

## Maka-Niu Endcap PCB

The endcap PCB is a 6-layer, 26mm diameter board that handles wireless Qi charging, GPS (including external antenna connector), IMU, and breakouts for the Keller pressure sensor and for an external thermistor to provide temperature-related shutdown capability.

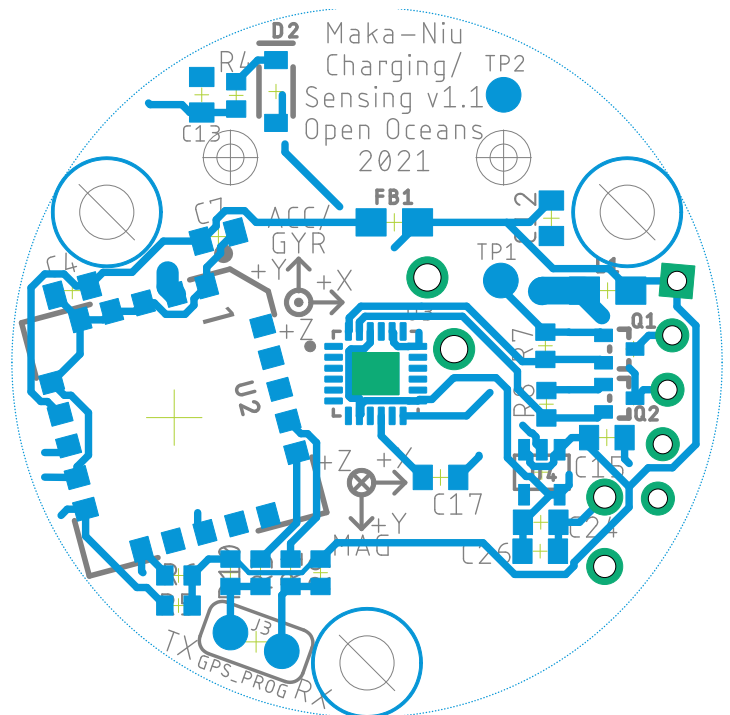
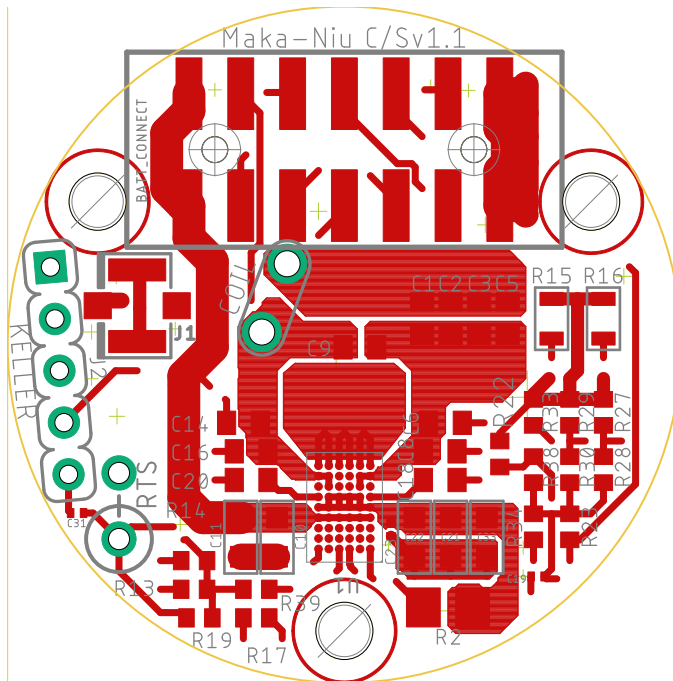
The endcap PCB connects to the other PCBs in the stack via a 14 pin Molex connector.

The wireless charging IC is an IDT P9221-R. The datasheet can be found here:  
[https://www.mouser.com/datasheet/2/464/IDT\\_P9221-R-Datasheet\\_DST\\_20171010-1093280.pdf](https://www.mouser.com/datasheet/2/464/IDT_P9221-R-Datasheet_DST_20171010-1093280.pdf)

The GPS module is an AirPrime XM1110. The most recent datasheet must be requested from Sierra Wireless.

