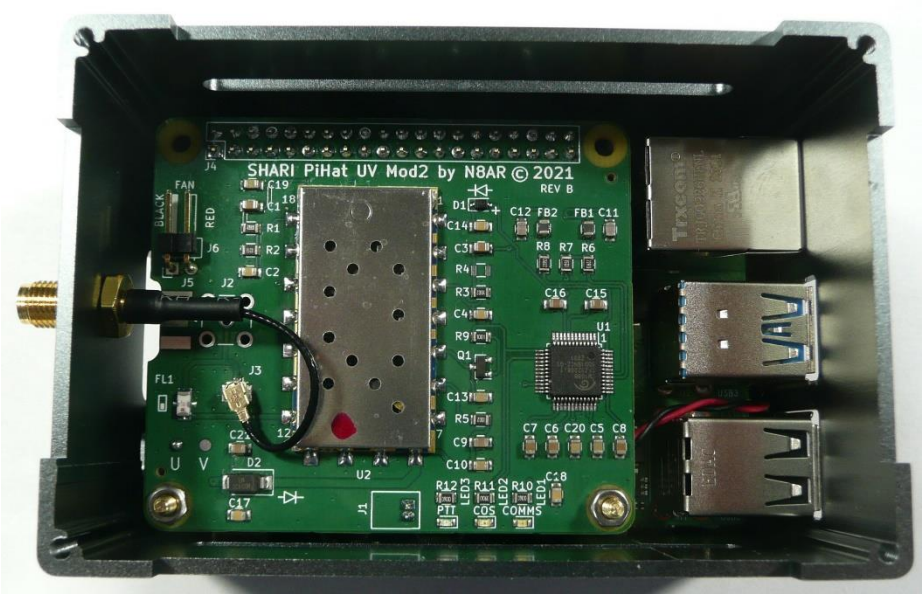
SHARI PiHat Allstar Node Construction Manual (52Pi/Pi4B Case)

SHARI (**S**A818 **H**am **A**llstar **R**adio **I**nterface) PiHat Allstar Node (52Pi/Pi4B Case) is a kit construction project that implements a Pi4 hosted Allstar node using a NiceRF SA818 embedded UHF (420 – 450 MHz) or a VHF (144-148 MHz) radio module. The radio module and interface circuits are located on a custom Raspberry Pi Hat board. A complete Allstar node can be created with a SHARI PiHat 52Pi/Pi4B Case kit, a Raspberry Pi4B (with power supply and microSD card) and an Allstar image.

The SHARI PiHat Mod2 PCB used in this kit is implemented with surface mount parts, a NiceRF radio module with castellated holes for soldering to the PC board and through-hole connectors. The board is supplied with all the small surface mount parts installed. To complete the PC board assembly, the kit builder installs three through-hole connectors and the SA818 radio module.

This kit uses the 52Pi/Pi4B tall case which allows a fan to be installed inside the unit. The top cover is made from Lexan with a slight “smoked” tint which permits the COMM (blinking green), COS (yellow) and PTT (red) LEDs to be viewed through the cover.

Unlike our other SHARI products that use an SMA connector soldered to the PC board, a coax cable with an SMA connector on one end and a U.FL (IPEX) male connector on the other is used to route the RF signal to the antenna. This simplifies construction and permits the antenna location to be easily changed by the builder.



Disclaimer:

This device interfaces with equipment that could be damaged by said device. You are responsible for installing, configuring, testing and verifying that the device performs properly in your environment. The developers cannot be held liable for any direct, indirect, consequential or incidental damage to other pieces of software, equipment, goods or persons arising from the use of this device.

Since you are assembling a kit for use in the amateur radio service, you are responsible for proper operation of the assembled unit including RF power output, proper modulation, output frequency and harmonic/spurious output levels.

By constructing this device you accept the above terms.

Release Notes:

RELEASE	DATE	CHANGES
1.00	2024-03-22	Initial release
1.01	2024-08-27	Revised to specify 52Pi/Pi4B case. Typing and spelling errors corrected

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SHARI PiHat (52Pi/Pi4B Case) Allstar Node Overview

Key Features

- 52Pi/Pi4B tall case with internal fan and Pi4B aluminum heatsinks.
- Uses CMedia CM108B USB Audio IC.
- Uses a NiceRF SA818 UHF (420-450 MHZ) or VHF (144-148MHz) embedded radio module (www.nicerf.com) with a lowpass output filter to meet FCC Part 97 requirements
- 300 to 600 milliwatts RF output power
- RX/TX serial connection from the Pi4B GPIO to the SA818 radio module to change RF module parameters including RF and CTCSS/CDCSS frequencies.
- Clamp-on ferrite is provided to mitigate buzz interference from high RF fields near the Pi power supply.
- Numerous EMI control techniques including ferrites, bypass capacitors and a multilayer PC board
- Internal coax cable routes RF from U.FL (IPEX) connector to SMA antenna connector
- Raspberry Pi4B, power supply and microSD card provided by kit builder.

Setting Expectations

- **Degree of soldering difficulty – Medium**
    - Assembly of the SHARI PiHat (52Pi/Pi4B case) kit requires standard through-hole soldering of three through-hole connectors (40 pin Pi GPIO, 2 pin right angle JST and 2 conductor pin header for the fan). The SA818 embedded radio module is surface mounted using castellated holes soldered to very large solder pads on the PCB. (we will install the SA818 module for you for a $5 increase in price). The board has footprints for vertical and edge mount SMA connectors, but they are not used. The U.FL connector which is used is already installed on the board.
    - The builder also must solder two small wires to test point pads on the Raspberry Pi4B.

