MAIANA™ Assembly and Installation Manual

Revision 4.3

September 2023

Kit Contents

The kit will arrive with all of these parts in a small box. These are:

1. The main PCBA and basic UART/USB breakout in an ESD envelope
2. The additional adapter (0183/N2K) if ordered in a separate ESD envelope
3. The antenna tube (two telescopic sections)
4. The vinyl end cap for the antenna tube
5. The antenna core (coiled and stripped coax with SMA male on one end)
6. The main case (high-UV resistance PVC)
7. 12” of 1.5” wide heat shrink tubing, black (enough for 2 builds)
8. 6” of ¾” 4:1 heat shrink tube, black (enough for 2 builds)
9. 48” of ⅜” 2:1 heat shrink tube, folded

What you will need

To complete the installation you will need:

- A soldering iron for the RJ45 connector and “breakaway” pin headers of the UART adapter
- Some kind of instant glue to secure the end cap of the antenna tube
- A pair of strong scissors for cutting (thick) heat shrink tubing
- A heat gun for the heat shrink tubing. You will need this both on your workbench for the initial assembly, as well as on your boat for the final installation. If you don’t have a proper heat gun, see this article here for some alternate options. That said, beware of anything that projects a flame, as it can easily melt the PVC enclosure!
- 1” OD steel railing or a similar diameter fiberglass mast on your boat. This is the preferred way to mount the unit. You may, of course, use your own mechanism, but then you’re responsible for sealing the (bottom) cable end from moisture
- A Cat5 cable for connecting the main unit to the breakout board in the cabin. This should be a regular “patch” cable and **not a “crossover” cable.** Pick one with appropriate length and flexibility to suit your installation. The exact configuration of the cable (568A or 568B) is not important.

ESD CAUTION: Many electronic components on the MAIANA boards are sensitive to electrostatic discharge. Although both the adapter and the main board feature strategically placed TVS diodes, these will not necessarily protect the circuit from a discharge at some random location **due to touch**. So make sure you follow these really basic rules:

- Work on an ESD-safe surface, ideally an ESD mat. Metal and wooden surfaces are usually safe. Avoid plastic ones.
- When you arrive at your workstation, stop walking and ground your hands immediately before touching any electronics. Ideally, you should start by putting on a grounding strap.

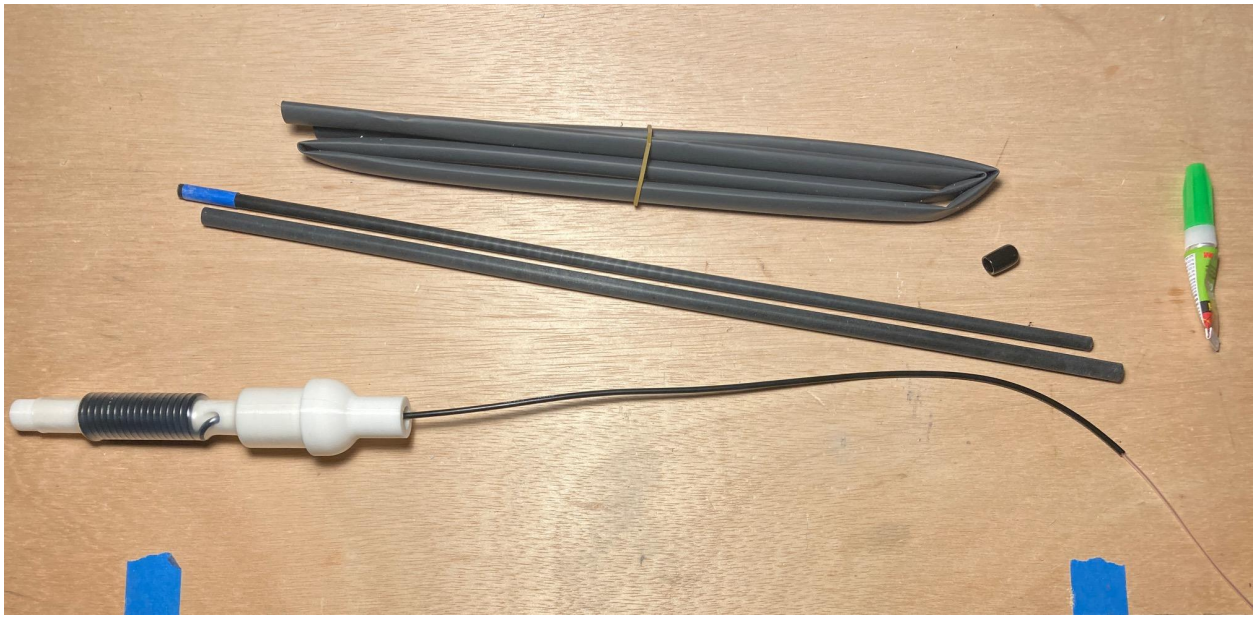
This is by no means a comprehensive guide, but it covers the most common mistakes. For more information, read this.

Assemble the antenna

The antenna will arrive in a very compact configuration. The heat shrink tube that coats the antenna tube will be folded as shown for shipping. This won't affect its performance.

The antenna radome is made of two telescopic epoxy wound filament tubes. The narrow tube will arrive with a piece of blue masking tape at the end as shown here.