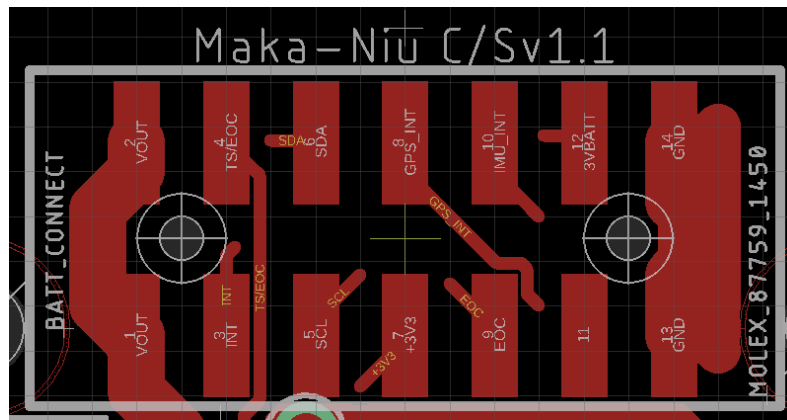
The IMU is a TDK InvenSense ICM-20948 9-axis IMU. The datasheet can be found here:  
<https://invensense.tdk.com/wp-content/uploads/2016/06/DS-000189-ICM-20948-v1.3.pdf>

Following are the layouts of the top and bottom of the board:



## Top of board, important details

The pinouts for the 14 pin Molex connector are as follows:



Pins numbered according to columns left to right and rows bottom to top within columns (as shown in diagram above, viewed in this orientation):

- 1: VOUT (to main battery)
- 2: VOUT (to main battery)
- 3: IINT (for wireless charger)
- 4: TS/EOC (temperature sensing/end of charge for wireless charger)
- 5: SCL
- 6: SDA
- 7: +3.3V
- 8: GPS INTERRUPT
- 9: EOC (from Keller pressure sensor)
- 10: IMU INTERRUPT
- 11: unused
- 12: 3V BACKUP BATTERY (for GPS)
- 13: GND (common)
- 14: GND (common)

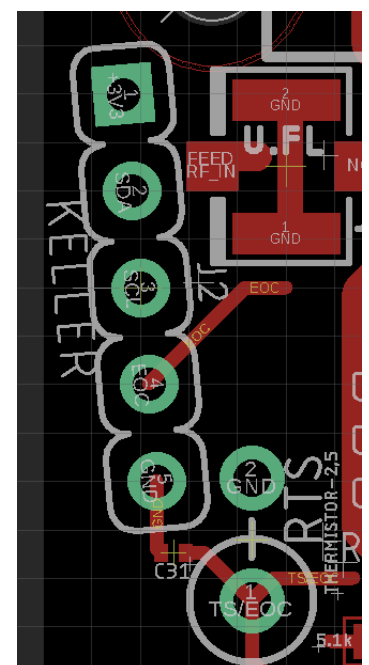
The pinouts for the Keller pressure sensor and the thermistor are as follows:

For the Keller sensor, where pin 1 has the square pad:

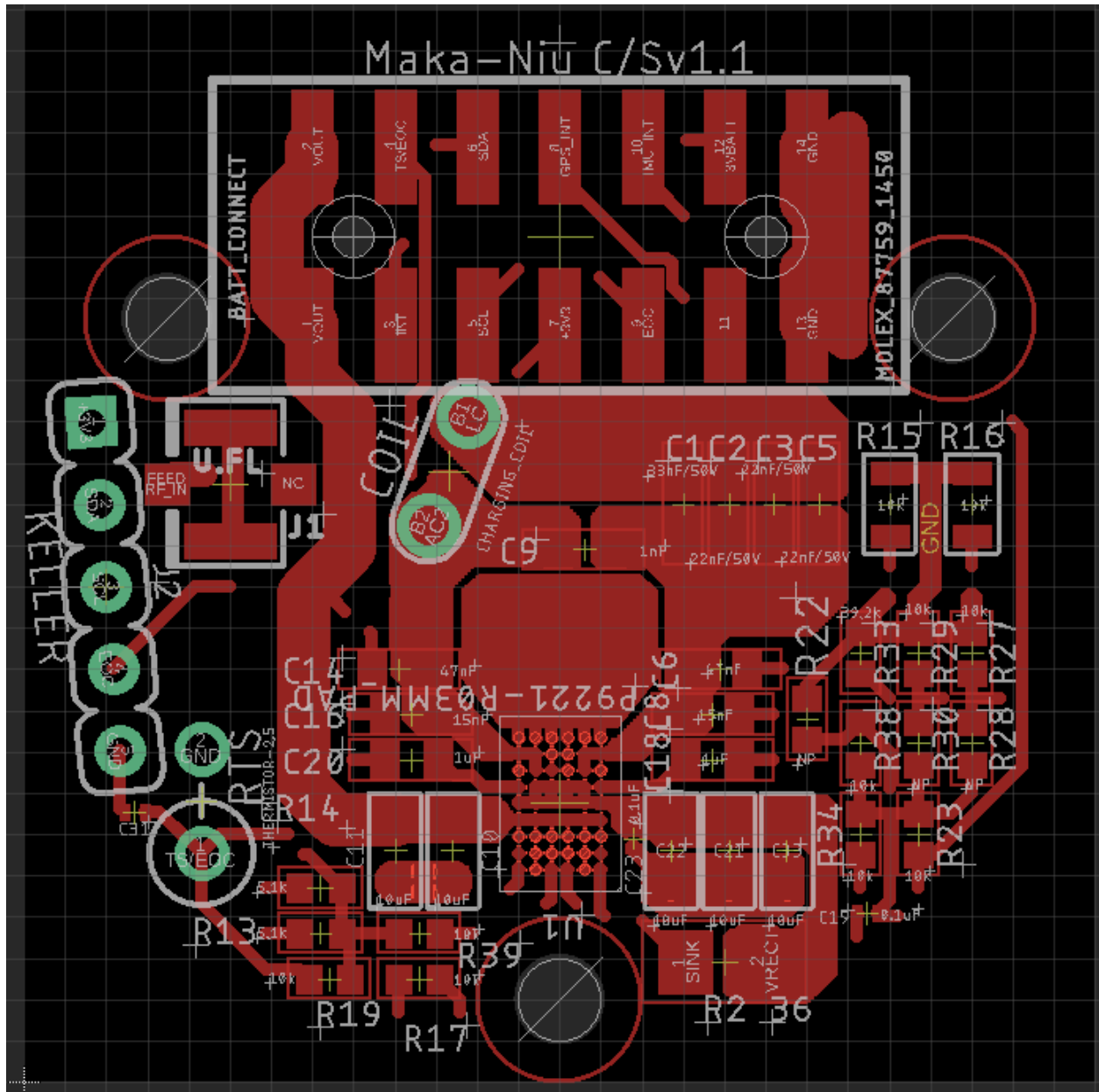
- 1: +3.3V
- 2: SDA
- 3: SCL
- 4: EOC
- 5: GND

For the thermistor, where pin 1 is circled:

- 1: TS/EOC
- 2: GND



Here is the ECAD layout of the full top of the board:



Important programming resistors to note in the resistor cluster to the bottom right:

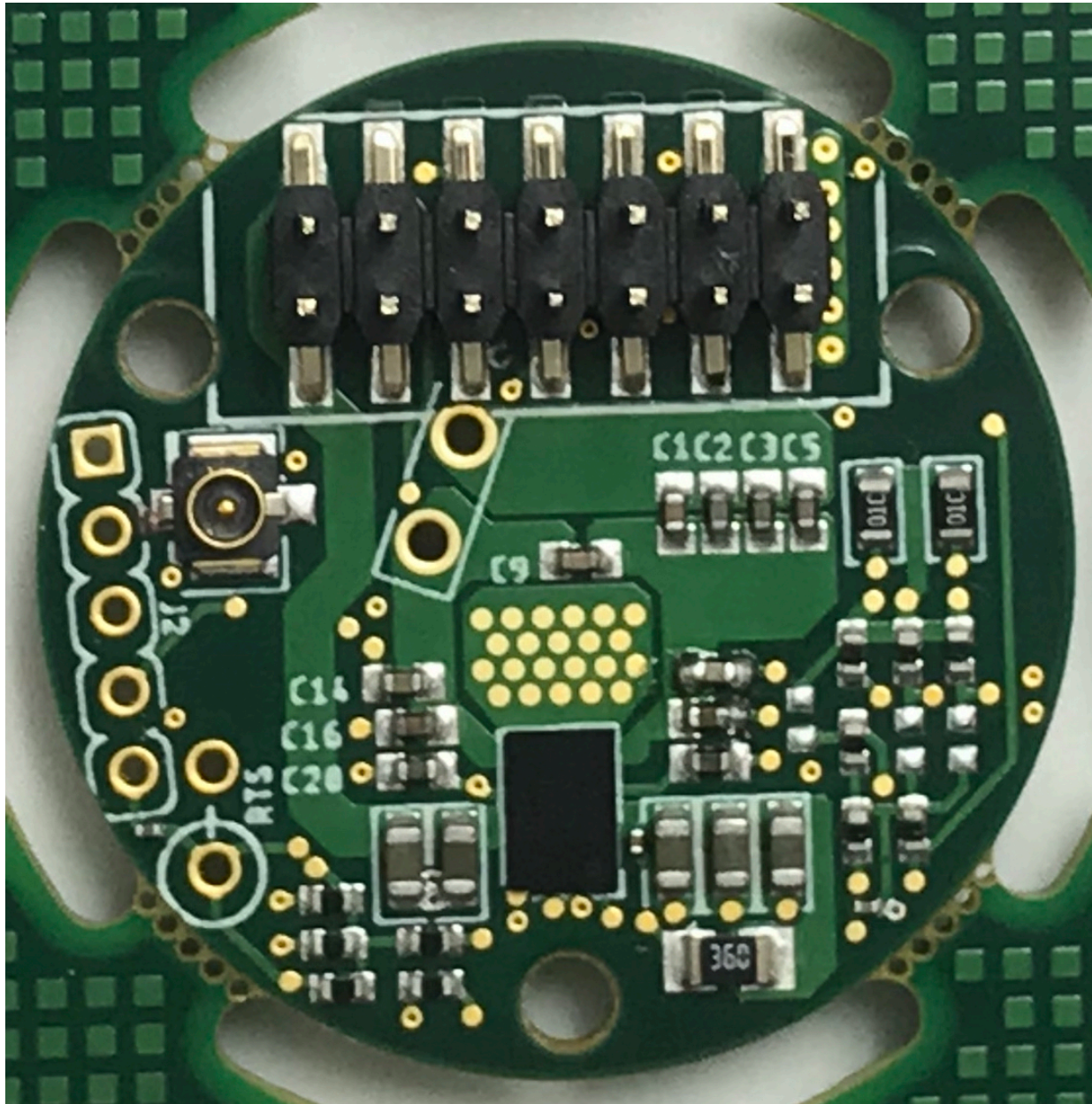
R22: used as part of a resistor divider for setting the overcurrent limit (ILIM)

R28: used as part of a resistor divider for tuning foreign object detection (FOD); tunes received packet power gain (RPPG)

R30: used as part of a resistor divider for tuning foreign object detection (FOD); tunes received packet power offset (RPPO)

These resistors are unpopulated in the initial assembly.

