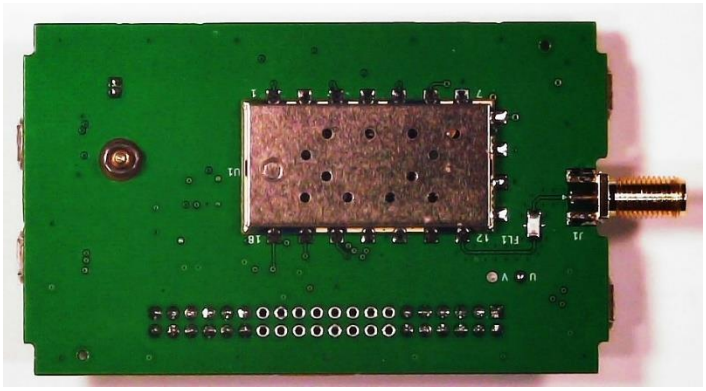
SHARI PiZero Allstar Node Construction Manual

The **SHARI** (**S**A818 **H**am **A**llstar **R**adio **I**nterface) PiZero Allstar Node is a kit construction project that implements a Raspberry PiZero 2W (**must be the 2W**) hosted Allstar node using a NiceRF SA818S embedded UHF (420 – 450 MHz) or a VHF (144-148 MHz) radio module. The VHF or UHF radio module, interface circuits and a USB hub for the PiZero are located on a custom printed circuit (PC) board using surface mount components. The Raspberry PiZero 2W plugs into the PC board via its 40 pin GPIO connector and a custom USB adapter cable.

The SHARI PiZero PC board is supplied with all the small surface mount parts installed. The kit builder installs two through-hole connectors, an SMA RF connector and the SA818 radio module.

The design uses a custom 2 conductor adapter cable with a JST cable on one end and a small PC board with a male microB USB connecter on the other end to connect the PiZero USB port to the PC board.

Three USB ports with microB connectors are provided by the USB hub on the PiZero PC board. This permits the node owner to utilize a wired ethernet connection to the node using a USB to ethernet dongle cable. Power is provided to the node using a suitable Raspberry PiZero power supply (microB connector)



The kit features a Hammond extruded aluminum case with 3d printed end caps. No drilling of the case is required to construct the kit.

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 damages 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 to comply with FCC part 97 rules 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	2022-04-10	Initial release
1.01	2023-09-21	Added SA818 pin 7 to list of acceptable short to shield (i.e. ground)
1.02	2023-12-13	Revised GPIO connector installation

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SHARI PiZero Allstar Node Overview

Key Features

- Uses a CMedia CM108B or CM119B USB Audio IC.
- Uses a NiceRF SA818S UHF (420-450 MHZ) or VHF (144-148MHz) embedded radio module (www.nicerf.com)
- LTCC lowpass output filter ensures compliance with Part 97 spurious requirements
- 200 to 500 milliwatts RF output power.
- Three microB USB ports to plug in USB devices such as an external ethernet adapter for a wired ethernet connection or an external keyboard.
- Raspberry PiZero 2W, power supply and microSD card provided by kit builder.
- Hammond extruded aluminum metal enclosure (approximately 3.25 x 2.25 x 1 inch).
- RX/TX serial connection via the PiZero GPIO to the SA818S radio module to program RF module parameters including RF frequency and CTCSS/CDCSS codes.
- Clamp-on ferrite provided to mitigate buzz interference from high RF fields near the Pi power supply.