- **Degree of mechanical difficulty – Easy**
    - There is one ¼ inch hole to drill in the case for the antenna SMA connector. A 3D printed hole location tool is provided with the kit.
    - The case screws together using a small Phillips screwdriver and provided Allen wrench.

Required Materials

The SHARI PiHat (52Pi/Pi4B case) kit

The above photo shows the parts in the SHARI PiHat (52Pi/Pi4B case) kit.

- 52Pi/Pi4B tall case with fan and heatsinks
- SHARI PiHat (U or V) label
- SHARI PiHat UV Mod 2 PCB with installed SMD components
- SA818S (U or V) radio module
- USB jack plug (prevents plugging a connector into the USB port used by SHARI)
- UHF (or VHF) right angle antenna
- U.FL to SMA connector cable with washer and nut
- Two 11 mm brass spacers with nuts
- Dual row, 40 pin female GPIO connector
- 2 position JST right angle female jack
- 2 conductor cable with JST male plug
- Two ferrite cores
- 3D Printed hole location tool

The 52Pi/Pi4B case parts

Kit Builder Supplied Parts

- Raspberry Pi4B (1, 2 or 4 GB ram)
- Appropriate Raspberry Pi4B Power Supply
- MicroSD card (16 GB recommended, 4 GB minimum)

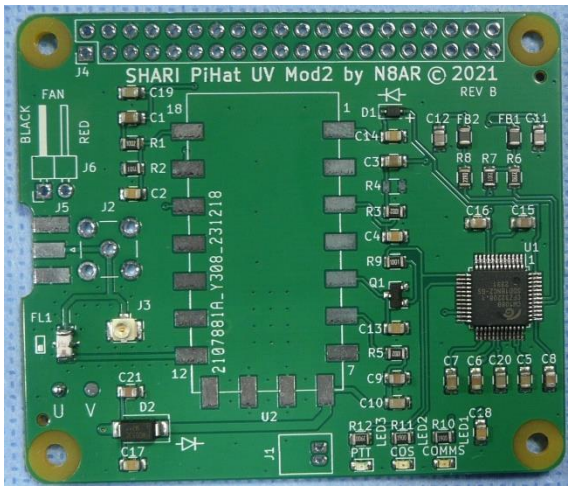
Tools

- Low wattage (50 watt) temperature-controlled soldering station with small tip and solder.
- Phillips screwdriver (#1)
- Center punch and drill set
- Small side cutters
- Small hot glue gun (recommended)

SHARI PiHat (52Pi/Pi4B case) Kit Construction Overview

This construction procedure uses pictures and written instructions to guide you through the process of constructing a SHARI PiHat node in a 52Pi/Pi4B case with a right angle antenna and a coax cable routing the RF signal from the U.FL connector to the SMA connector mounted to the wall of the case.

The SHARI PiHat Mod2 PC board is used in this model.



Step 1. SHARI PiHat Mod2 PCB/ RPi 4B Assembly

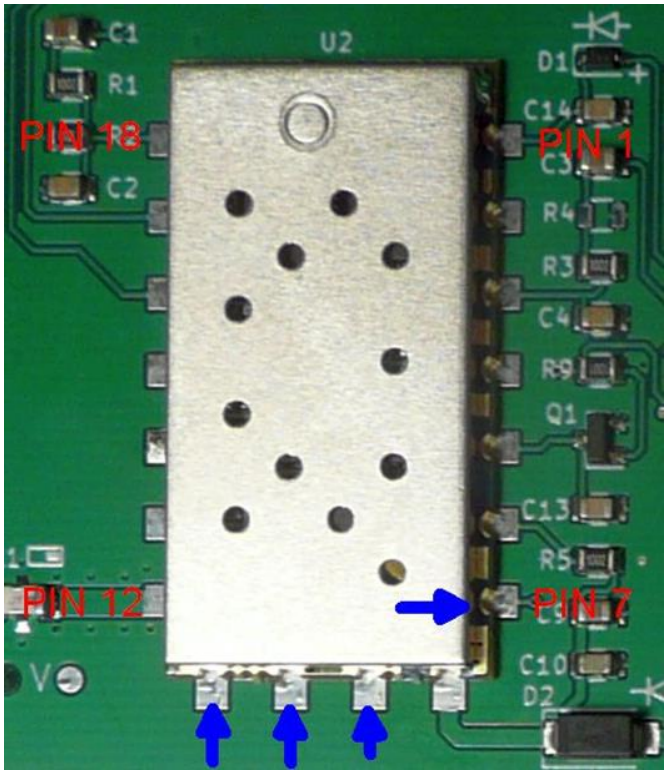
In this step you will fabricate the SHARI PiHat Mod2 PCB and integrate it with the Raspberry Pi4B. You will install the SA818S radio module, the 2 position right angle JST connector, the 40 pin GPIO connector and the 2 position RA male pin header for the fan. You will attach the Mod2 board to the Pi and install an interconnecting cable to route the USB signal from the Pi to the CM108B on the Mod2 board