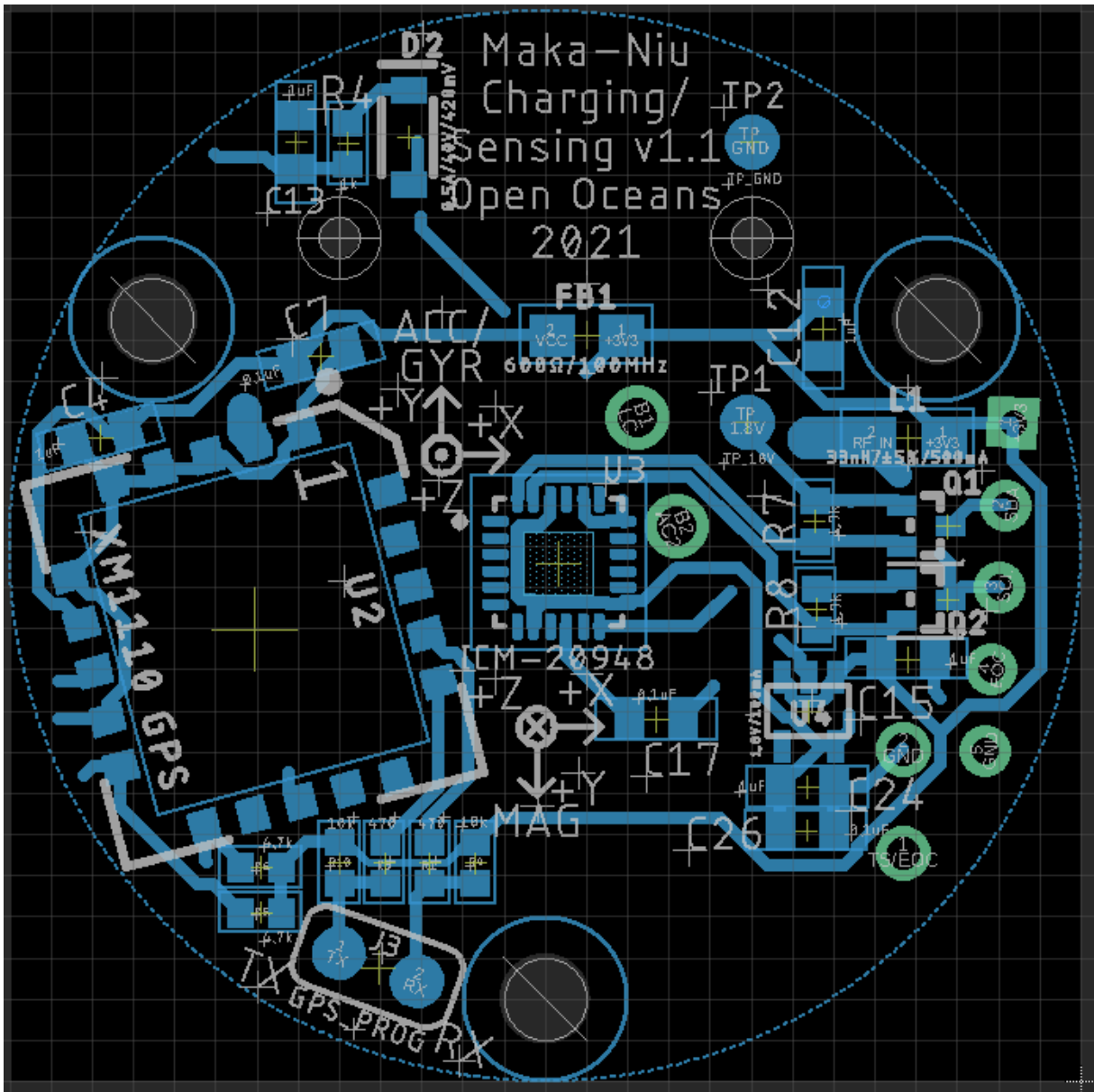
Here is a photograph of the prototype assembly. The unpopulated resistors are visible in the lower right, although they are not labeled on the silkscreen. They will be labeled in the final production run.



## Bottom of board, important details

The bottom of the board contains the GPS module and the IMU. The important features for manual adjustment/testing are J3, the GPS programming connector, and the two electrical testpoints TP1 and TP2.

Here is the ECAD layout of the bottom of the board:



As can be seen from this image, J3 has TX on the left and RX on the right.