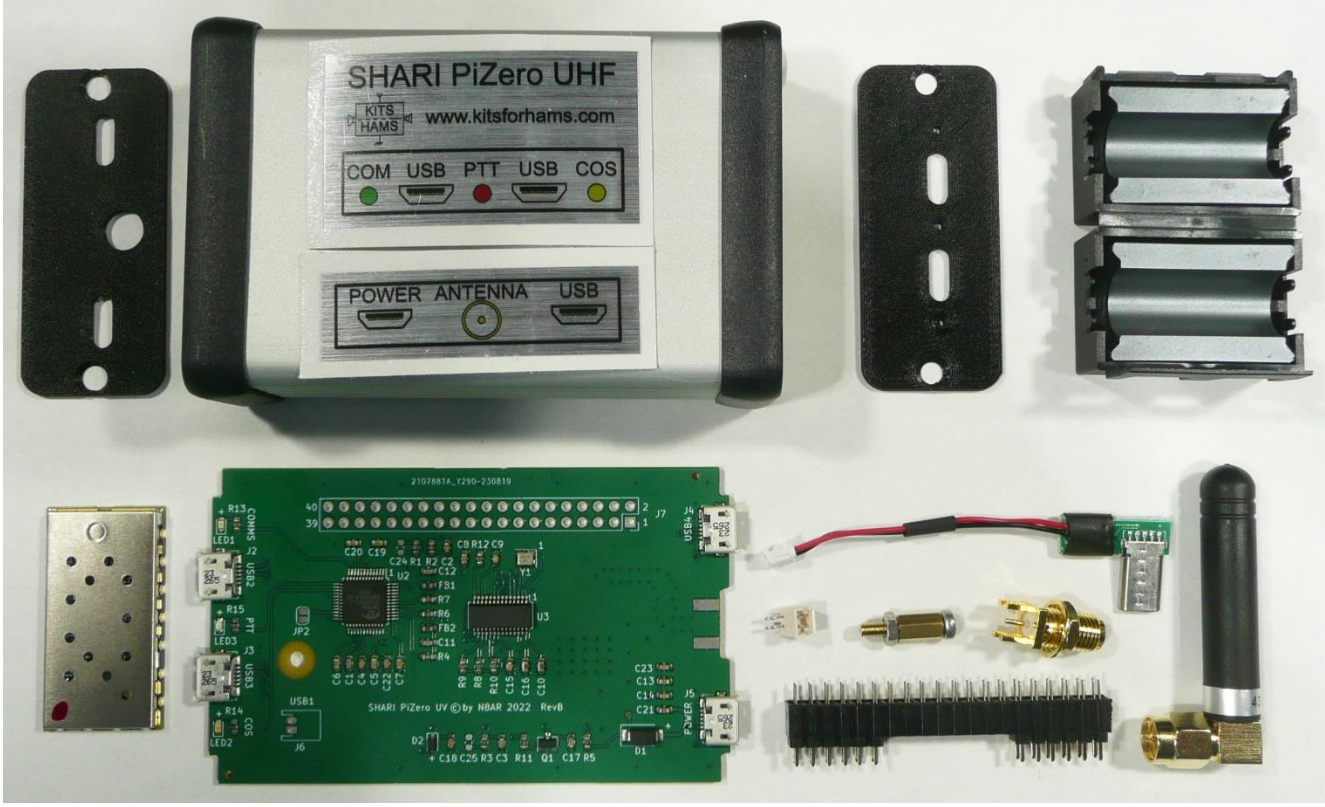
Setting Expectations

- **Operational Issues?**
    - Case must be opened (two screws) to access the microSD card used with the PiZero (normally not required after setup)
- **Degree of soldering difficulty –Medium**
    - Assembly of the SHARI PiZero kit requires standard through-hole soldering of 2-pin, 12 pin and 40-pin leaded connectors. The SA818 embedded radio module is surface mounted using 18 castellated holes soldered to very large solder pads on the PCB. (as an option, we will install the SA818 module for you for $5.00). The SMA RF connector is also soldered to large pads on the PCB.
    - A preassembled microUSB adapter cable is provided with the kit.
- **Degree of mechanical difficulty – Easy**
    - There are no holes to drill in the case.
    - The case screws together using a #2 Phillips screwdriver.

Required Materials

SHARI PiZero Kit

The following photo shows the parts supplied with the SHARI PiZero UHF kit.



- SHARI PiZero UV PCB with installed SMD components
- SA818 (U or V) radio module
- UHF (or VHF elbow antenna)
- Edge mount SMA connector and nut
- 2 row, 40 pin female GPIO connector (installs in PC board)
- Two 12 pin male headers (installs in your PiZero 2W)
- 2 position JST right angle connector
- Threaded M/F brass standoff with screw and nut
- Preassembled 2 wireUSB interconnect cable
- Hammond extruded aluminum case with 3D printed end caps
- SHARI PiZero (U or V) labels
- Large ferrite filter (installs on your power supply lead)
- 3D printed end caps

Kit Builder Supplied Parts

- Raspberry PiZero 2W
- Appropriate Raspberry PiZero 2W Power Supply
- MicroSD card (16 GB recommended)

Tools

- Low wattage (50 watt) temperature controlled soldering station with small tip and solder.
- Phillips screwdrivers (#1 and #2)

SHARI PiZero Kit Construction Overview

This manual uses pictures and written instructions to guide you through the process of construction of a SHARI PiZero node. Software setup is described in a separate document.

The construction process consists of the following tasks:

1. Solder components on the SHARI PiZero PC board
    a. SA818 radio module U1
    b. Two pin JST connector J6
    c. 40 pin GPIO connector J7
    d. SMA connector J1

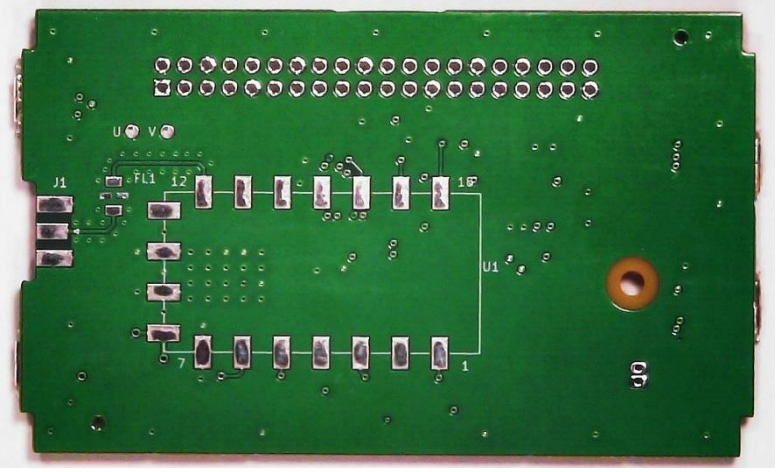
2. Solder pin headers on the PiZero 2W CPU board and mount it to the SHARI PiZero PC board.