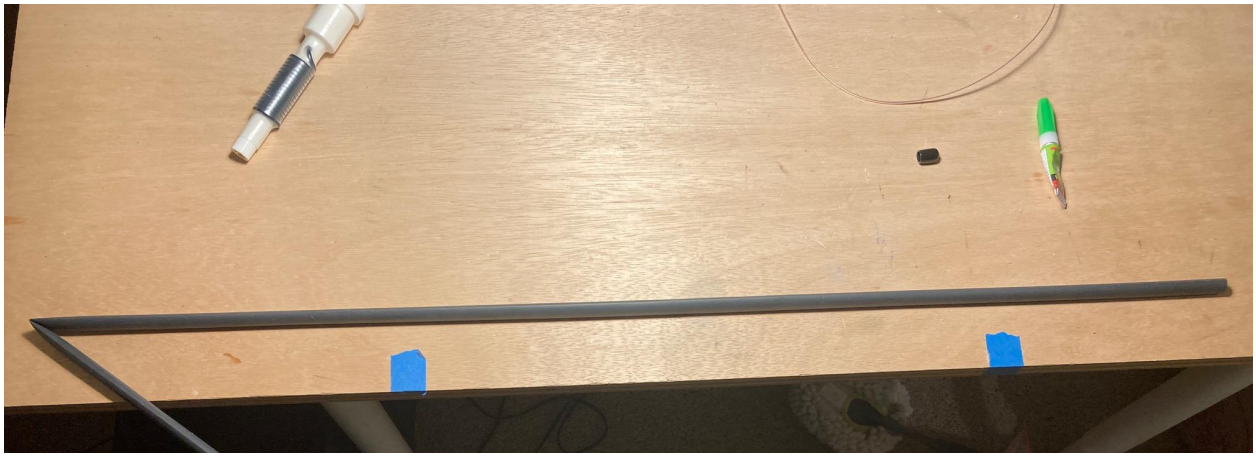
The end cap should be included in your kit, but you will need to furnish your own instant glue to attach it.

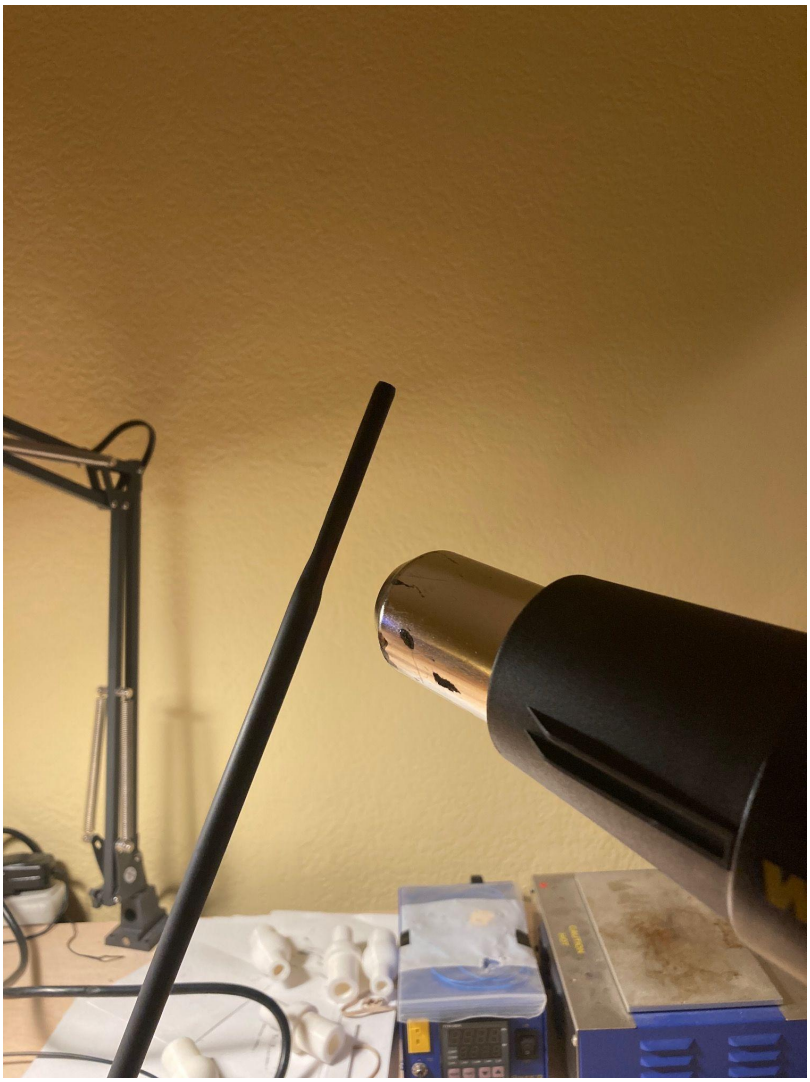


Start by inserting the wide tube over the cable and through the antenna subassembly until it stops moving.

Now insert the narrow tube over the cable and through the wide tube. You should not be able to see the blue tape anymore. Keep pushing through until the cable shows up on the other end, then pull back slightly until it’s flush. This is the optimal configuration for mechanical strength.