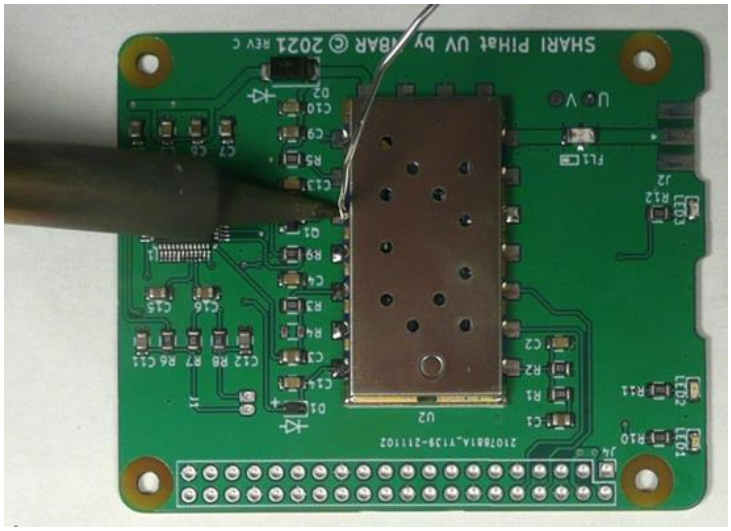
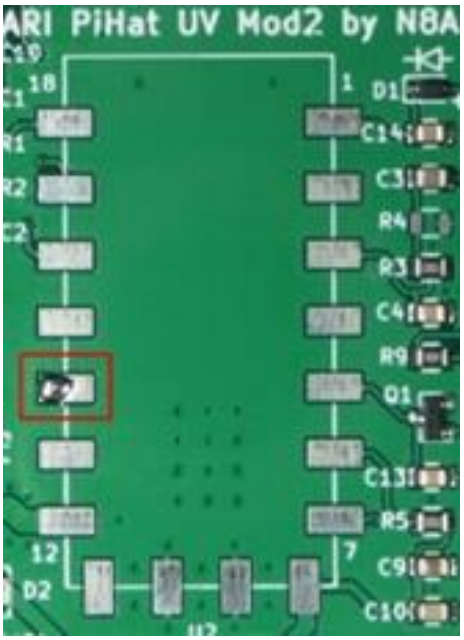
In this task, you will solder the SA818 radio module to the PC board in the U2 position. You will solder 18 castellated holes on the module edges to the pads on the PCB. If you have never soldered castellated holes before, please go to https://learn.sparkfun.com/tutorials/how-to-solder-castellated-mounting-holes/all for an excellent tutorial on how to solder castellated mounting holes as used on the RF module you are about to install. There are some things to be aware of before you begin soldering.

- The SA818 radio module pin numbering is shown in the photo. The pin numbers increase clockwise from Pin 1. Note that Pins 7, 9, 10 and 11 (blue arrows) are connected to ground of the PCB and to the SA818 module shield.

- Pins 8, 9, and 10 require more time to heat as you are soldering to pads connected to a large trace (pin 8) or the board ground plane (pins 9 and 10). Make sure that the solder contacts the wall of the castellated hole on all your solder joints. In the picture to the right, note how the solder attaches to and flows up the wall of the castellated hole on the two outside solder joints but fails to attach to the wall in the two middle solder joints.

- The module shield is notched above each castellated hole except pins 9, 10 and 11 to minimize the possibility of a solder short to the shield from the castellated hole. Ensure that your soldering does not create a short of any castellated hole to the shield except for pins 7, 9, 10 and 11. Check with an ohmmeter if in doubt.



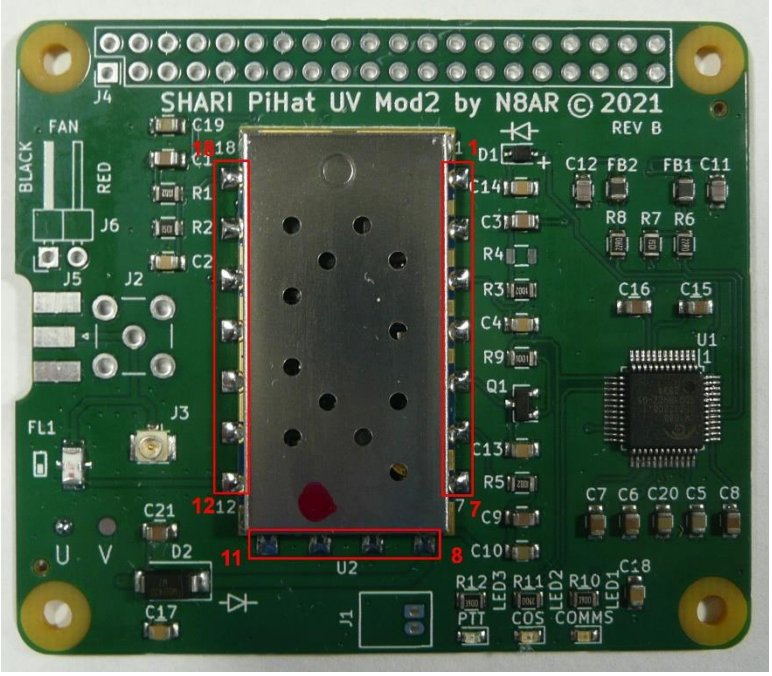
Soldering Hint for castellated holes Clean your soldering iron tip. Hold the solder vertically with the end against the pad on the PC board and the solder touching the wall of the castellated hole. Then, with the soldering iron tip touching the pad and at about a 30 degree angle to the PC board, push the tip into the solder. As soon as the solder melts pull it away and continue to push the molten solder towards the wall of the castellated hole. As soon as the solder flows up the side of the castellated hole, remove the soldering iron tip.	
Flow a small amount of solder onto pad 14 outlined in red on the SHARI PiHat Mod2 PCB.	

