MARK Manual

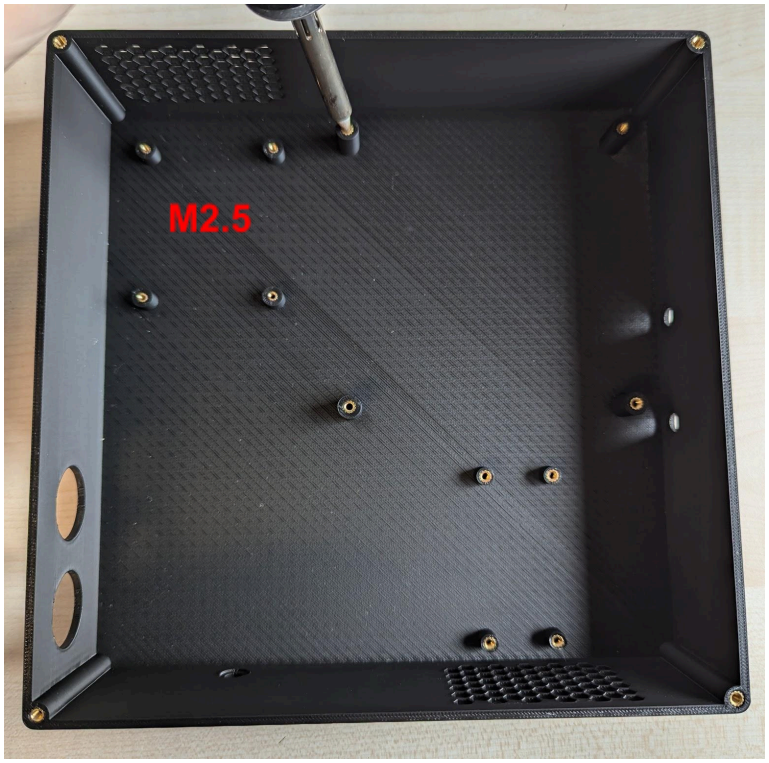
Materials

1x Raspberry Pi 4
1x MicroSD Card
1x Raspberry Pi 5 Usb-C power supply
1x Mega4 PPPS Hub
1x TRM240
1x TRM250
1x Tinkerforge Masterbrick
1x Tinkerforge GPS Brickelt
3x Tinkerforge Current/Voltage Bricklet
1x Tinkerforge mounting plate 22x22
1x Tinkerforge GPS Antenna SMA 300cm
1x USB-C to USB3.0 built-in plug
1x RJ45 built-in plug
2x SIM PCB Adapter
2x adapter cable JST XH to Dupont 3-pin 30 cm
1x U.FL to SMA Adapter
4x Tinkerforge Bricklet Kabel 6cm
1x USB 3.0 Splitterkabel
2x USB-A to USB-C 0.3m
3x USB-C 90° angle plugs
1x USB 3.2 to USB-C 0.5m
2x Micro USB 90° links 0,45m
2x SMA female to male 0.3m
1x SMA female to male 0.15m
1x Cat6 ribbon cable 0.1m
16x M3 6+6mm female standoffs
32x M3 6mm screws
20x M3 nuts
8x M3 15+6mm female standoffs
4x M2.5 6mm screws
4x M2.5 10+6mm female standoffs
12x M3 Heat Insert 5mm
4x M2.5 Heat Insert 5mm
Heat shrink tubing black D=1.6mm, d=0.8mm
Shrink tube red D=1.6mm, d=0.8mm
Tesa self-connecting repair tape