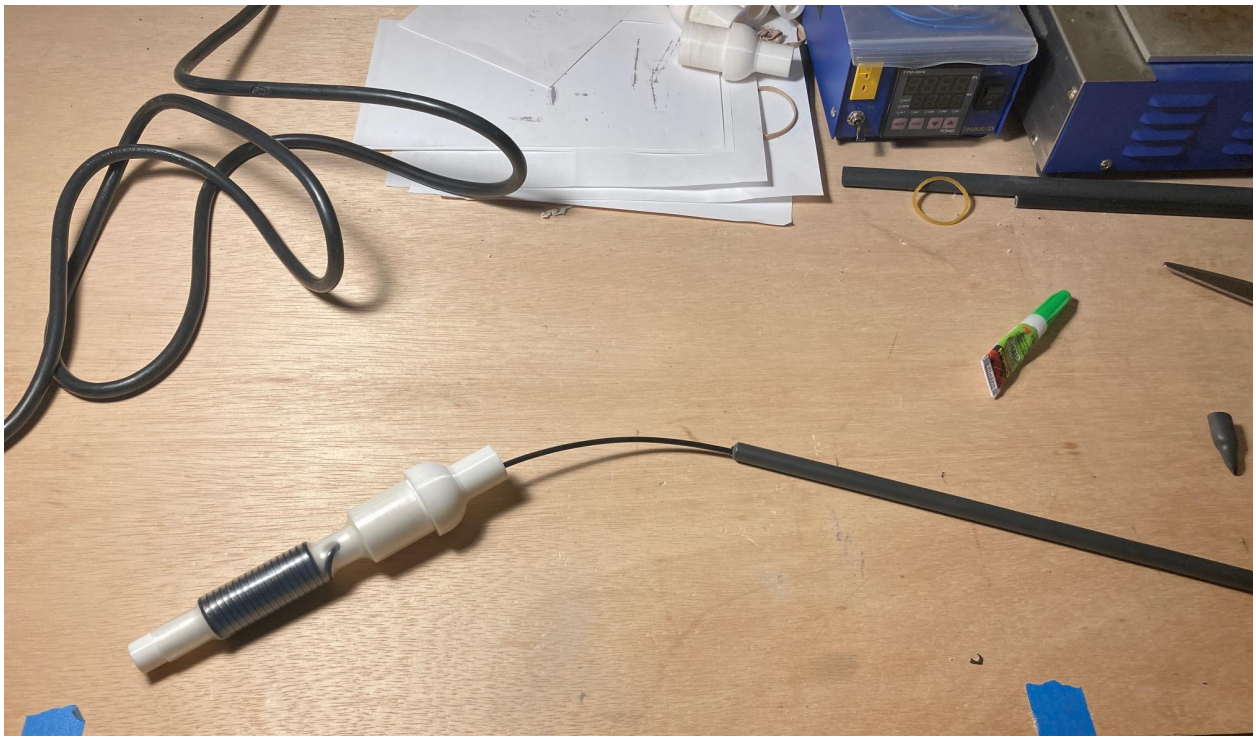
Carefully pull the telescopic subassembly out and cover it with the heat shrink tube. Allow for a bit of overhang and cut the excess with a pair of scissors.





Start at one end of the tube and keep melting the heat shrink thoroughly while rotating it. The idea is to apply heat evenly and work the air pockets toward the other end.

Allow the heat shrink to cool down, then insert the full telescopic tube over the cable and into the subassembly as before. You may have to **twist** to help the end of the cable go through the narrow overlap portion and into the upper section.