3. Install the microB to JST USB adapter cable

4. Final assembly
    a. Install microSD card with Allstar image into PiZero CPU
    b. Install PCB's into case and assemble case
    c. Apply labels
    d. Install ferrite filter on your PiZero power supply

Step 1. SHARI PiZero PCB Assembly

In this step you will solder 3 components on the SHARI PiZero PC board. These are the SA818 radio module, the 2 position JST connector and the SMA RF.

Begin this task by locating the SHARI PiZero PC motherboard in the kit.	

In this task, you will solder the SA818 radio module to the PC board in the U1 location. 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 radio module you are about to install.

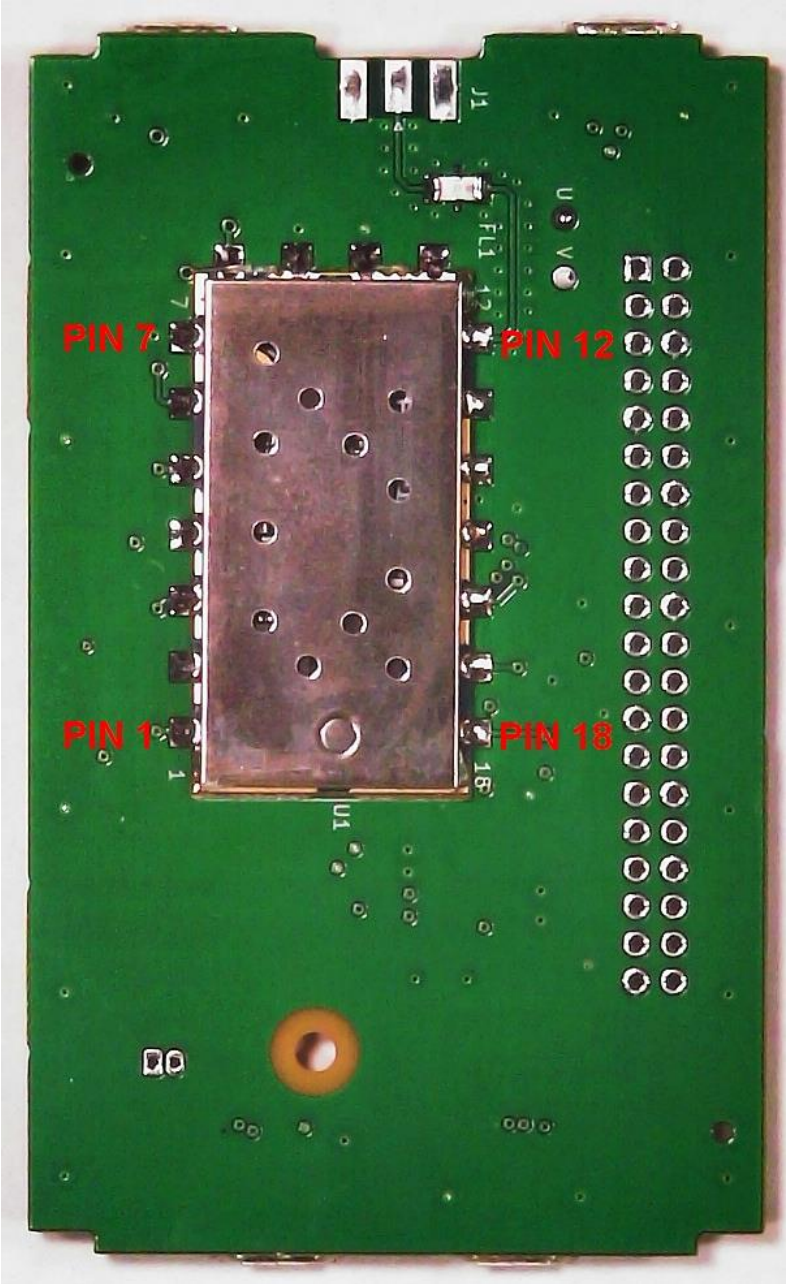
Here are some things to be aware of before you begin soldering.