Tools

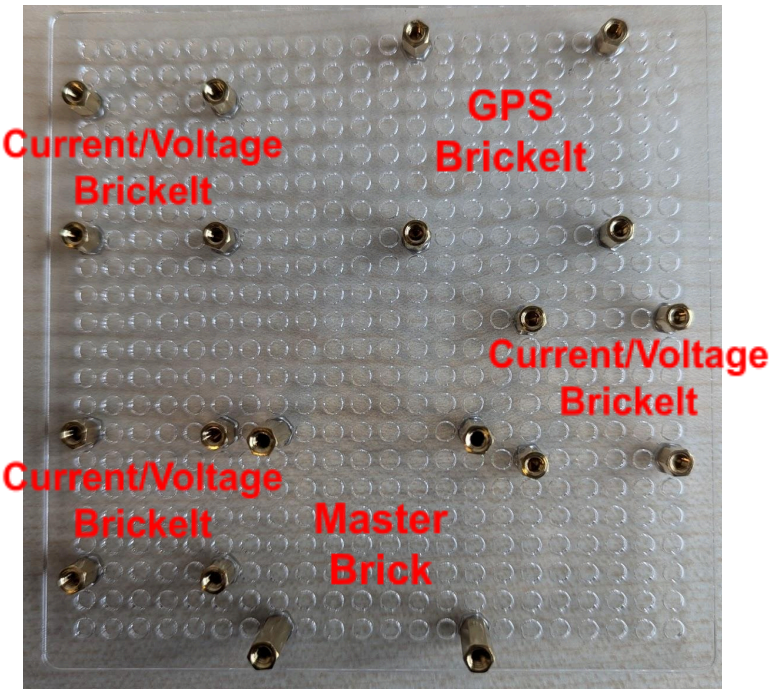
Scissors, iFixit kit/cordless screwdriver, wrenches 5 and 8, Allen key (included with TRM modems), wire stripper, scalpel, heating gun, soldering aid set, 3D printed gadgets

Instructions

1. If not available, print box and lid
    a. Mark_v2_enclosure.stl & mark_v2_enclosure_lid.stl
2. Prepare Raspberry Pi + SD card
    a. Materials
        i. Raspberry Pi
        ii. SD card
    b. Install Ubuntu 24.04 with the following settings and enable ssh
3. Insert heat inserts
    a. Materials
        i. Box
        ii. Heat Inserts
            1. 4x M2.5
            2. 12x M3
        iii. soldering iron
        iv. optional: pair of tweezers
    b. (Attach correct tip to soldering iron)
    c. Set the soldering iron to 235°C
    d. Put on heat inserts
    e. do not apply pressure
    f. If necessary, press/adjust with tweezers → but be careful, otherwise the plastic will give way!
    g. 

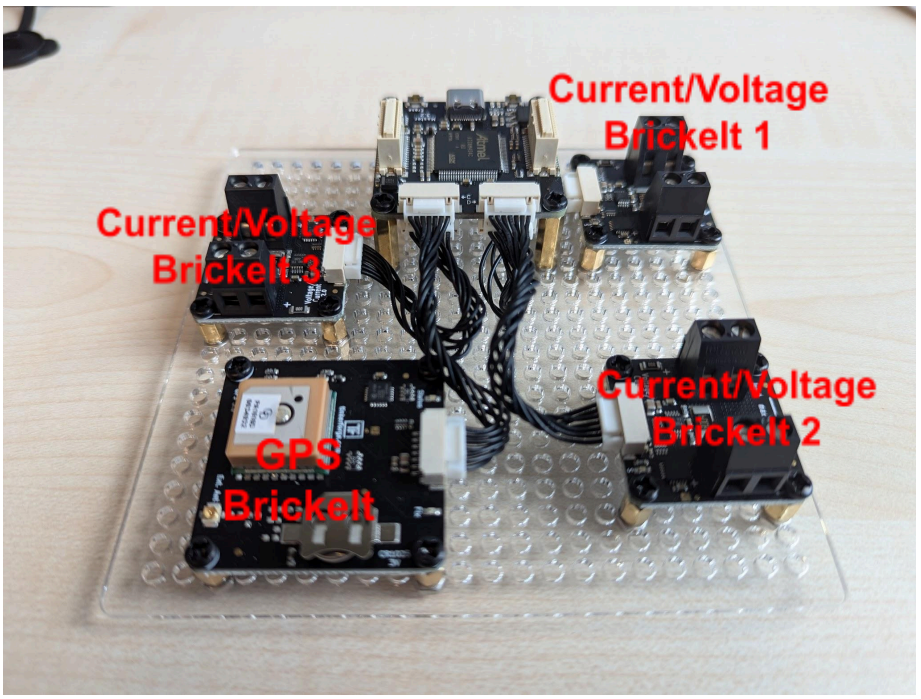
4. Assembling the Tinkerforge board
    a. Materials
        i. 1x Tinkerforge mounting plate 22x22
        ii. 1x Tinkerforge Masterbrick
        iii. 1x TInkerforge GPS Bricklet