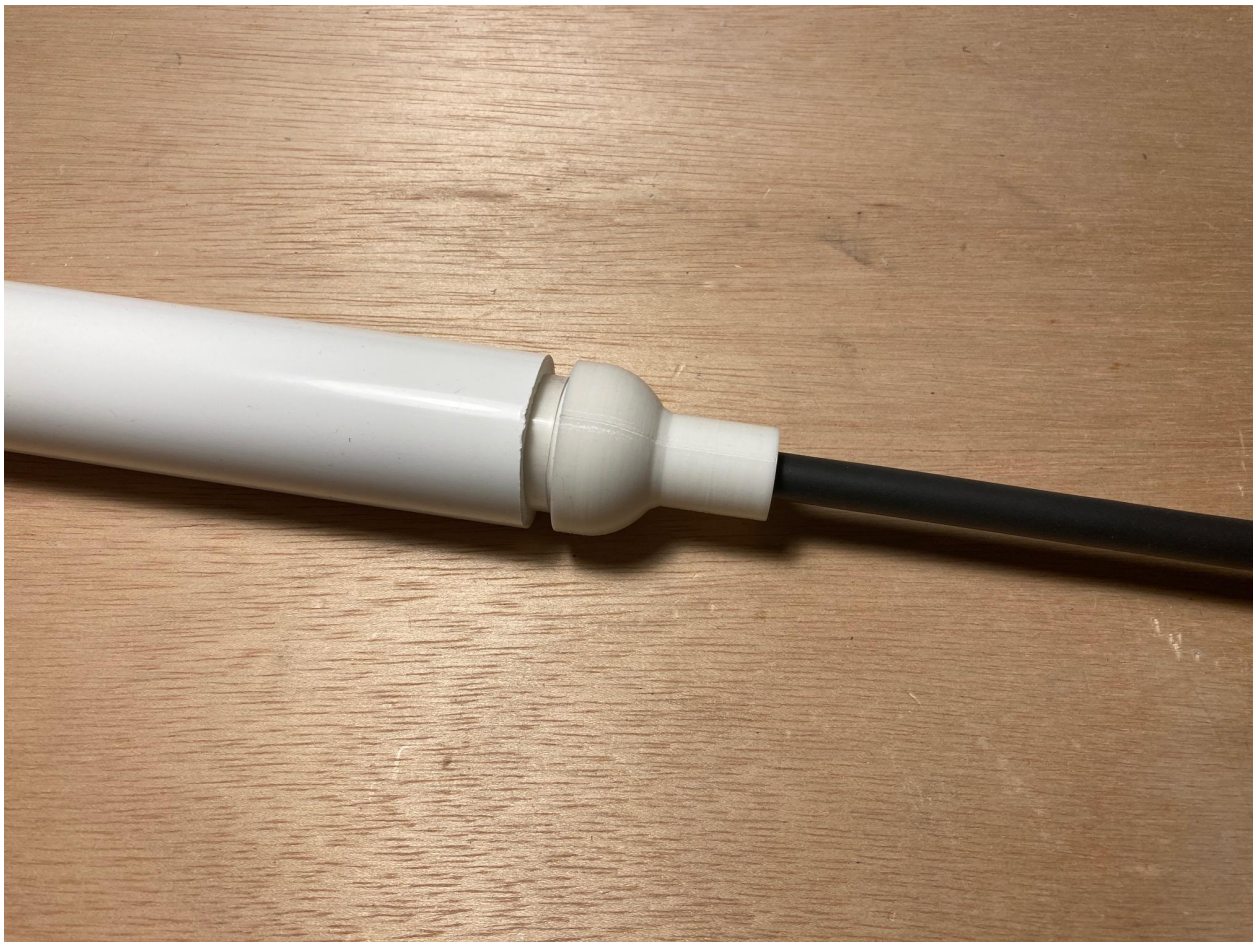


Now apply a generous amount of glue into the vinyl cap and quickly fit it over the end.

The antenna tube is ready.

Attach the transponder board to the SMA female end of the pre-assembled antenna core as shown here: Make sure you tighten it adequately so it doesn't come loose, but use *hand tightening* only, no wrench. The board is already sprayed with silicone conformal coating, so it will resist moisture even if water seeps in (very unlikely if you follow these instructions).

Now push the entire lower assembly into the housing tube. It may be a tight fit, and it may even be necessary to sand the inside of the tube for the two ends to mate comfortably. This is by design, as the joint between the PVC and the polyolefin tubing forms a secondary water seal.



This is a good time to practice connecting the transponder end of the Cat5 cable. You should be able to simply push the cable into the jack until it latches:

To release the cable, simply insert your index finger or a long flat screwdriver into the bottom of the tube to push the latching tab. This may work better if your cable does not have a rubber boot. Practice doing this until you’re comfortable. You will have to repeat this step during final installation on your boat.

Seal the antenna

Cut a 4” long piece of the 1.5” heat shrink as shown here, and use the heat gun to shrink it until the entire tube has taken the shape of the housing. It’s best if you start at the bottom and work your way up, while rotating the unit with one hand.

For a strong bond, apply extra heat **near the bottom** of the seal until you see it glaze. Avoid overheating the upper portion at this stage.

Cut a 2” long piece of the ¾” tube and insert it over the cap as shown, then shrink it quickly without overheating and deforming the assembly.

Allow the assembly to cool for a bit. You should be able to lift the entire unit from the antenna tube. Now, use one hand to hold and suspend the unit from the tube and the other hand to heat the center of the heatshrink area, while rotating the assembly continuously. Do this for about 20-30 seconds and you will notice the material softening, elongating and straightening. This forms your primary water seal. Set it down upright and let it cool. The main unit is now ready for installation on the boat.

Test and provision the system

To test the system at home, you will need a source for 12V power, ideally a reliable benchtop power supply. The NMEA2000 adapter is only bus powered, so you may not be able to test it at home unless you have a network there.