Use the following procedure to solder the module. **Observe that there are castellated holes on only one end of the SA818 module. Be sure to orient the module so the castellated holes on the module align with all the PC pads on the board.**

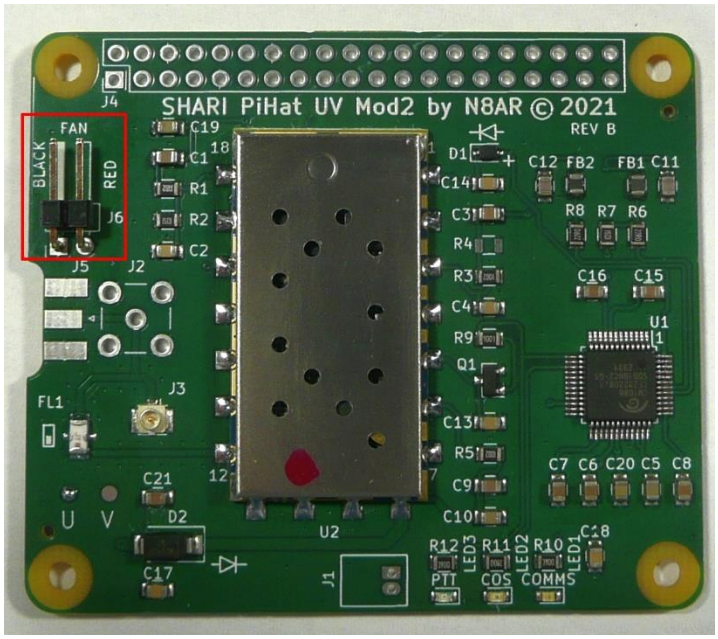
Place the U2 radio module in the correct position on the board. Reheat the solder on pad 14 from the previous step. Reposition the module as necessary and let the solder cool to hold the module in the correct position.

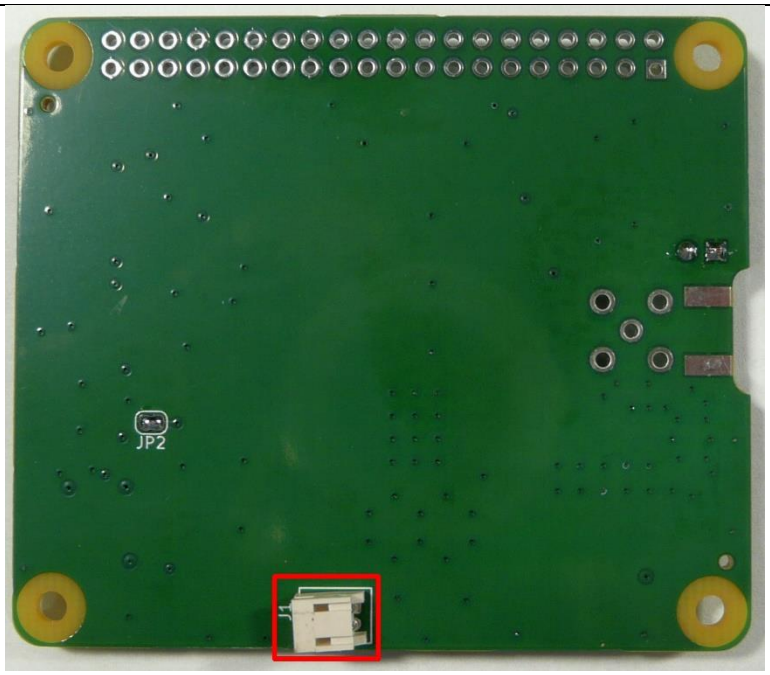
IMPORTANT - Make sure the module is oriented properly on the PCB and flush (**very important**) with the surface of the PC board.

1) Solder pin 1 through pin 7
2) Solder pin 18 through pin 12
3) Solder pin 8 through pin 11