iv. 1x U.FL to SMA Adapter
v. 3x Tinkerforge Current/Voltage Bricklet
vi. 4x Tinkerforge Bricklet Kabel 6cm
vii. 16x M3 6+6mm female standoffs
viii. 4x M3 15+6mm female standoffs
ix. 20x M3 nuts
x. 20x M3 6mm screws
xi. Screwdriver/cordless screwdriver, 5 mm Allen key/template

b. Peel off the film on both sides of the mounting plate
c. Insert battery into GPS Bricklet
d. Install spacers and nuts
    i. 

e. Install 4 deep bricklets
f. Attach Bricklet cables to Brickelts
g. Assemble master brick
h. Connect all cables to Masterbrick
    i.

C: GPS Brickelt	D: Current/Voltage Bricklet 2
A: Current/Voltage Bricklet 3	B: Current/Voltage Bricklet 1

ii. 

i. Attach U.FL to SMA adapter to GPS Bricklet

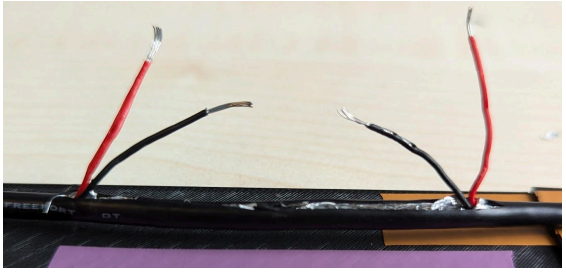
5. Cut cable
   a. Materials
      i. 1x USB 3.2 to USB-C 0.5m
      ii. 2x Micro USB 90° links 0,45m
      iii. Heat shrink tubing red and black D=1.6mm, d=0.8mm
      iv. Tesa self-connecting repair tape
      v. Scalpel, stencil, wire stripper, scissors, soldering aid set, heating gun
   b. Cut off pieces of paper from cables
   c. Insert cable into template

   d. Cut the cable lengthwise in the marked area
   e. Push the wire aside in 3 places (left, middle, right) and cut the foil

   f. Cut red and black wire in the middle section

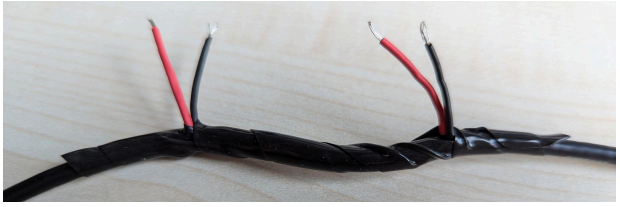
   g. Pull out the red and black wire in the two outer cuts