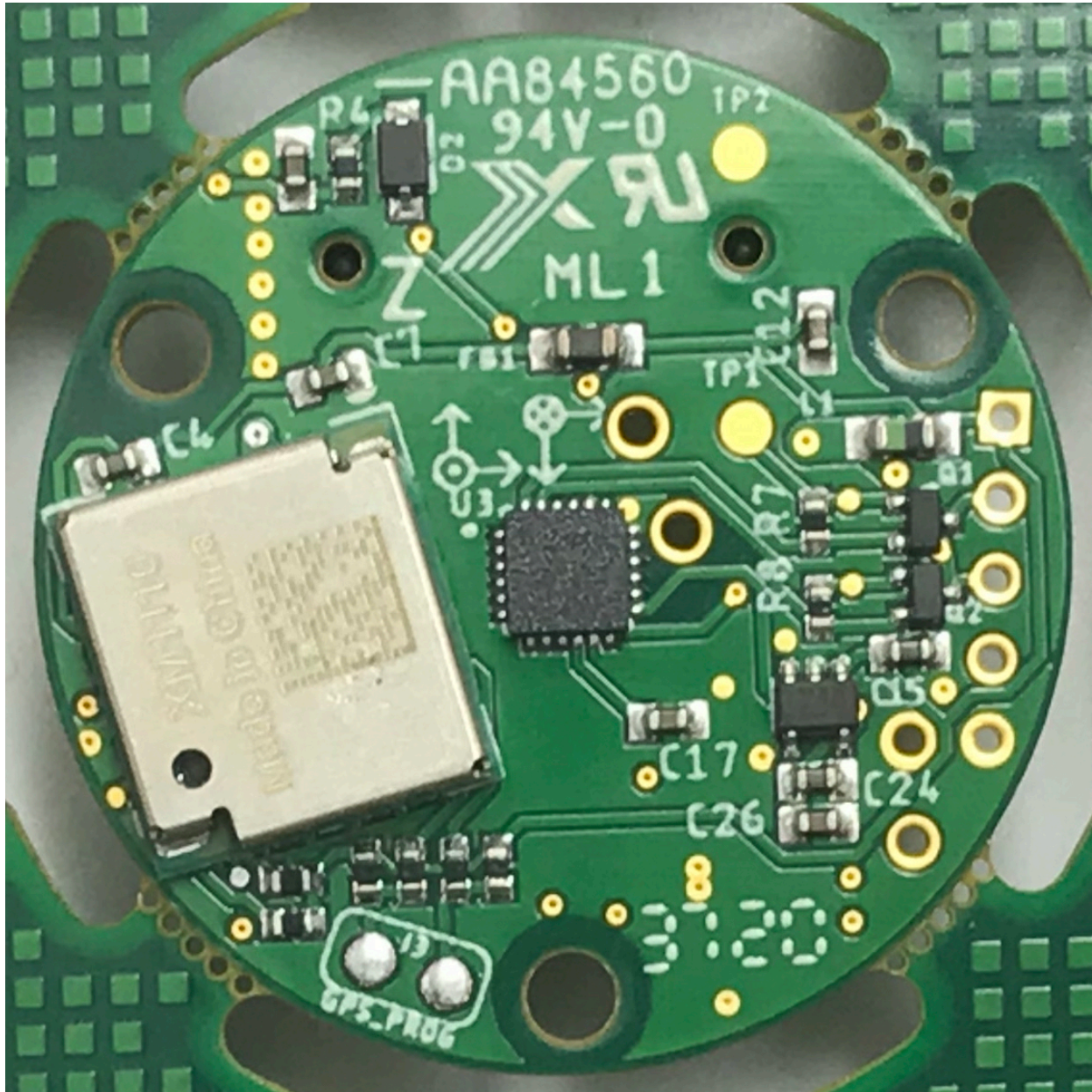
The expected testpoint voltages are as follows:

TP1: +1.8V

TP2: GND



Here is a photograph of the prototype assembly. Note that TX and RX are unlabeled in the silkscreen; they will be labeled in the final production run. Note also that the GPS module is 180° rotated from its correct orientation; this photograph was taken before this assembly error was corrected. It will be correctly oriented in the production run.



## Schematic