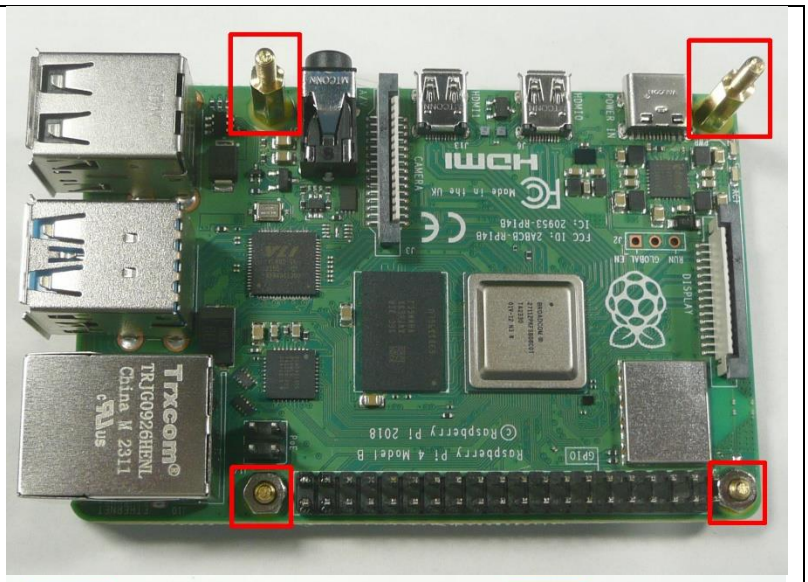
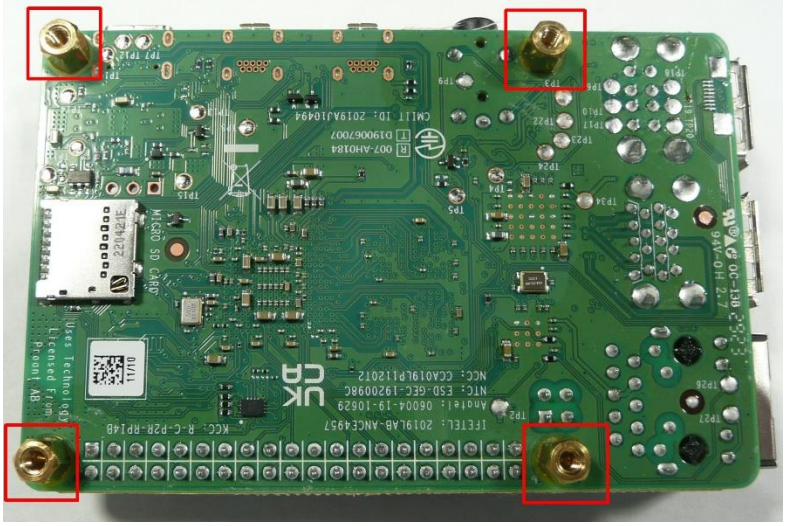
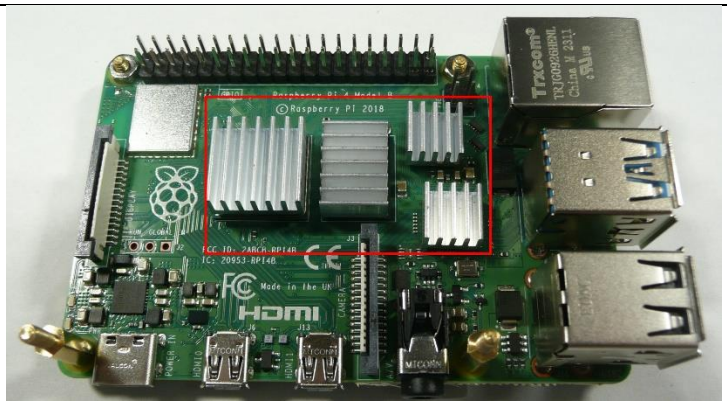


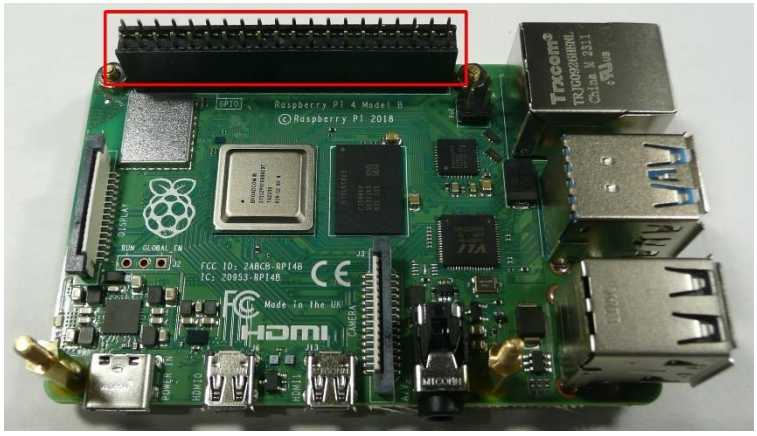
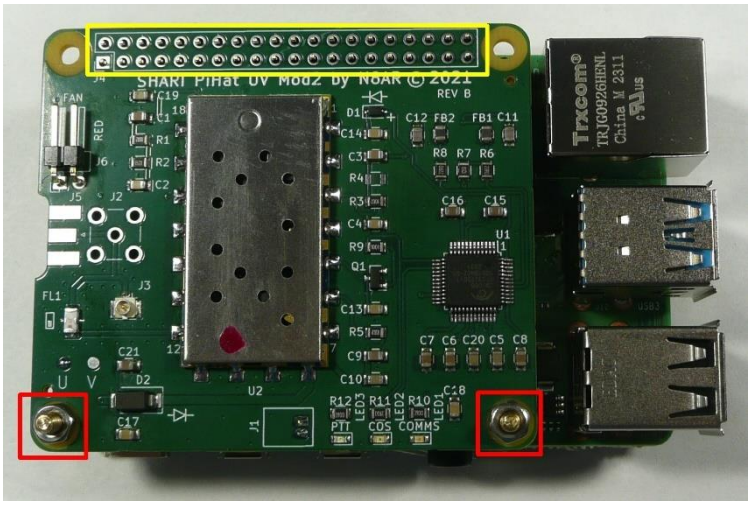
Insert the 2 position RA male pin header into the J6 location on the PC board and solder 2 pins.