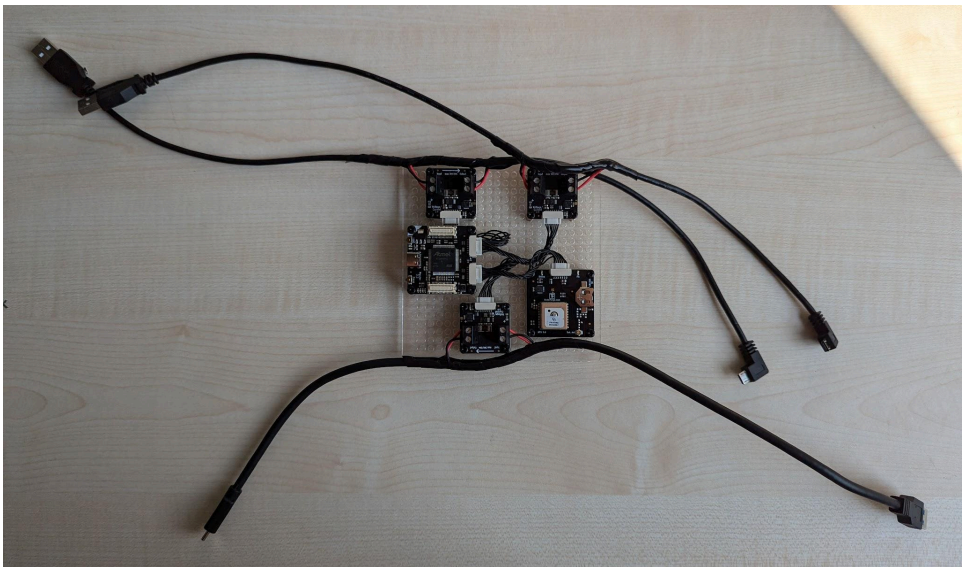
h. Strip the 4 wire ends



i. Attach red and black heat shrink tubing

j. Wrap self-welding insulating tape around the entire jacket



6. Attach cut cables and current/voltage bricklets
    a. Materials
        i. Tinkerforge Board
        ii. Cut cables
        iii. Screwdriver/cordless screwdriver
    b. USB-C cable and Current/Voltage Bricklet 3 screws
    c. Lila micro USB Kabel an Current/Voltage Bricklet 2
    d. Braun micro USB Kabel an Current/Voltage Bricklet 1
    e. 
7. Insert wall mounts and Y-cables
    a. Materials
        i. Box
        ii. 1x RJ45 Mount

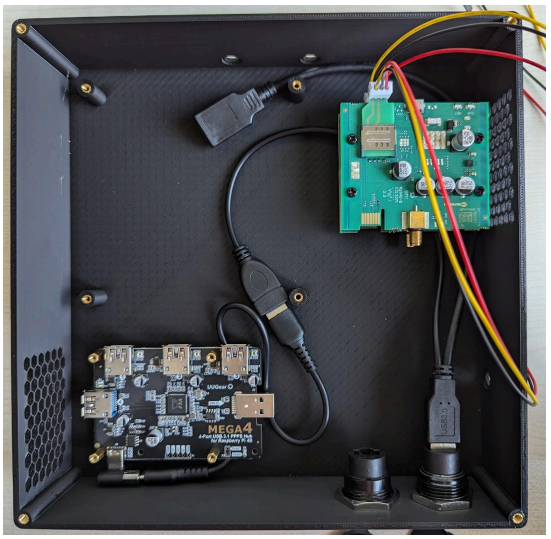
iii. 1x USB-C → USB 3.0 Mount
iv. 1x USB 3.0 Splitterkabel

b. Rechts USB, Links RJ45
c. Pay attention to the direction of the USB mount!
d. Plug the Y cable into the USB mount

