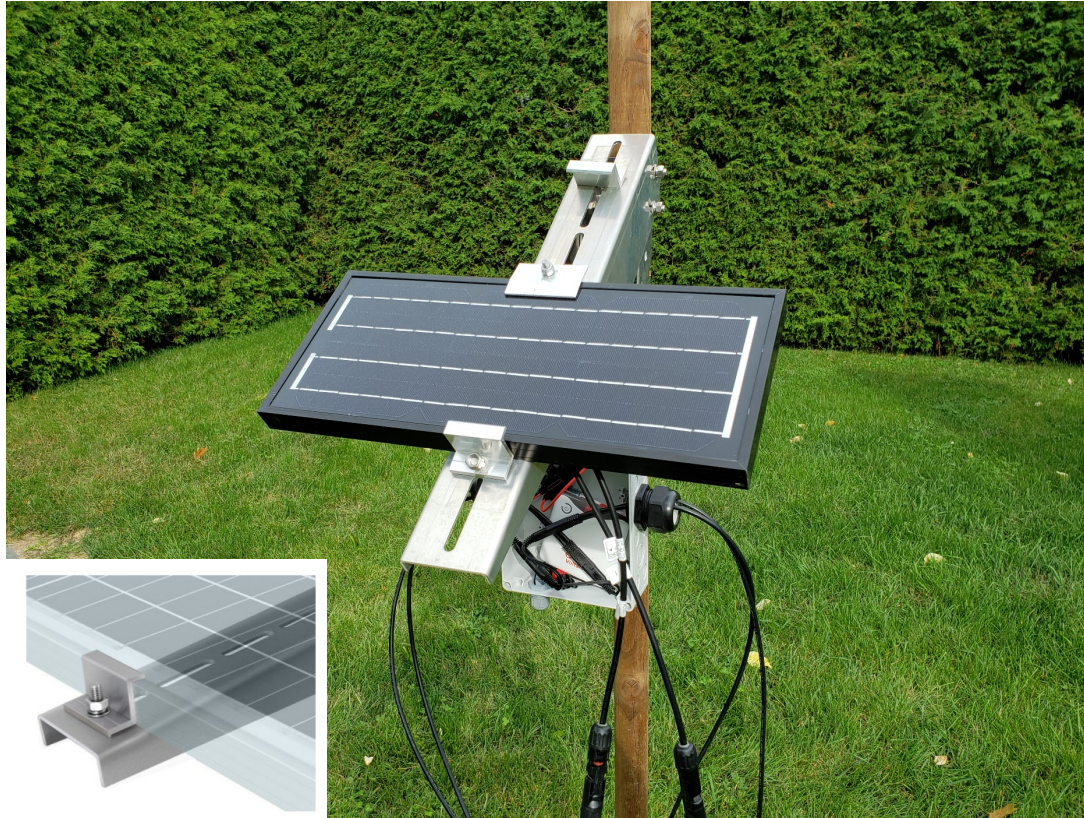


Attach the box to the post



- Wooden Post:
 - Punch out two holes in the box to fasten it to the post.
 - Drill bolts into the wooden post.
 - Add waterproof caulking to the external screw connection to seal the hole.

Mount the panels onto the solar arm.





- Orient the panels for maximum solar gain.
- For acoustic monitoring only, it may be wise to affix the box under the panels to keep the box from overheating (last slide).
- If camera monitoring, ensure the panel arm does not interfere with the camera view.

Stickers

- We affixed white stickers to the top of the box (interior side) to hide the box components and provide information about the box itself.
- We then used an exacto knife to cut and remove a small square section (to the right of the flag).
- We then secured a wide piece of Velcro to the interior of the box lid, oriented such that the camera lens peeked through the square.



Secure the wires with zip ties

- The station was tidied by clamping the solar cables to the post with zip ties.
- This reduced any sound may be clanging wires (undesirable noise for recording purposes).
- Box overheating was an issue on hot days with no cloud cover. A temporary solution was to place a plastic flower pot lid over the top of the box.