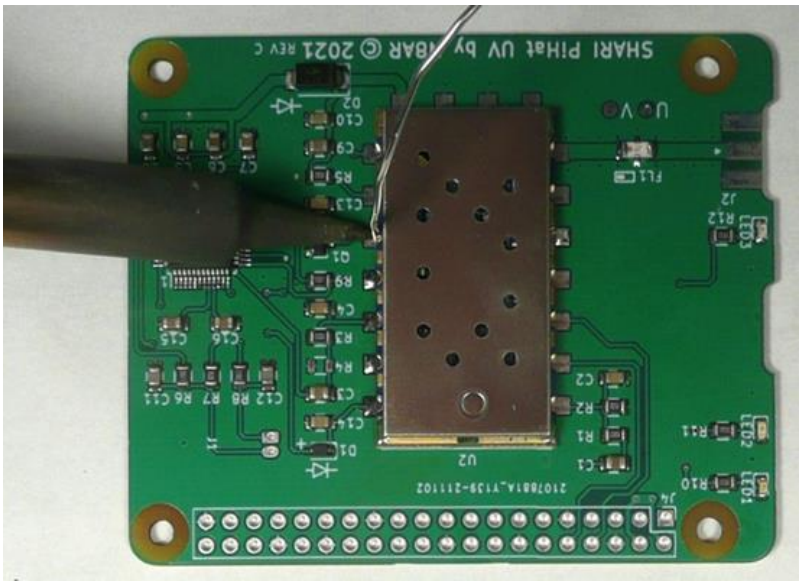
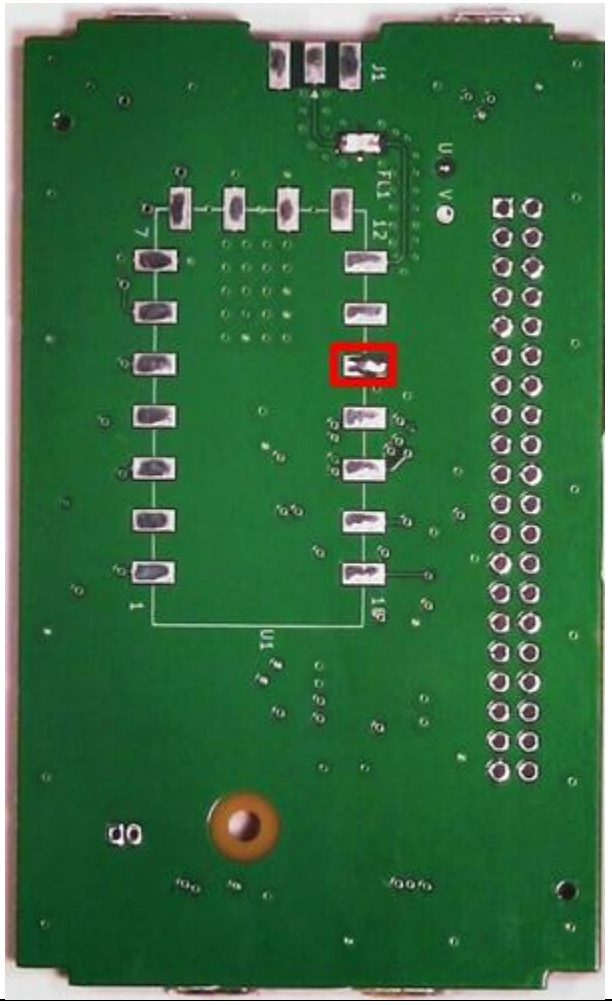
- The SA818 radio module pin numbering is shown in the photo. The pin numbers increase clockwise from Pin 1.

- 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 second 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 with the exception of pins 7, 9, 10 & 11. Check with an ohmmeter if in doubt.

Do not solder yet. Continue to the next instruction!



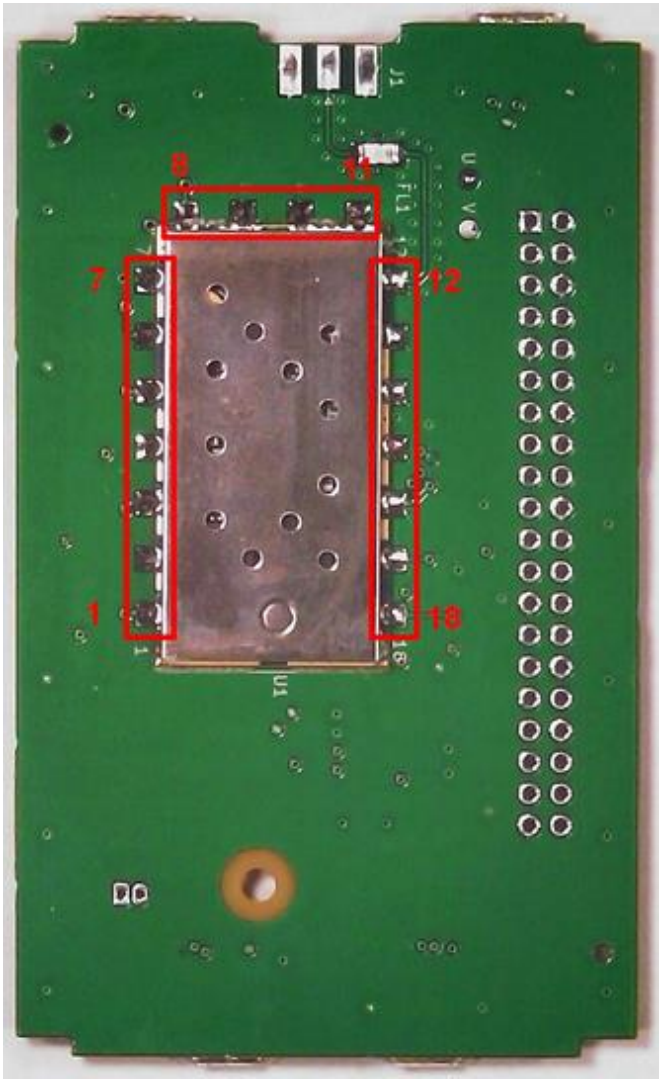
Soldering Hints for castellated holes Clean your soldering iron tip. Hold the solder vertically with the end against the pad on the PC board and the solder touching the wall of the castellated hole. Then, with the soldering iron tip touching the pad and at about a 30 degree angle to the PC board, push the tip into the solder. When 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.	
OK – now you can solder! Flow a small amount of solder onto the right side of pad 14 outlined in red on the SHARI PiZero 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.**