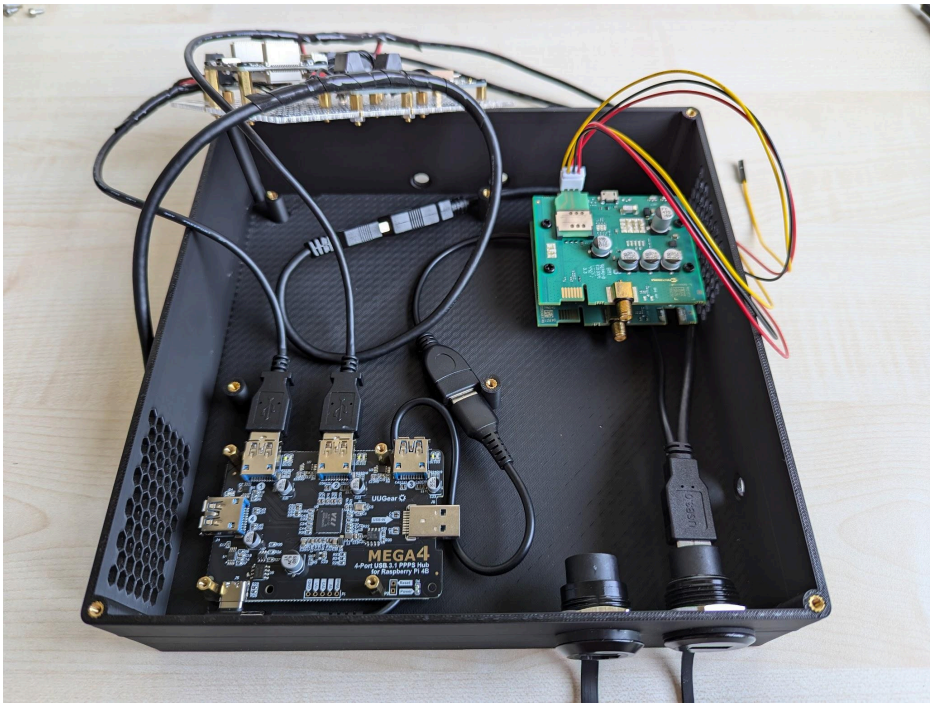
8. Assemble the hub

a. Materials
   i. Box
   ii. Mega4 PPPS Hub
   iii. 1x USB-C 90° angle plug
   iv. 1x USB-A to USB-C 0.3m
   v. 4x M2.5 10+6mm female standoffs
   vi. Screwdriver/cordless screwdriver
b. Remove plastic around angle plug
c. Connect the angle plug to the hub
d. Plug the USB cable into the right angle plug
e. Screw the USB hub into the box with spacers
f. Connect the USB cable to the thin end of the Y-cable

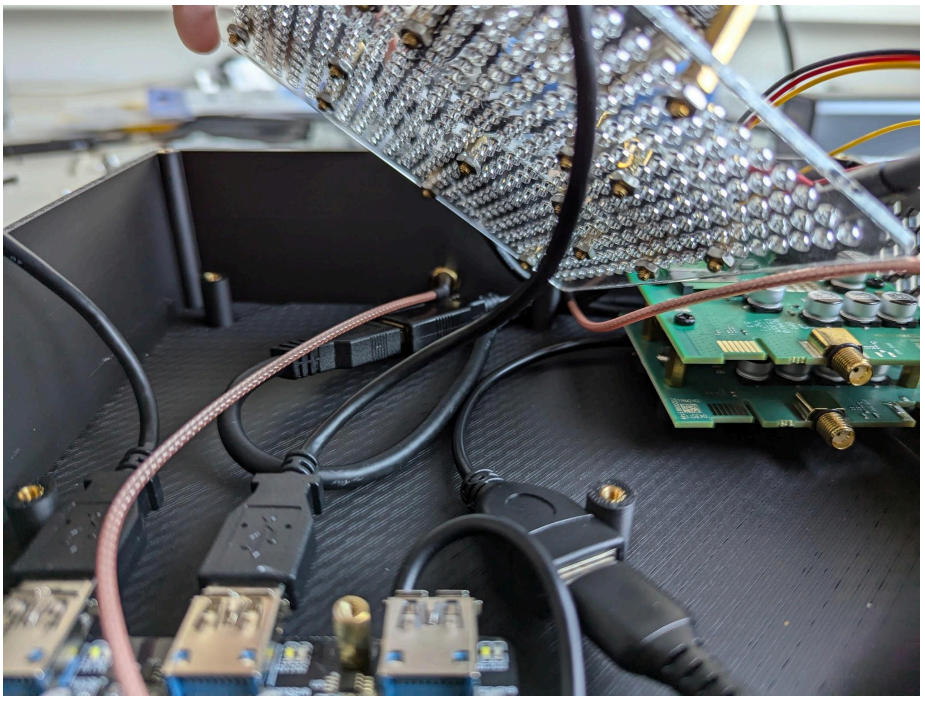
9. Install modems



   a. Materials
      i. Box
      ii. TRM 240
      iii. TRM 250
      iv. 2x SIM PCBs
      v. 2x adapter cable JST XH to Dupont 3-pin 30 cm
      vi. 4x M3 15+6mm female standoffs
      vii. 4x M3 6mm screws
      viii. Screwdriver/cordless screwdriver/Allen key
   b. Remove modems from the metal cases
   c. Insert adapter cable into SIM PCB
   d. Insert SIM PCBs into modems
   e. Screw the TRM 240 into the box with spacers
   f. Screw the TRM 250 onto the spacers with screws
10. Assemble the Tinkerforge plate and antenna cable
   a. Materials
      i. Box
      ii. Tinkerforge Platte
      iii. 2x SMA beech to plug 0.3m
      iv. 4x M3 6mm screws
      v. Screwdriver/cordless screwdriver
   b. Plug the USB-C cable into the Y cable
   c. Connect UBS cable to hub

d. 