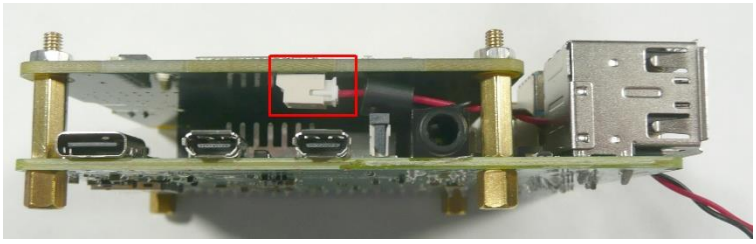
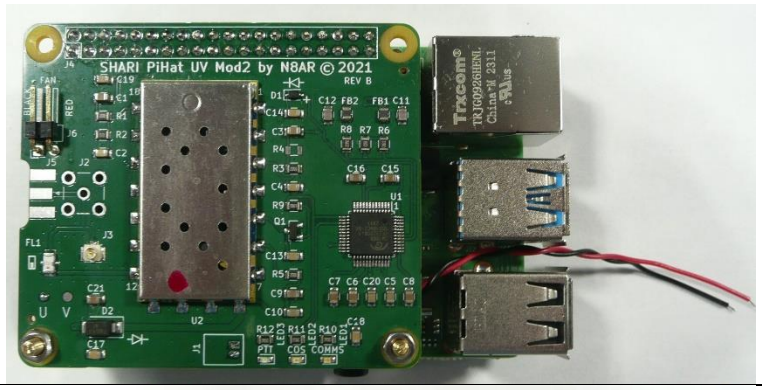
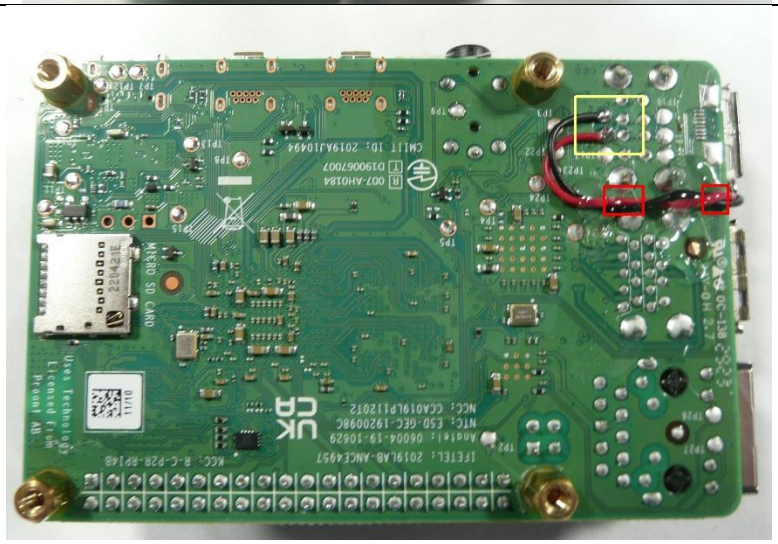


Insert the right angle JST connector into the J1 position on the bottom of the board in the orientation shown in the picture and solder its 2 leads on the top of the PC board.	

You are now going to use some parts from the Pi52/Pi4B case. For reference, here is the 52Pi/Pi4B vendors suggested assembly process. We vary from it by using two threaded standoffs in place of two of the nuts.

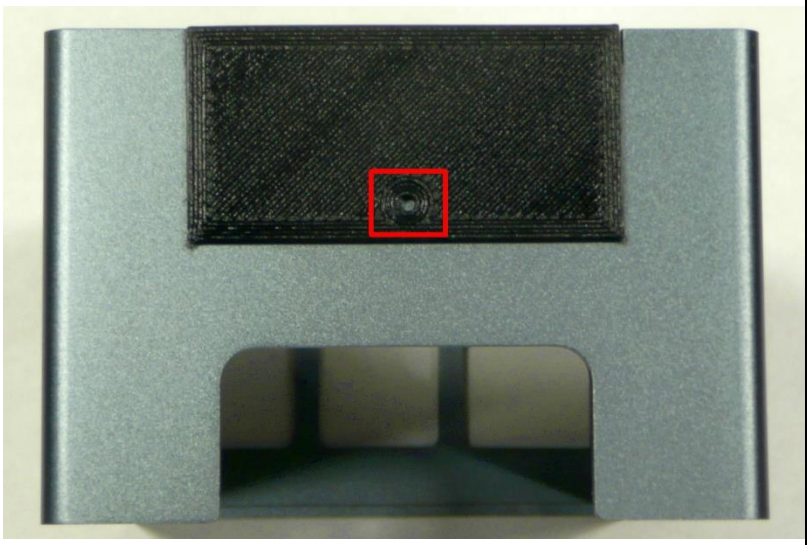
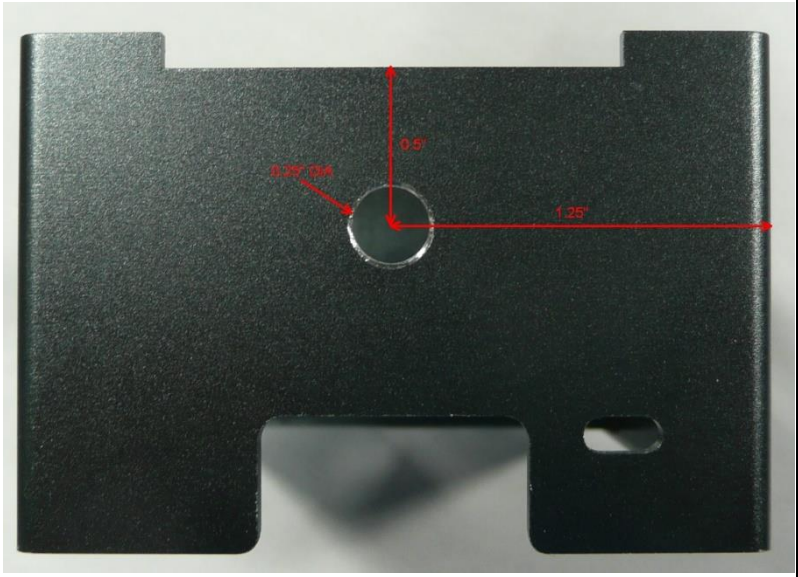
Unbox your Raspberry Pi 4B. Install two 11mm brass spacers and 4 short brass spacers (from the 52Pi/Pi4B case parts) as shown in the two photographs. Only tighten finger tight at this time.	 
Install four heatsinks on the Raspberry Pi 4B ICs as shown. Ensure that the metal heatsinks do not contact any surface mount components adjacent to the part you are installing the heatsink on.	