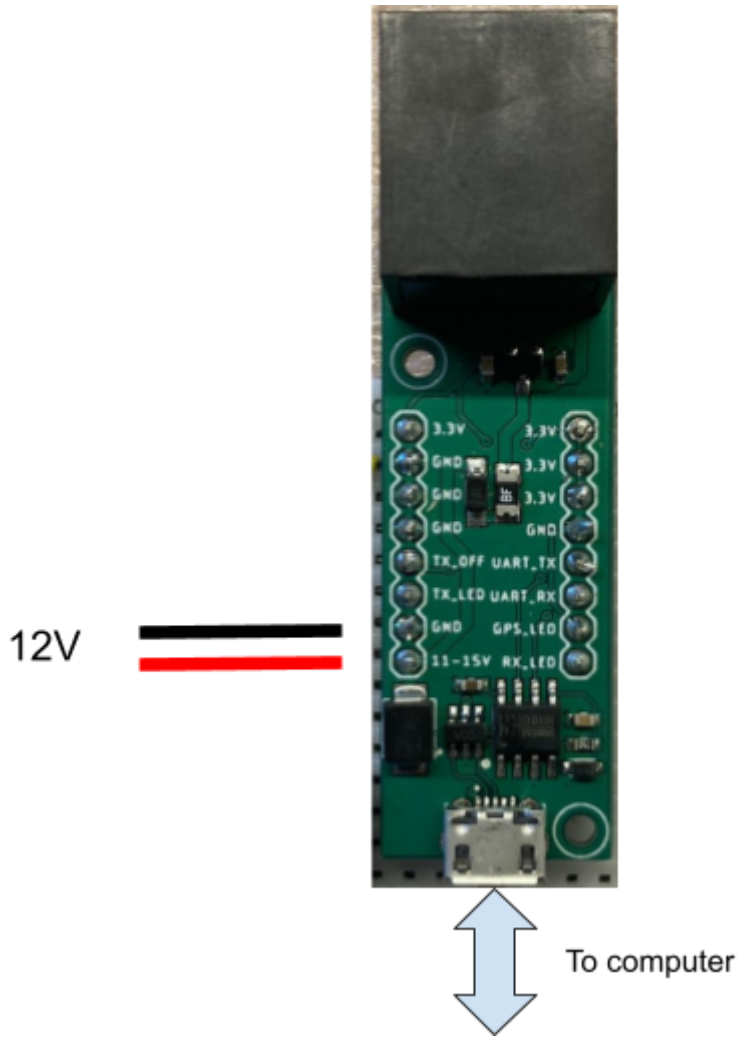
If you use some kind of 12V “wall wart” adapter, make sure you measure its voltage output before attaching it to MAIANA**.** Many cheap AC to DC switches output as much as **twice** their nominal voltage with light loads. The absolute maximum input voltage for MAIANA is **16V**. Anything beyond that will likely cause irreparable damage, often accompanied by some really nasty smelling smoke. Do not assume, measure!!!

If you plan to use the USB interface, make sure your system has the driver for the WCH340 IC. Linux systems (like the Raspberry Pi) have it built in. For Windows and Mac OS, download a driver directly from the manufacturer at this page (sorry, it’s only in Chinese):

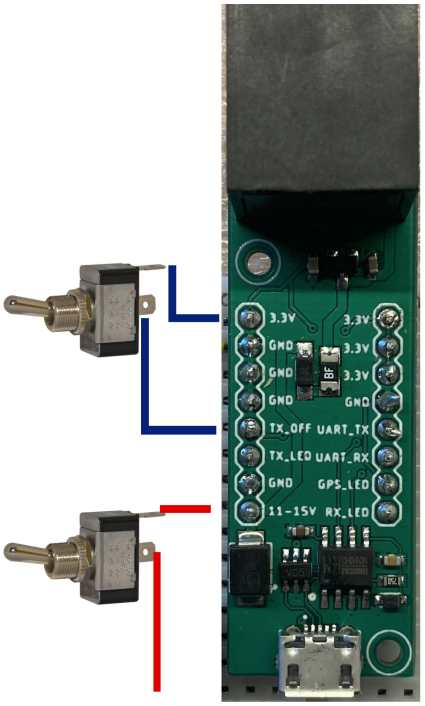
http://www.wch.cn/downloads/CH341SER_EXE.html

UART Adapter

This adapter is now included in every kit. You will need to supply 12V from a battery or a power supply and connect the USB cable to the computer. Alternatively, you may choose to wire the UART RX and TX lines directly to an adapter or the Raspberry Pi pin headers.



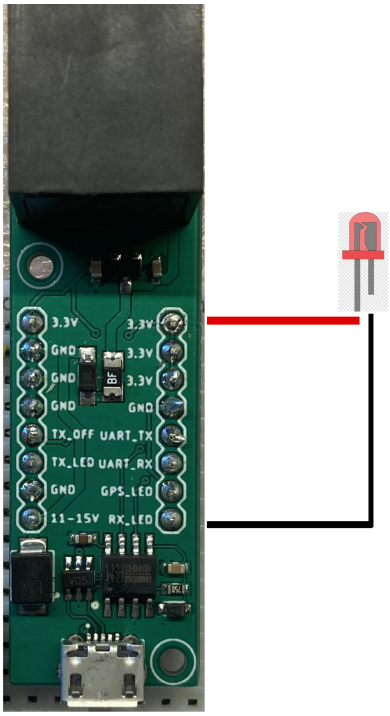
The breakout board should be mounted below deck, somewhere where it's going to be protected from the elements. How and where it is fitted is entirely your choice.



If you want a power and/or TX switch, you can use simple rocker switches as shown here.

A 1A-rated SPST can simply interrupt the main 12V supply.

If you want a hardware switch for "silent mode", you need to remember that transmission is disabled if the TX_OFF signal is driven to a logic "high" (above 2V), so wire it as shown here.