e. Attach antenna cable

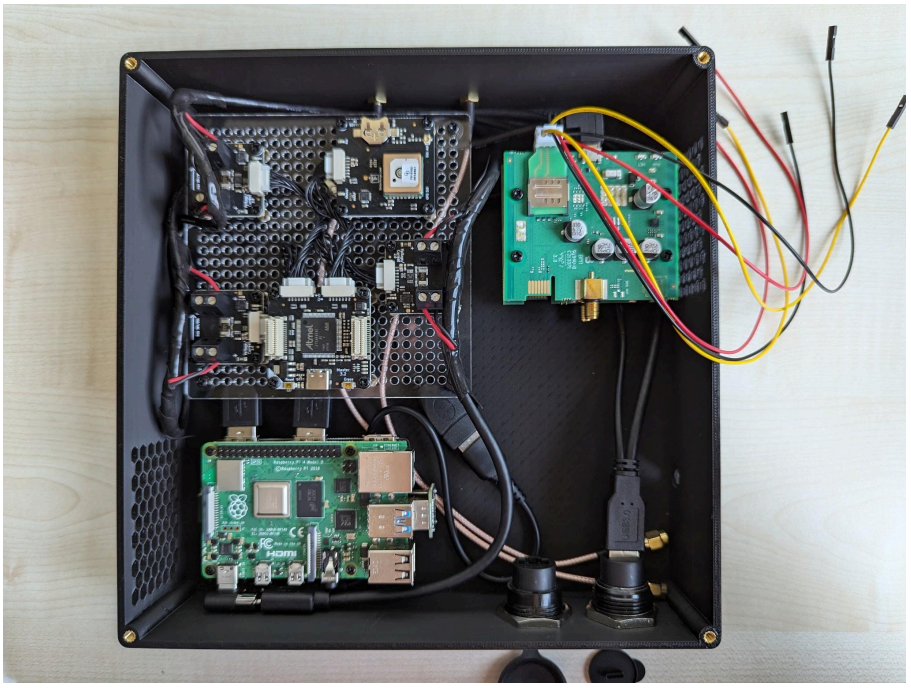


f. Connect TRM modems to micro USB cable
g. Bend the cable appropriately
h. Screw the Tinkerforge mounting plate tight

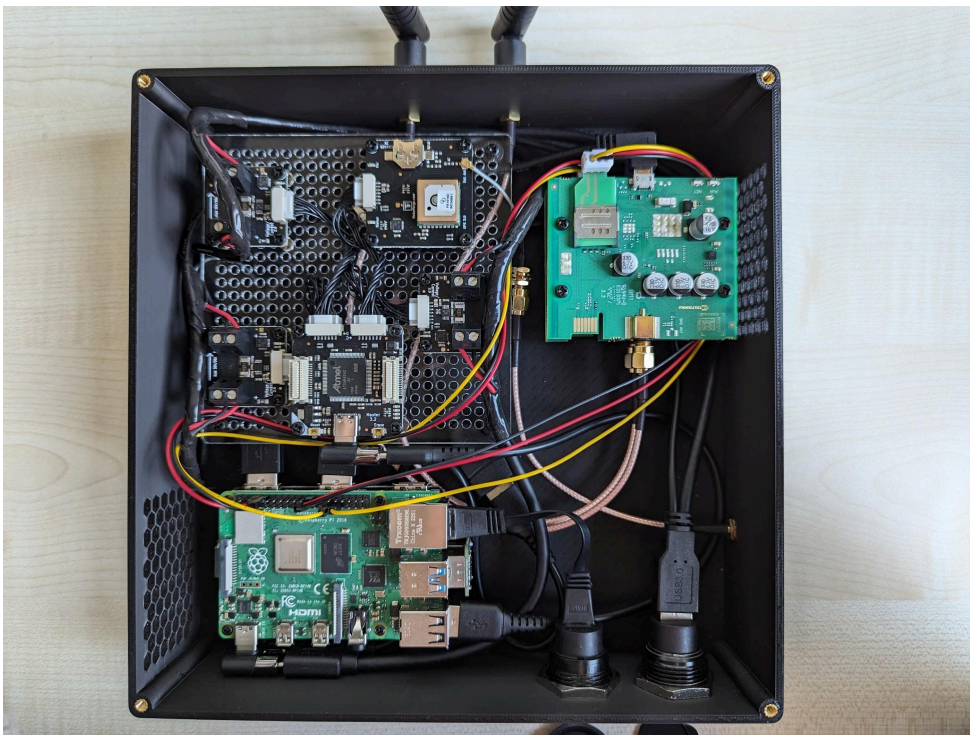
11. Install Raspberry Pi 4
    a. Materials
        i. Box
        ii. Raspberry Pi 4 with SD card inserted
        iii. 1x U-shaped USB adapter
        iv. 1x USB-C 90° angle plug
        v. 4x M2.5 6mm screws