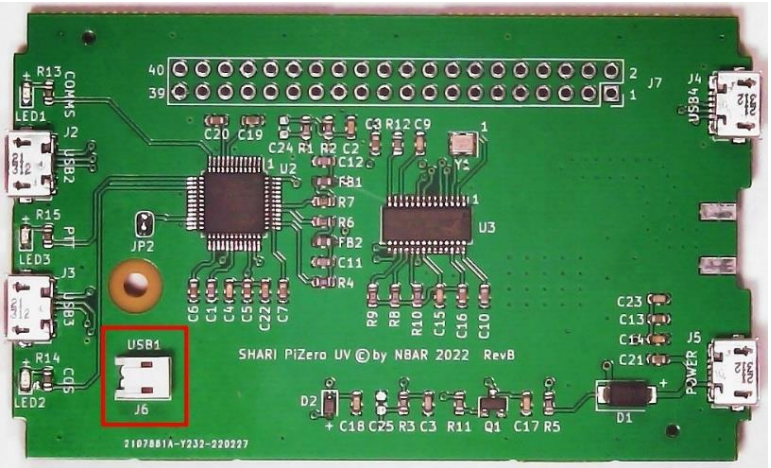
Place the U2 radio module slightly to the left of the correct position on the board. Reheat the solder on pad 14 from the previous step and slide the module to the right into the correct position. Remove the soldering iron and check for proper position alignment. Reheat the solder on pad 14 and reposition the module as necessary and let the solder cool to hold the module in the correct position.

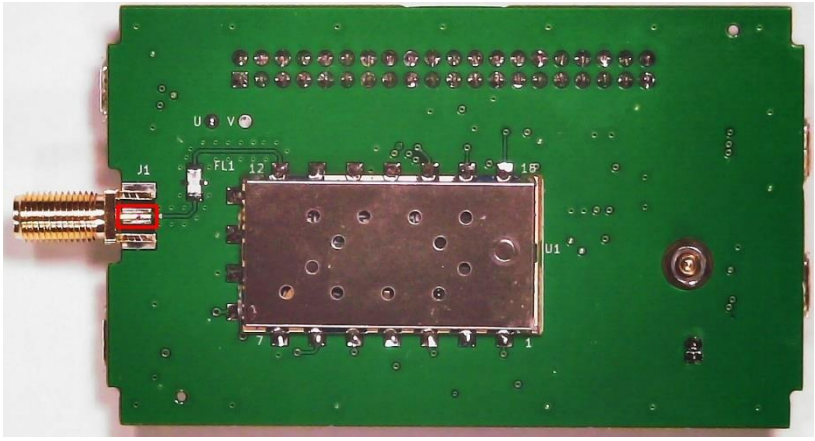
IMPORTANT - Make sure the module is oriented properly on the PCB and flush (**very important**) with the surface of the PC board.

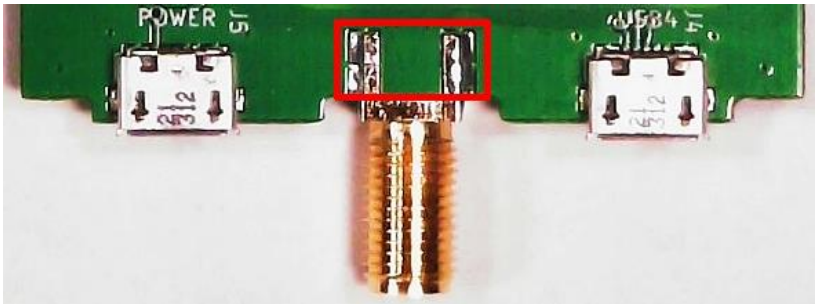
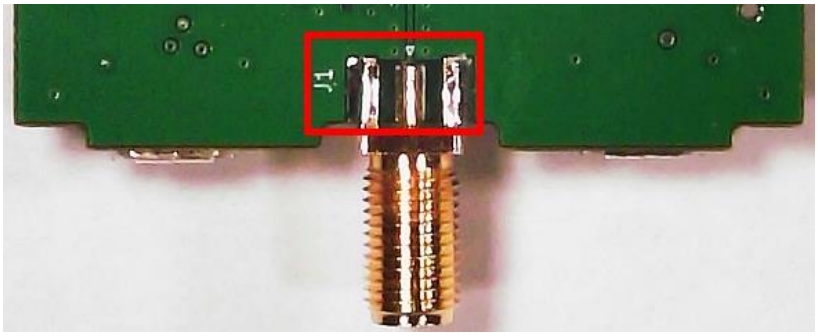
1) Solder pin 1 through pin 7
2) Solder pin 18 through pin 12
3) Solder pin 8 through pin 11