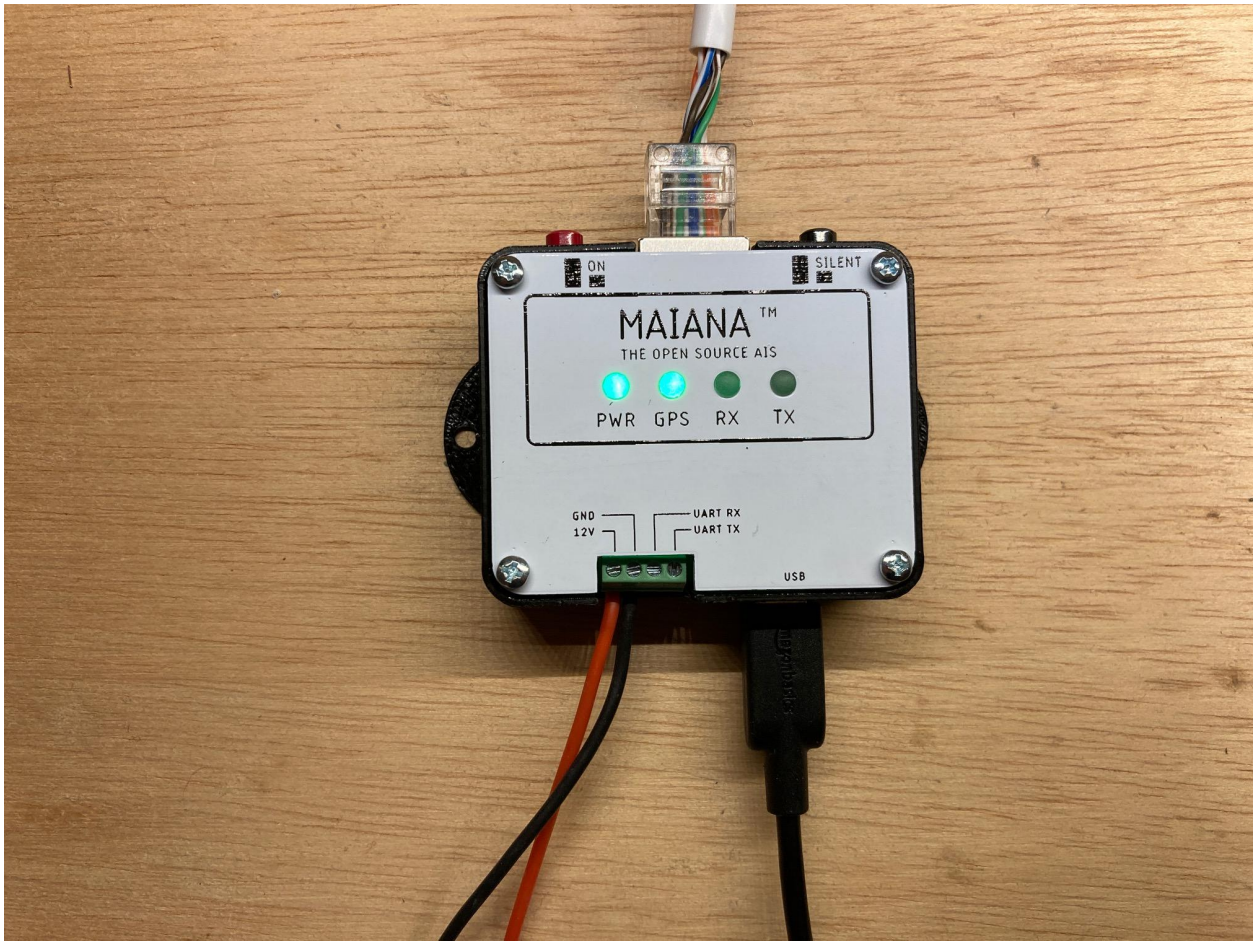


If you intend to wire LEDs, this is the correct way. The LED signals are *open drain* outputs. Rather than supplying a voltage, they pull the cathode of the LED to GND via a built-in 100 Ohm resistor.

The voltage you apply to the anode is flexible (up to 30V tolerated), but the breakout supplies 3.3V so take advantage! That said, some LEDs may still draw too much current and will need an extra resistor added in series. You can wire that on either the anode or the cathode side.