vi. Screwdriver/cordless screwdriver
vii. Heat Sinks

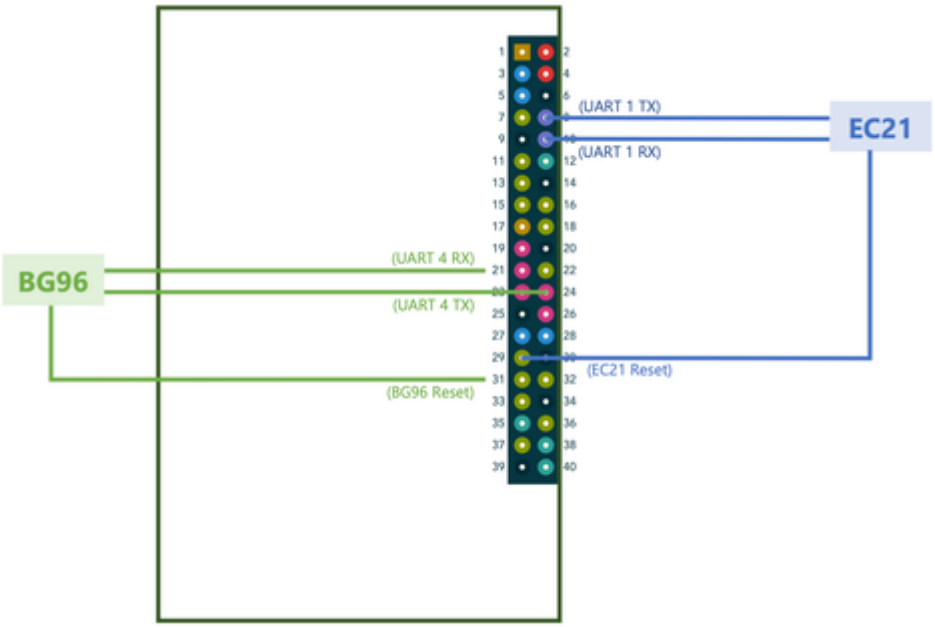
b. Glue heat inserts to the Pi
c. Screw the Pi onto the spacer
d. Plug in the USB adapter