Insert the right angle JST connector into the J6 location on the top of PC board in the orientation shown in the picture and solder its 2 leads on the bottom of the board.

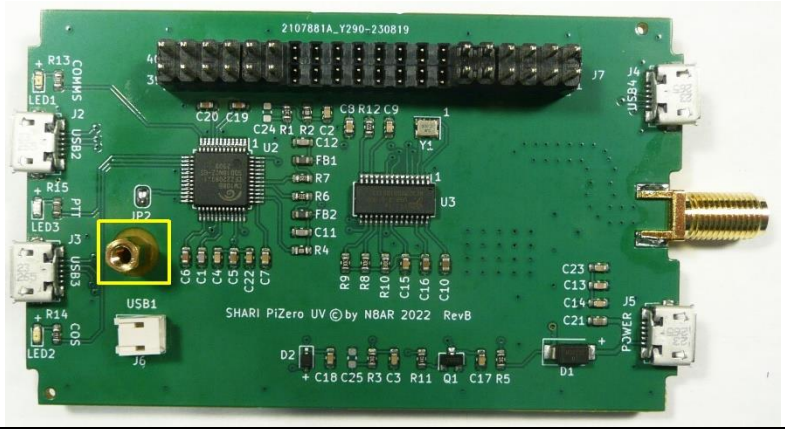


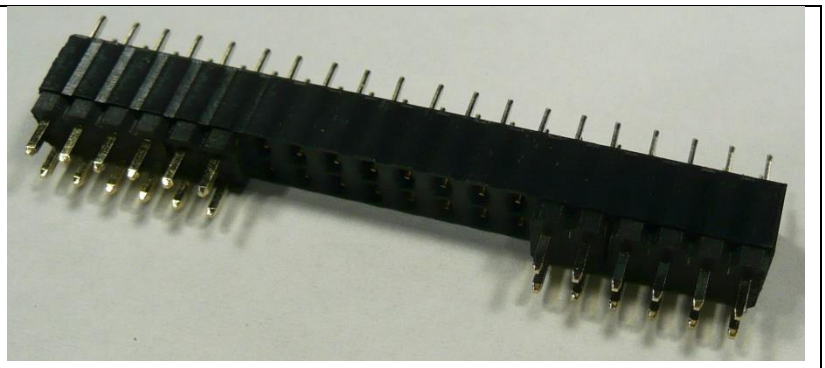
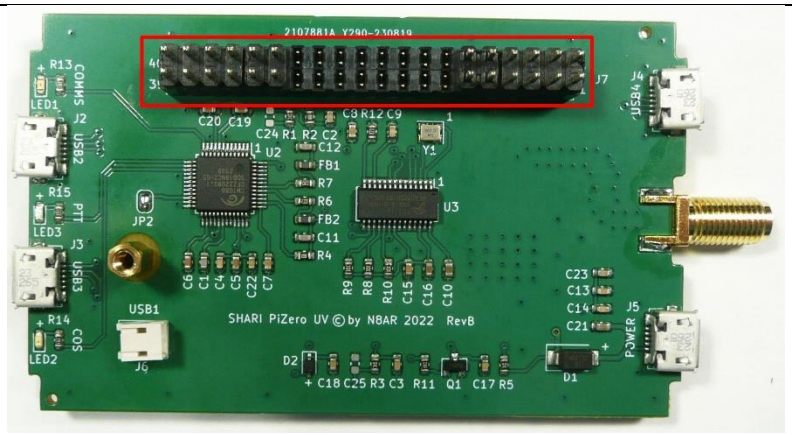
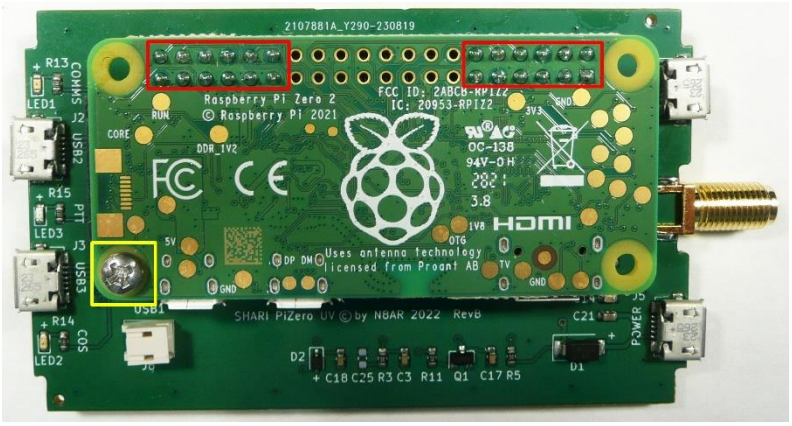
Install the edge mount SMA connector J1 on the PC board. Center it on the solder pads. Make sure it is pushed tight to the edge of the PC board and parallel to the plane of the PC board. Lightly solder the center pin of the connector to its solder pad.	
Place the 3D printed end cap over the SMA connector and two microB USB jacks to verify the proper location and alignment of the SMA connector. Reheat the lightly soldered center pin solder connection and reposition the SMA connector as required. CAUTION – The 3D printed end cap will melt if touched by the tip of the soldering iron so remove it before reheating the solder joint or use extreme care.	