USB Adapter

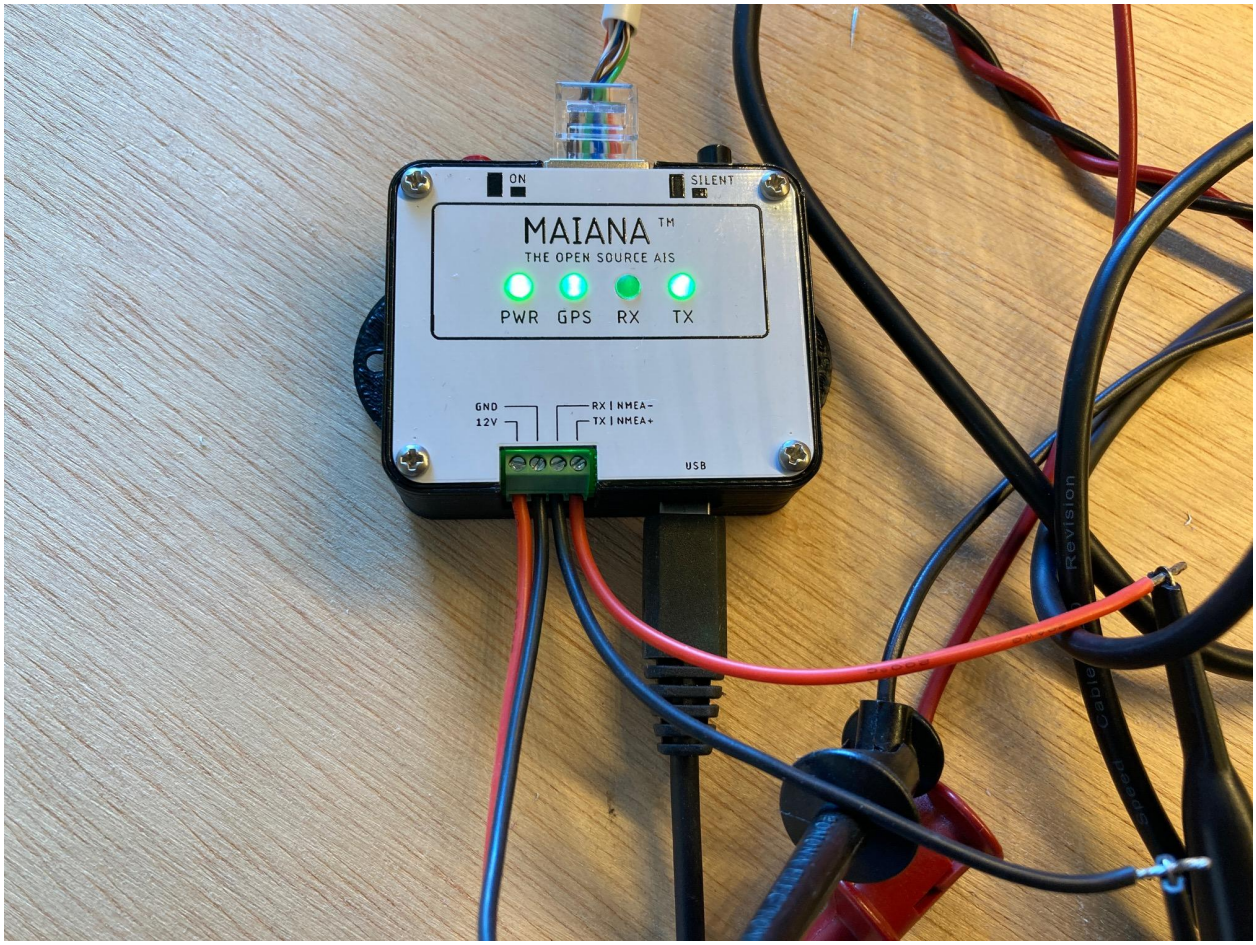
If you have ordered this adapter, wire it to a 12V supply as shown here.



The wires labeled “UART RX” and “UART TX” simply expose the raw UART signals from the main board in case you need them. You may consume AIS NMEA data from both USB and UART at the same time, but only one interface should be sending commands to it.

NMEA 0183 Adapter (RS422)

If you have ordered this adapter, wire it to a 12V supply as shown here.