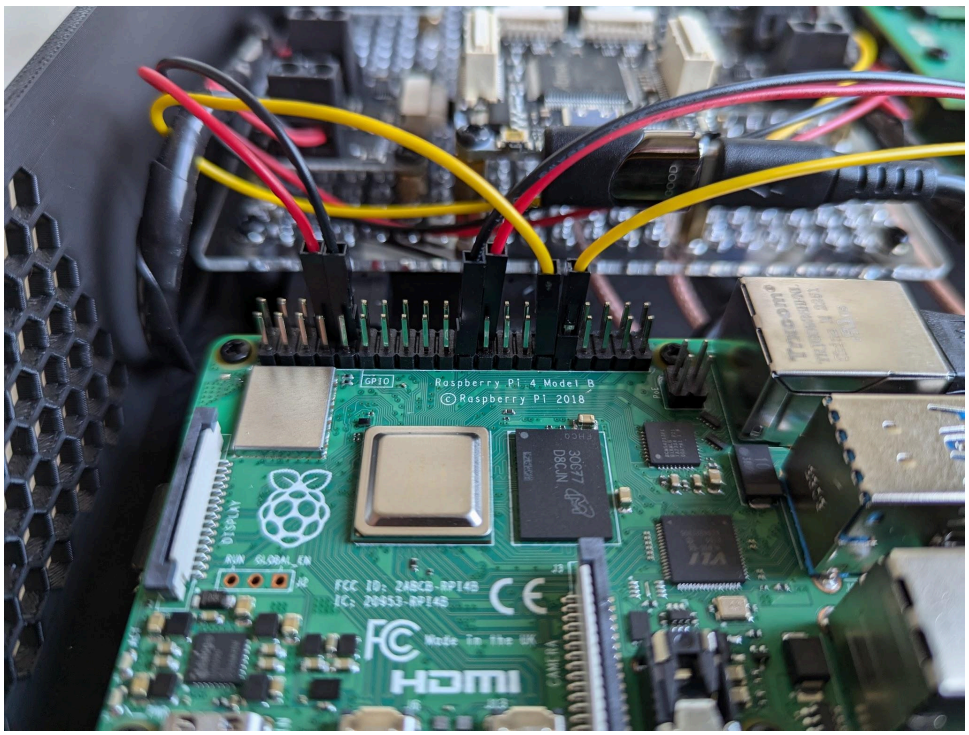


12. Attach remaining cables
    a. Materials
        i. 1x SMA beech to plug 0.15m
        ii. 1x Cat6 ribbon cable 0.1m
        iii. 1x USB-C 90° angle plug
        iv. 1x USB-A to USB-C 0.3m
        v. 1x U.FL to SMA Adapter
    b. Screw antenna cables to modems
    c. Screw the GPS antenna cable into the box
    d. Connect U.FL to SMA adapter to antenna cable and GPS Bricklet
    e. Attach angle connector to Masterbrick
    f. Connect the USB cable to the Pi and the angle plug on the master brick
    g. Connect the ribbon cable to the wall mount and Pi

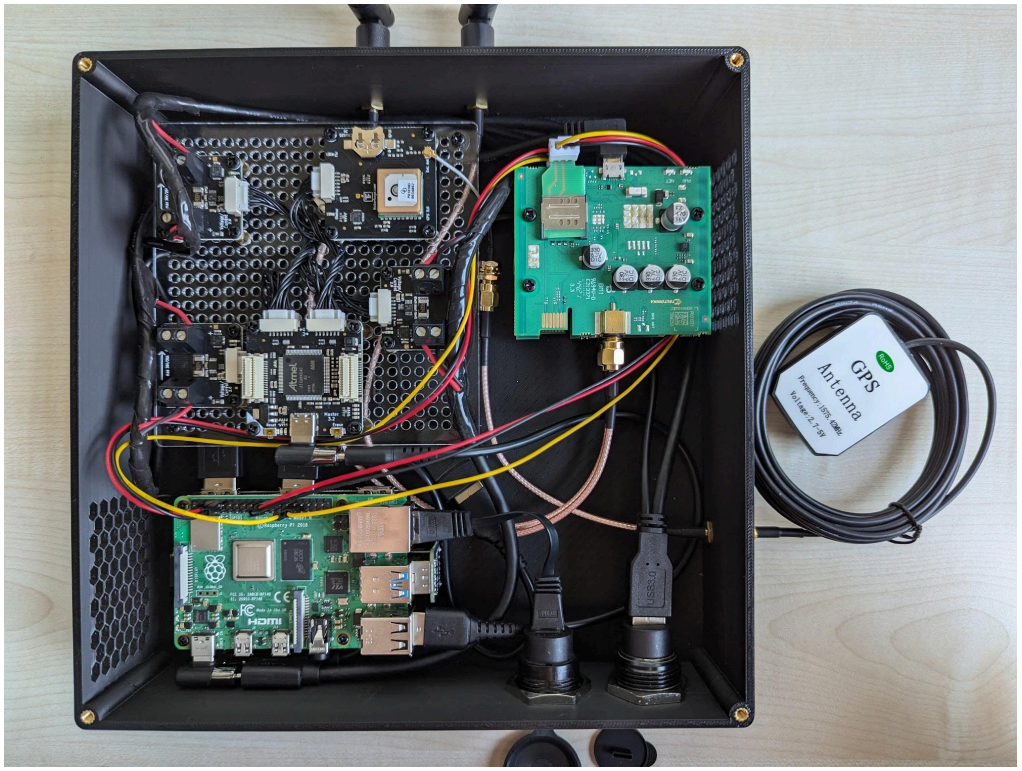


h. Connect Dupont connector to Pi





13. Attach antennas and power supply
    a. Materials
        i. 1x Tinkerforge GPS Antenna SMA 300cm
        ii. 2x TRM Antenna
        iii. 1x Raspberry Pi 5 Usb-C power supply
    b. Attach antennas



    c. Attach power supply