Plug the 40 pin GPIO female receptacle onto the Pi 40 pin header and seat completely.	
Mount the SHARI PiHat Mod2 PC board onto the GPIO connector pins and the two 11 mm brass standoffs. Install nuts onto the brass standoffs (shown in red boxes). Shift the positions of the two PC boards so that the GPIO connector pins are approximately centered in the PCB holes and tighten the mounting hardware (two nuts and 4 standoffs). Ensure that the PiHat PC board is in contact with the insulation of the 40 pin female GPIO connector as you solder all 40 pins of the GPIO connector (shown in yellow).	
Prepare the JST cable used to route the USB signal from the Pi4B to the CM108 on the SHARI PiHat Mod2 board as follows. Slide the ferrite with the 2 small holes onto the two wires of the cable. Position it close to the JST connector and then twist the black and red wires together as shown.	

Plug the JST cable plug into the JST right angle jack as shown. Ensure the plug latches properly into the jack. Route the cable as shown. **Hint:** You may need to use tweezers to perform this operation or temporarily remove the PiHat board from the Pi 4B.	 
Apply solder to the TP06 and TP10 pads . (outlined in yellow) on the Pi 4B to create a spherical mound of solder on the pad. Solder the end of the black wire to TP06 and the red wire to TP10 by reheating the solder and pushing the end of the wire into the solder. Route the wires as shown and apply hot glue or equivalent (location outlined in red) to act as a strain relief for the wire and hold it in place.	

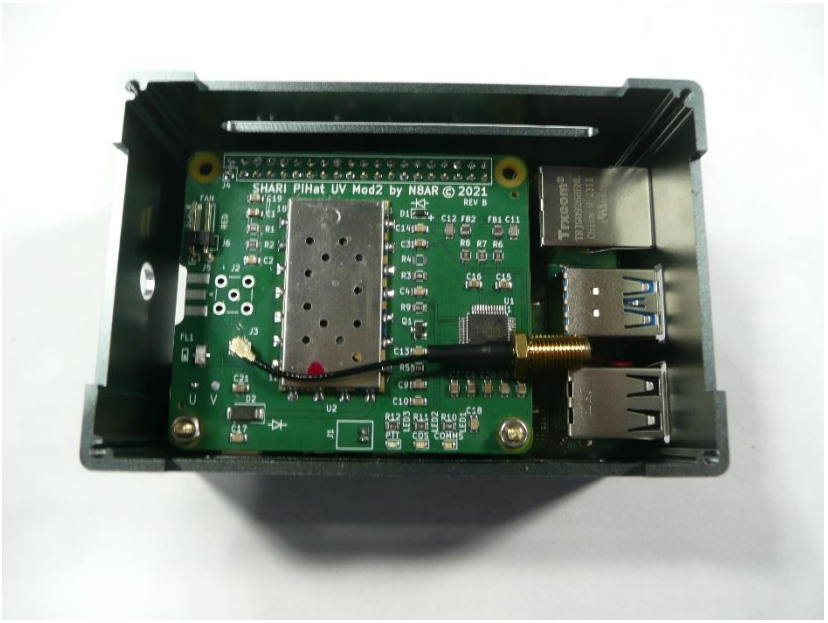
Step 2. SHARI PiHat Pi52 Case Preparation

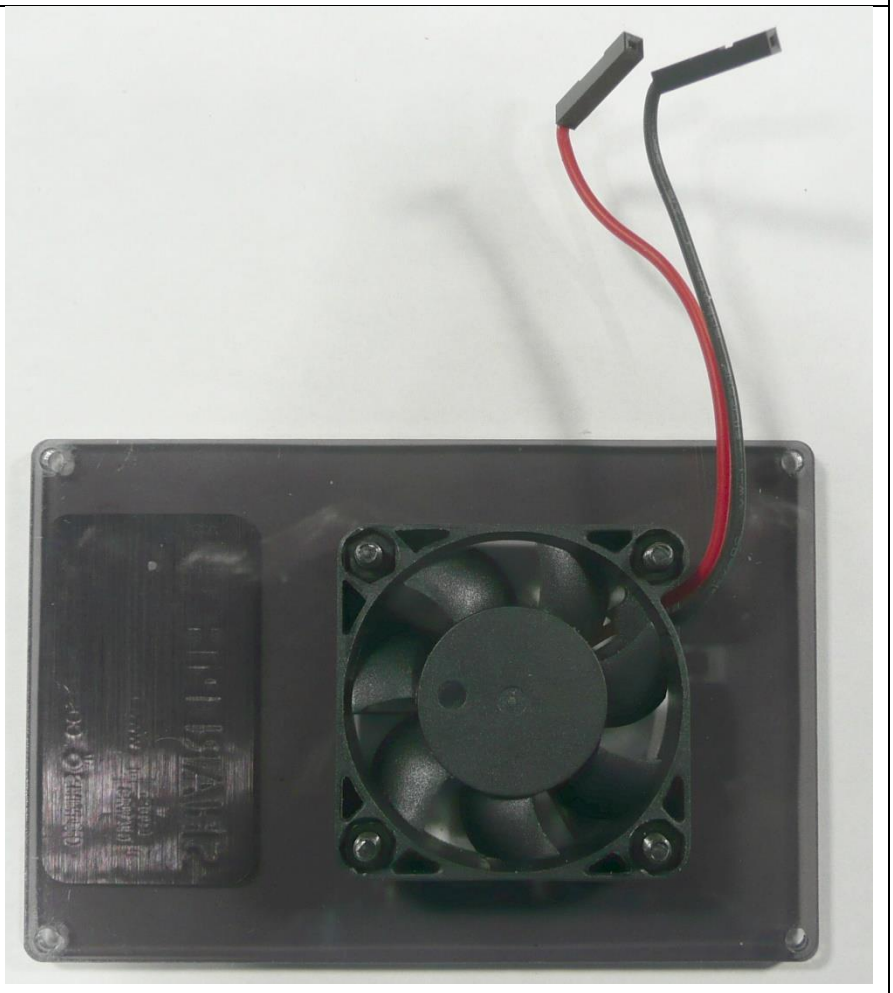
In this step, you will drill the 0.25” hole for the SMA antenna connector in the 52Pi/Pi4B case. In this step we recommend a location for this hole by providing a 3D printed template but because the SMA connector is part of a coax cable assembly, other locations are possible. Also, similar coax cables with right angle SMA connectors are available on Amazon which could be used to mount the SMA connector on the top cover. If you choose to use another location, be sure it does not interfere with the fan or other parts when the cover is installed.