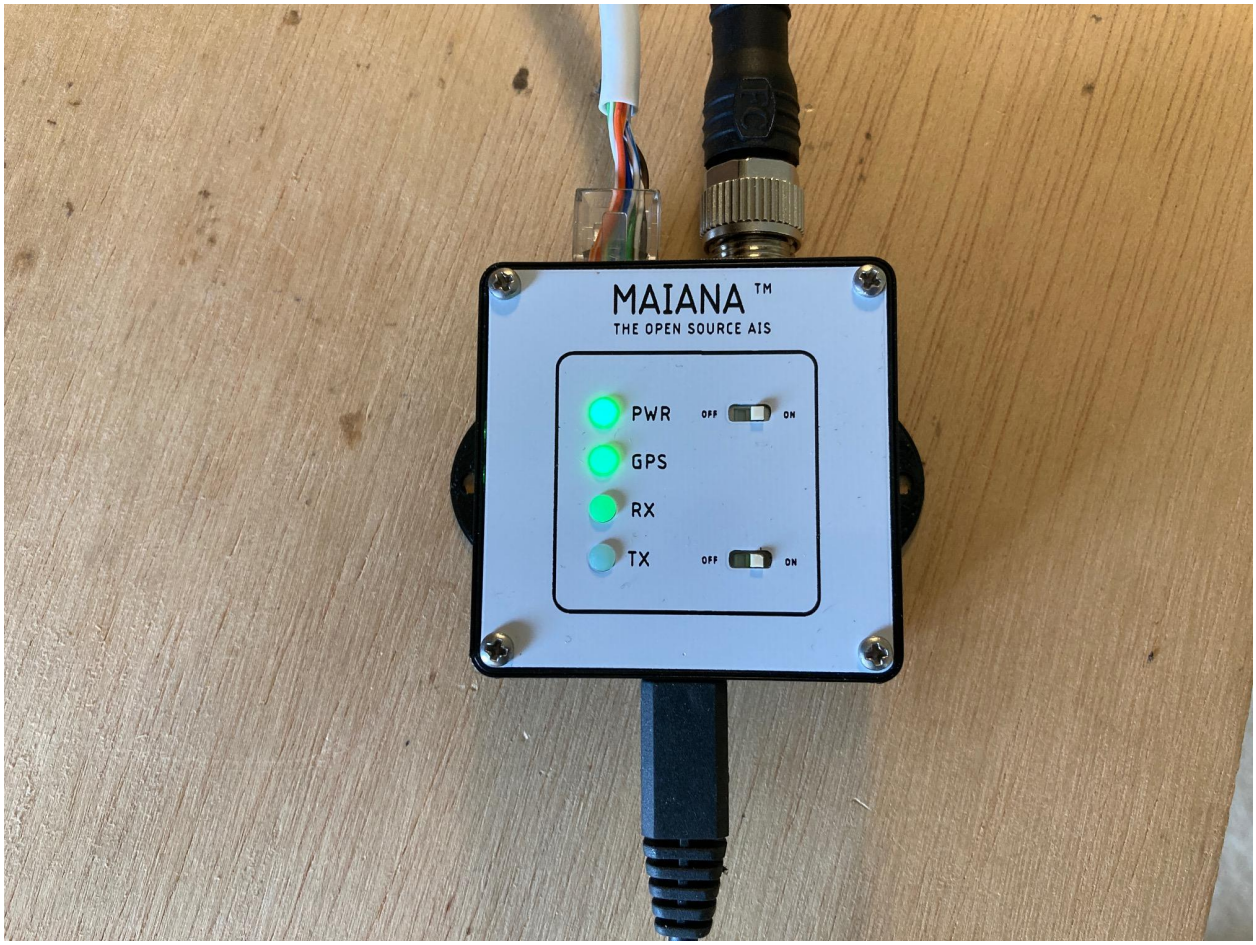


The wires labeled “NMEA+” and “NMEA-” make up the differential output that must be wired to your NMEA0183 listener. If you don’t use differential signaling on your boat then wire “NMEA+” and “GND” instead.

The NMEA0183 (RS422) interface is output *only*, so you cannot use it to speak *to* the unit. For this purpose, the adapter also has a USB connector for bidirectional serial port access. You can use both interfaces at the same time.

NMEA 2000 Adapter (CAN)

Wire the breakout box to a NMEA 2000 bus with a drop cable as shown here:



Power up the system, and you should see the PWR LED turn on. If MAIANA is near AIS stations, it should be receiving transmissions, so the RX LED will be blinking. Finally, after it acquires a GPS fix, the GPS LED will turn on.

Provisioning

Configure the COM port for 38400 bps, 8 bit data, no parity, one stop bit. Attach the serial terminal to this port and power up the system. You should see a continuous feed of NMEA0183 sentences.

To interact with the unit using commands, configure your serial terminal application for line input with CRLF (‘\r\n’) termination. Then send the *cli* command (you may need to send it more than once). The unit should reboot and respond with this output:

```
CLI mode. Send the 'reboot' command or cycle power to exit.
```

With the terminal really quiet now, it’s a lot easier to send the *station* command for provisioning. This command has eight comma-separated arguments with no quotes or spaces in between. It must be sent in one line like this:

```
station mmsi,name,callsign,type,len,beam,portoffset,bowoffset
```

The arguments are:

- MMSI (you should have one for your boat already)
- Boat name (up to 20 alphanumeric characters, no punctuation. Use all caps)
- Call sign (may be empty if you don’t have one)
- Type (this is the numeric type of the vessel, see below)
- Length in meters (integer only)
- Beam (width) in meters (integer only)
- Port offset (meters from the port side where the unit is located).
- Bow offset (meters from the bow where the unit is located).

For vessel type, here are some numeric values that apply to class B transponders:

- 30 - Fishing
- 34 - Diving
- 36 - Sailing
- 37 - Pleasure craft

Choose whichever you think is appropriate.

When you send the command, the unit will program the data into its EEPROM and respond with the $PAISTN proprietary sentence. Here is an (invalid vessel) command example:

```
station 987654321,NAUT,,37,0,0,0,0
```

response:

```
$PAISTN,987654321,NAUT,,37,0,0,0,0*2A
```

If you made a mistake, you can always send the *station* command again. If this looks like it worked, issue the *reboot* command to restart the unit.

Final installation

The antenna housing is designed for mounting on 1” OD railing, which is fairly standard for boats. It can also work with 1” OD fiberglass masts.

Feed the Cat5 cable through the railing and make sure there is at least 20cm of slack where the unit will mount. Cut another 3” long piece of the 1.5” heat shrink tube and place it at the edge of the railing. Now snap the R45 into the transponder board like you practiced before, and feed the transponder case over the tube (you may need to twist to coil the cable into it).

Once the casing is fully seated, you can bring the heat shrink tube up to cover the joint:

Finally, use the heat gun to shrink the tube. Apply heat generously, until the material glazes. That should be all for the exterior unit!

You must support the Cat5 cable somewhere below the tube. Do not hang long, heavy sections of cable from the main board, as it can put excessive pressure on the SMA connector of the antenna and cause it to fail.

If you run into trouble, email maiana.kits@gmail.com

Enjoy!