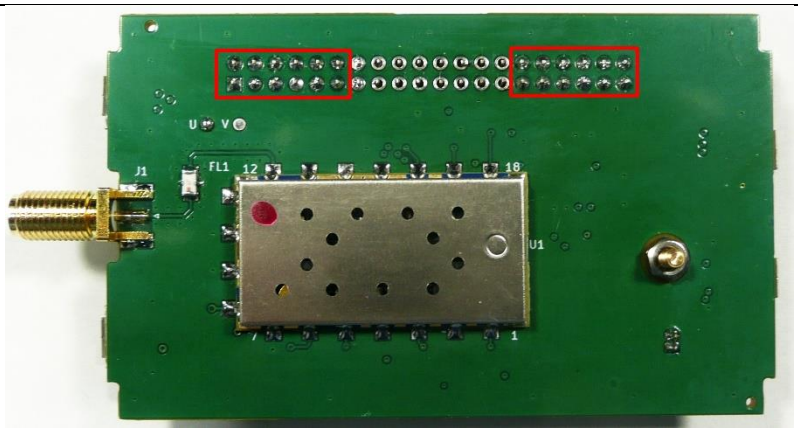
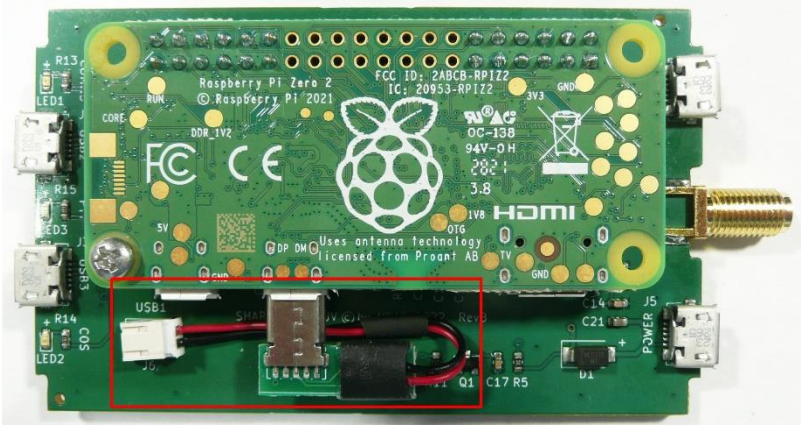
Solder the two ground connections of the SMA connector on the top of the PC board first. Then solder the two ground connections and the center pin of the SMA connector on the bottom of the PC board. This completes the assembly of the SHARI PiZero PC board.	 

Step 2. Raspberry PiZero 2W Assembly and Installation.

In this step, you will place the Raspberry PiZero onto the SHARI PiZero motherboard using male and female pin header GPIO connectors and a male/female standoff. You will then solder the female 40 pin GPIO connector to the SHARI PiZero motherboard and two 12 pin male pin headers to the Raspberry PiZero.

Pass the male end of the 7mm brass spacer through the provided hole from the top of the PC board (yellow rectangle in photo) and thread on the 2.5mm nut on the bottom of the PC board. Center the standoff in the hole and tighten the nut.	

Next you will place the GPIO connector assembly in position. Note that it consists of a 40 pin female pin header with 12 pin male pin headers inserted at each end. (Note that each 12 pin male header is actually an 8 pin and a 4 pin header).	
Place the 40 pin female header with 12 pin male pin headers in position on the SHARI PiZero motherboard as shown in the photo. Note that the female connector pins plug into holes in the SHARI PiZero motherboard.	
Place the PiZero 2W in position on the two 12 pin male pin headers and the 7mm standoff. Install a 2.5 mm screw into the 7mm standoff (yellow rectangle). Center the screw in the hole and tighten. Ensure that the PiZero board is firmly seated (no gap) on the two male pin headers and solder 12 pins on each header (red rectangles).	