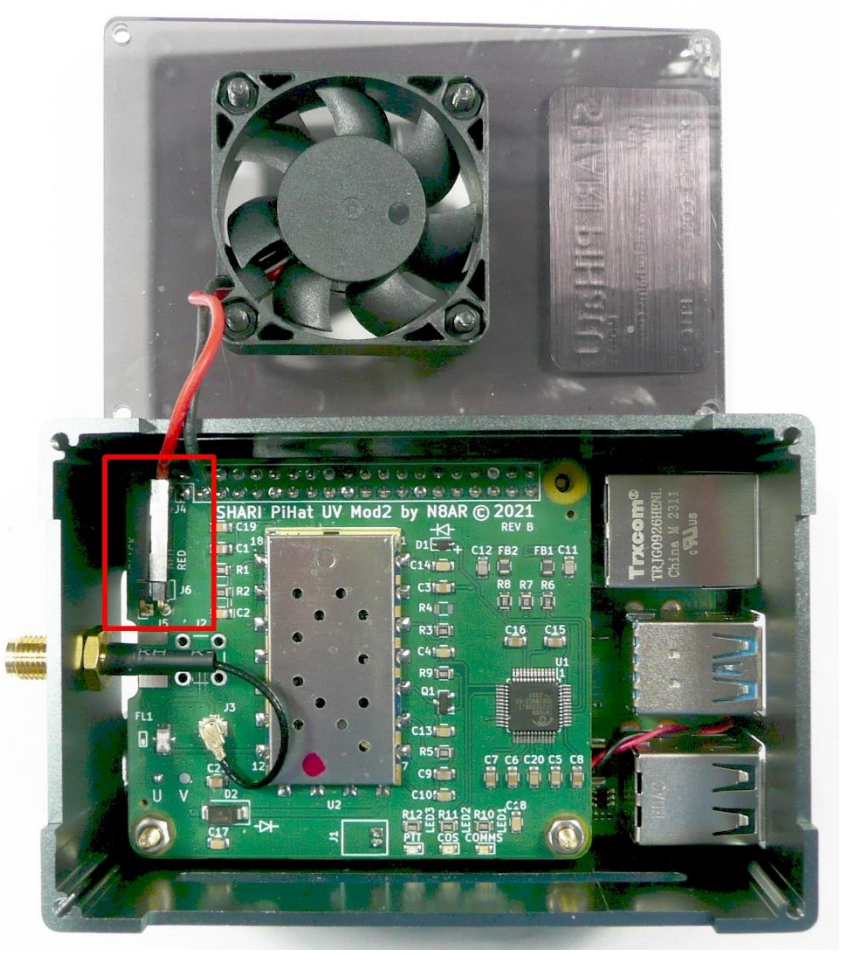
Place the hole location tool as shown in the photo and mark the hole location with a spring-loaded center punch or similar tool	
Drill a 0.25 inch hole. Remove a small amount of paint around the periphery of the hole to expose bare aluminum so that the serrated washer used with the SMA connector will contact bare aluminum.	

Step 3. SHARI PiHat 52Pi/Pi4B Case Final Assembly

In this step, you will complete the assembly of your SHARI PiHat 52Pi/Pi4B case node.

Plug the U.FL connector of the coax cable assembly into the U.FL jack on the PiHat Mod2 PC board. **This is much easier to do with the assembly outside the case.** Then place the SHARI PiHat/Pi 4B/coax cable assembly in the case so that the Pi4B's connectors align with the cutouts in the case.	
Fasten the PC board assembly in place using the bottom cover and four screws. Then install the two cushioning strips. We recommend cutting them so that the mounting screws are exposed as shown in case you require access to the Pi4B at a later time.	

Route the coax cable with SMA connector as shown. Place the star washer onto the SMA connector with its tangs pointing toward the case. Thread a nut onto the SMA connector and tighten.	
Install the fan on the inside of the top cover using the hardware supplied with the 52Pi/Pi4B case.	

Plug the red and black wires from the fan into the labeled pins of the fan connector.	
Install the top cover using the screws and Allen wrench provided with the 52Pi/Pi4B case. Afix the Shari PiHat label.