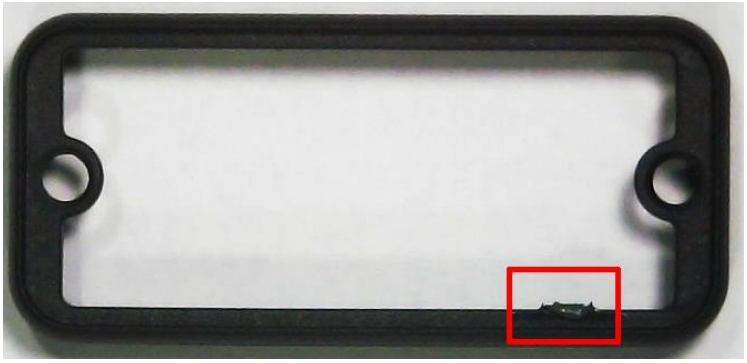
Ensure that the GPIO connector assembly is firmly seated (no gap) on the SHARI PiZero motherboard and solder 12 pins (2 rows of 6) at each end of the connector. (If you accidently solder more than 12 it is OK as there are no connections to these pads on the SHARI PiZero motherboard)	
Plug the USB adapter cable into the **data** microB USB jack on the Raspberry PiZero and the JST jack J6 on the SHARI PiZero PC board. Route the cable as shown in the photo. Ensure that the microB plug is **completely seated** in the microB jack. IMPORTANT – Make sure you plug the cable into the MicroB USB data jack as shown and not the MicroB power jack of the PiZero. Be firm but gentle. Press on the end of the PCB adapter with your thumb and rock side to side as you plug it in.	

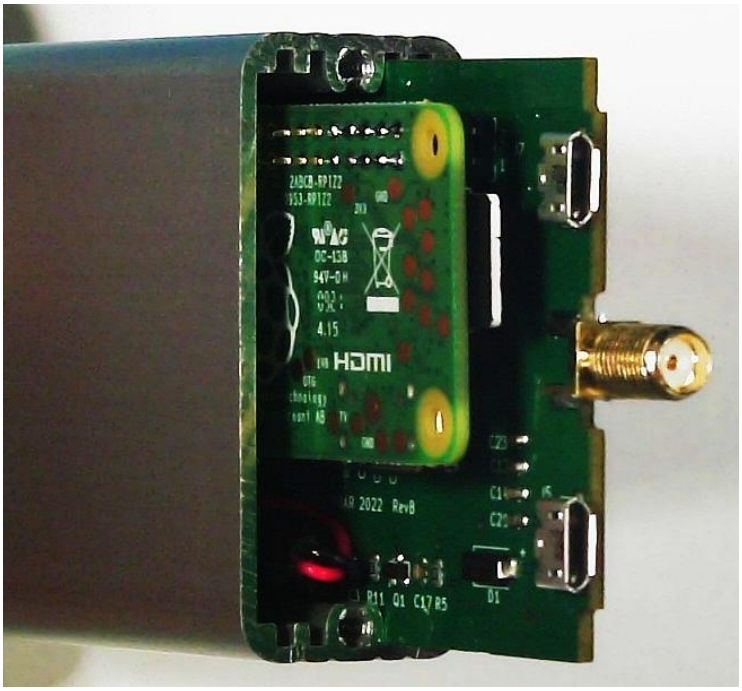
Step 3. SHARI PiZero Final Assembly

In this step, you will complete the assembly of your SHARI PiZero.

Since you can't install/remove the microSD card without removing the SHARI PiZero board stack from the case, you must install a microSD card containing an Allstar image into the PiZero before proceeding with final assembly.

<table>
<tr><td colspan="2">HINT – The SHARI PiZero case uses special thread forming screws to secure the end plates because the locations that the screws thread into in the extruded case body are not tapped. We have found it easier to run the screws into the untapped locations and remove them one time before inserting the SHARI PiZero board stack and installing the end plates</td></tr>
<tr><td>The case used for the SHARI PiZero uses an extruded aluminum body with plastic bezels on each end and our 3d printed end caps.</td><td>  </td></tr>
<tr><td>We have found that some of the plastic bezels supplied by the case manufacturer have a minor imperfection which is hidden by the end cap after assembly. However, it may have some material in a location which prevents our 3D printed end caps from seating completely.

If you find your bezels have the imperfection which interferes with the end cap, please trim it off with a razor blade or sharp knife so that the 3D printed end cap seats in the bezel correctly.</td><td>  </td></tr>
</table>

Insert the SHARI PiZero board stack into the extrusion. Use either slot closest to the center of the case. Install the plastic bezels on each end with the deeper recess in the bezel over the extrusion. Place the 3d printed end caps in position and fasten with the thread forming screws. Install the SMA connector nut.	
Install the two SHARI PiZero labels and the antenna as shown. This completes the construction of your SHARI PiZero. Install the ferrite on your power supply as directed in the next step.	
Install the ferrite core supplied with the kit at the power supply end of the cable. Pass the wire through the center of the core 3 times This ferrite will help to ensure that you have no “hum” or “buzz” interference while using the node. Here is a link to a discussion on this topic. https://groups.io/g/SHARI/topic/hum_buzz_on_signal/73406860?	

Notes: