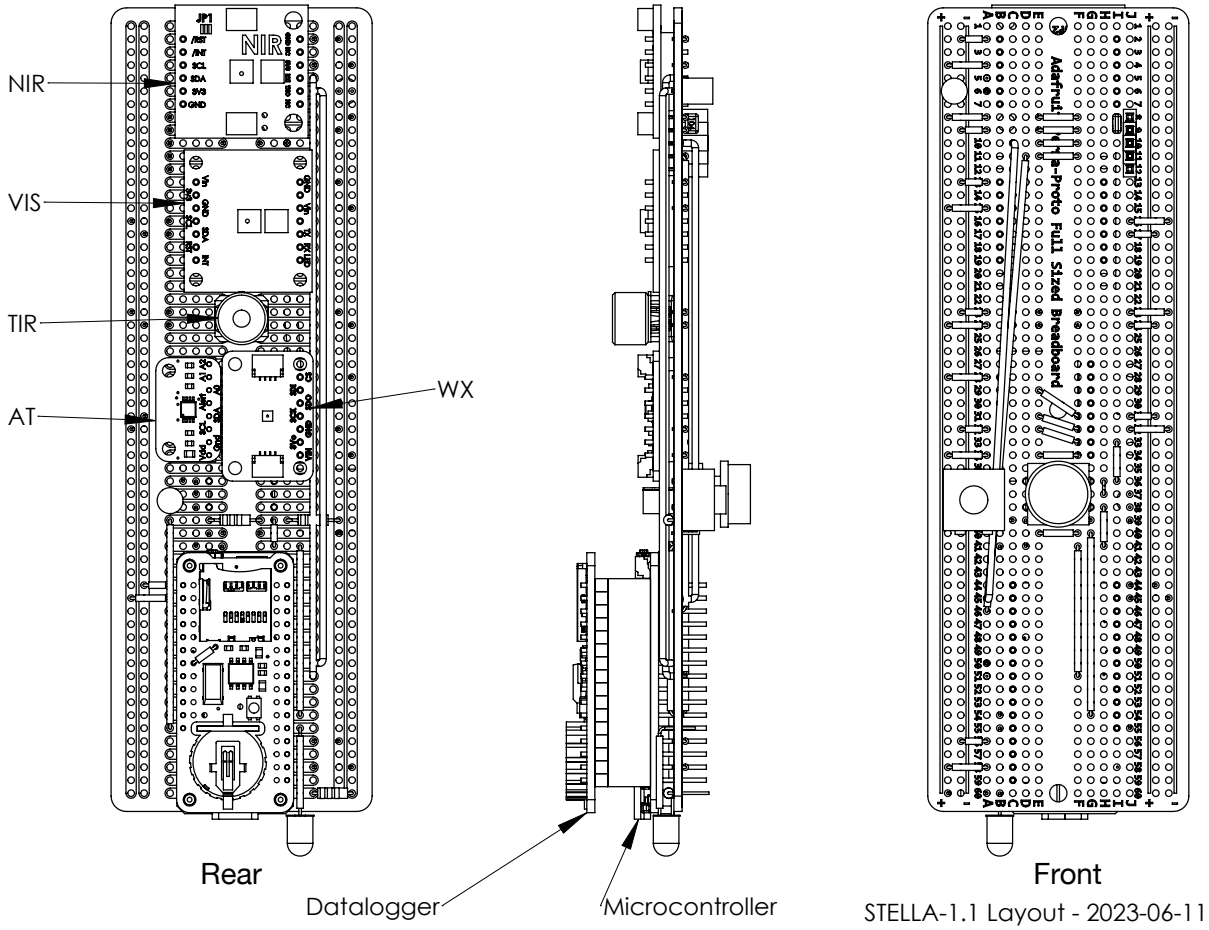
STELLA-1.1 Assembly list - 2023-07-03

Item	Step	Description	Front/ Rear	Location 1	Location 2	color	done
1	R	Resistors 100Ω	Rear	A60	(+) bus	Brown-Black-Brown	☐
2	R	Resistors 10kΩ	Rear	C39	(-) bus	Brown-Black-Orange	☐
3	R	Resistors 10kΩ	Rear	E39	G39	Brown-Black-Orange	☐
4	G	GND test point	Front	H36	H37	GND — bare wire loop	☐
5	0	black wires	Front	A2	(-) bus	GND	☐
6	0	black wires	Front	A9	(-) bus	GND	☐
7	0	black wires	Front	A13	(-) bus	GND	☐
8	0	black wires	Front	A23	(-) bus	GND	☐
9	0	black wires	Front	A32	(-) bus	GND	☐
10	0	black wires	Front	A56	(-) bus	GND	☐
11	0	black wires	Front	E9	F9	GND	☐
12	0	black wires	Front	E32	F33	GND	☐
13	0	black wires	Front	I33	I36	GND	☐
14	1	brown wires	Rear	B41	B54	Main Battery Voltage / 2	☐
15	1	brown wires	Rear	D39	D41	Main Battery Voltage / 2	☐
16	2	red wires	Front	A4	(+) bus	+3.3V	☐
17	2	red wires	Front	A8	(+) bus	+3.3V	☐
18	2	red wires	Front	A15	(+) bus	+3.3V	☐
19	2	red wires	Front	A24	(+) bus	+3.3V	☐
20	2	red wires	Front	A28	(+) bus	+3.3V	☐
21	2	red wires	Front	A34	(+) bus	+3.3V	☐
22	2	red wires	Front	A58	(+) bus	+3.3V	☐
23	2	red wires	Front	E8	F8	+3.3V	☐
24	2	red wires	Front	E34	F34	+3.3V	☐
25	3	orange wires	Rear	J39	J55	Vbat Main Battery Voltage	☐
26	4	yellow wires	Rear	A6	A50	UART Main RX1 Sensor TXO	☐
27	4	yellow wires	Front	D11	A46	UART Main RX0 Sensor TXO	☐
28	4	yellow wires	Front	E11	F11	UART Main RX0 Sensor TXO	☐
29	5	green wires	Front	J16	SCK bus (-)	i2c Serial Clock	☐
30	5	green wires	Front	J23	SCK bus (-)	i2c Serial Clock	☐
31	5	green wires	Front	J32	SCK bus (-)	i2c Serial Clock	☐
32	5	green wires	Front	E31	F32	i2c Serial Clock	☐
33	5	green wires	Rear	J45	SCK bus (-)	i2c Serial Clock	☐
34	6	blue wires	Front	H38	H41	Pushbutton (active low)	☐
35	6	blue wires	Front	F41	F51	Pushbutton (active low)	☐
36	7	violet wires	Rear	A5	A51	UART Main TX1 Sensor RXI	☐
37	7	violet wires	Front	C10	A45	UART Main TX0 Sensor RXI	☐
38	7	violet wires	Front	E10	F10	UART Main TX0 Sensor RXI	☐
39	8	grey wires	Front	E40	F40	Enable	☐
40	8	grey wires	Front	G40	G54	Enable	☐

Item	Step	Description	Front/ Rear	Location 1	Location 2	color	done
41	9	white wires	Front	J17	SDA bus (+)	i2c Serial Data	☐
42	9	white wires	Front	J24	SDA bus (+)	i2c Serial Data	☐
43	9	white wires	Front	J31	SDA bus (+)	i2c Serial Data	☐
44	9	white wires	Front	E29	F31	i2c Serial Data	☐
45	9	white wires	Rear	J44	SDA bus (+)	i2c Serial Data	☐
46	10	modify NIR	Front/Rear	A. JP1 open	B. JP2 close	For UART communication	☐
47	11	sensor pins	Rear	B2 - B7	I2 - I7	2x 6 pins for NIR spectral	☐
48	11	sensor pins	Rear	B13-B19	H13 - H19	2x 7 pins for VIS spectral	☐
49	11	sensor pins	Rear	B28 - B34	NA	1x 7 pins for WX weather	☐
50	11	sensor pins	Rear	H27 - H34	NA	1x 8 pins for AT temperature	☐
51	11	sensor socket	Front	J8-J12	NA	1x 5 pos low header socket for GPS	☐
52	12	discretes	Front	I8	I9	0.1uF capacitor	☐
53	12	discretes	Front	[-] 6	[+] 6	10uF capacitor	☐
54	12	discretes	Rear	J37 [-]	J38 [+]	10uF capacitor	☐
55	12	discretes	Rear	B60 [+]	B55 [-]	Red LED (bend leads)	☐
56	12	discretes	Front	D36, 38	G36, 38	push button	☐
57	12	discretes	Front	A40	(-) bus	power button	☐
58	13	modify data logger	Front	SDCS	reroute to 11	yellow	☐
59	14	assemble microcontroller		12 pin	16 pin	stacking headers	☐
60	15	mount microcontroller	Rear	I44	I55	12 positions	☐
61	15	mount microcontroller	Rear	C44	C59	16 positions	☐
62	16	mount sensors	Rear	B2 - B7	I2 - I7	NIR spectral	☐
63	16	mount sensors	Rear	B13-B19	H13 - H19	VIS spectral	☐
64	16	mount sensors	Rear	B28 - B34	NA	WX weather	☐
65	16	mount sensors	Rear	H27 - H34	NA	AT temperature	☐
66	16	mount sensors	Rear	E23 - E24	F23 - F24	TIR thermal	☐
		----------	-----	-----	----------	----------	☐
67	17	modify display	Rear	NA	IM1, IM2, IM3	Close jumpers IM1,2,3. Do not close IM0	☐
68	18	display board wiring	Front	C14	T14	Short header socket 16 pos	☐
69	18	display board wiring	Front	C22	N22	Short header socket 12 pos	☐
70	18	display board wiring	Rear	B1	W1	Header pins 20 pos	☐
71	18	display board wiring	Front	C14	J1	Display Reset	☐
72	18	display board wiring	Front	F14	F1	SPI MISO Main In Serial Out	☐
73	18	display board wiring	Front	G14	G1	SPI MOSI Main Out Serial In	☐
74	18	display board wiring	Front	H14	E1	SPI Serial Clock SCK	☐
75	18	display board wiring	Front	P14	B1	GND	☐
76	18	display board wiring	Front	S14	C1	+3.3V	☐
77	18	display board wiring	Front	C22	N1	i2c Serial Data	☐
78	18	display board wiring	Front	D22	P1	i2c Serial Clock	☐
79	18	display board wiring	Front	G22	H1	SPI CS Chip Select	☐
80	18	display board wiring	Front	H22	I1	SPI D/C Data/ Command	☐

STELLA-1.1 Component Layout:



NIR: AS7263 Near Infrared Spectrum Sensor on SparkFun Breakout Board

VIS: AS7262 Visible Spectrum Sensor on Adafruit Breakout Board

TIR:: MLX90614ESF-BCC-000 Thermal Infrared Remote Surface Thermometer

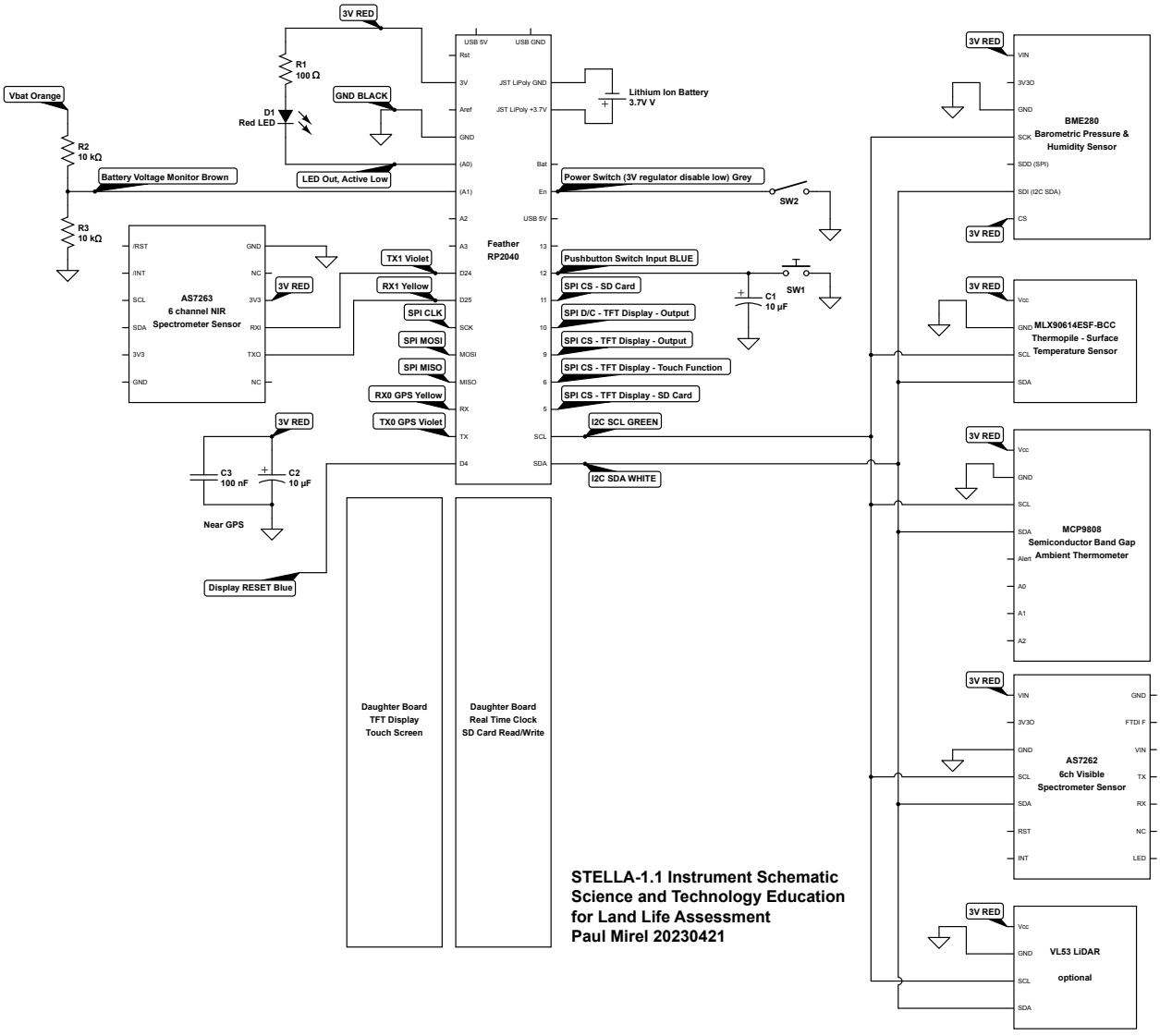
AT: MCP9808 Ambient Temperature Sensor on Adafruit Breakout Board

WX: BME280 Barometric Presssure and Humidity Sensor on Adafruit Breakout Board

Datalogger: PCF8523 Real Time Clock and SD Card Reader on Adafruit Adalogger Board

Microcontroller: RP2040 Microprocessor on Adafruit Feather Board

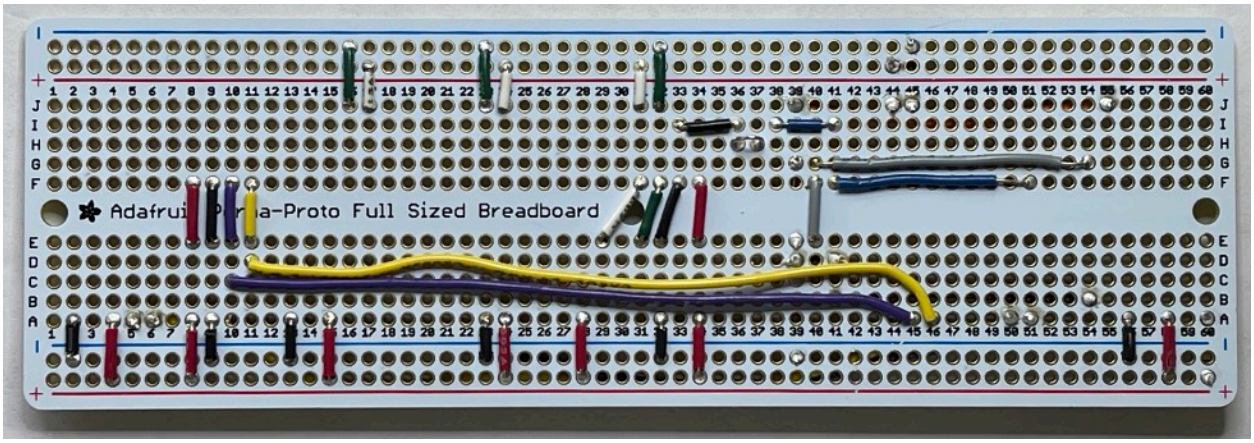
STELLA-1.1 Electrical Schematic:

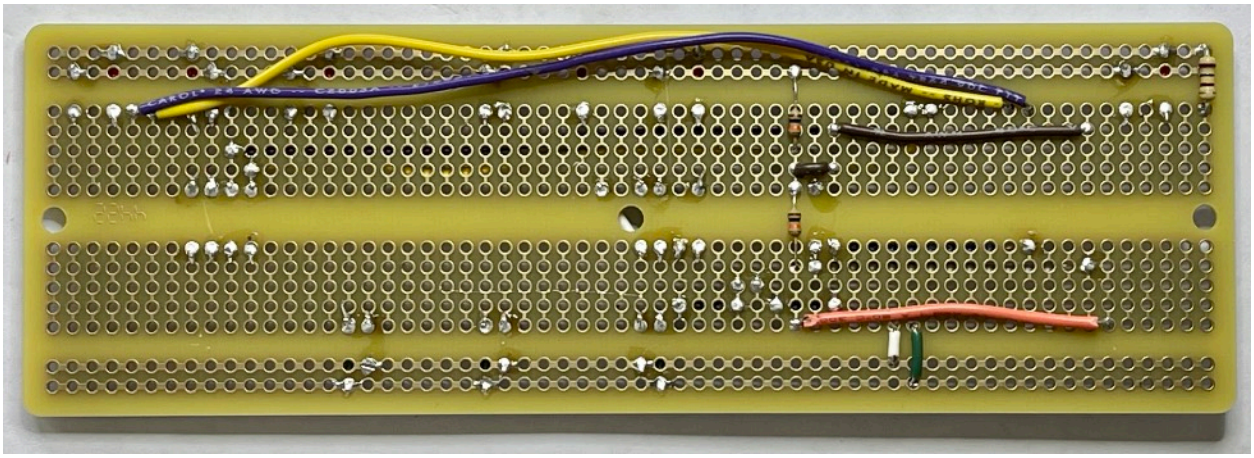


Part 1 — Steps R, G, and 0 through 9:

Follow the STELLA-1.1 Wiring List, items 1 to 45: Install and solder the resistors and the wires.

Leave some slack, as shown in the photos, on the orange, yellow, and violet wires, so that you can move them a bit when installing other components.





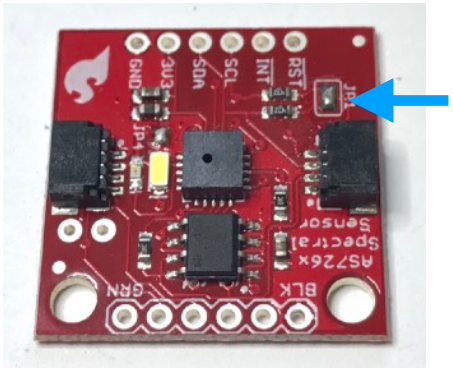
Double check your wiring against the assembly list to make sure that you have installed the wires correctly. It's a lot easier to fix problems now, than it is to move wires around after other components are in place.

Part 2 — Step 10:

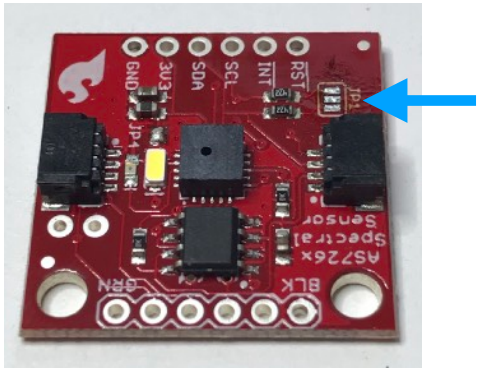
Modify Near Infrared Sensor, Item 46.

A. Using desoldering braid, remove the solder from JP1 on the front of the board.
B. Add solder to JP2 on the back of the board.

A:

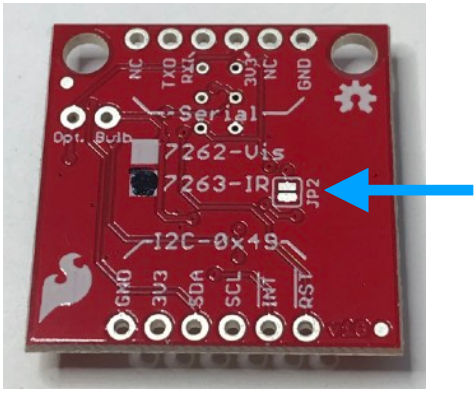


NIR Sensor front,
before desoldering JP1

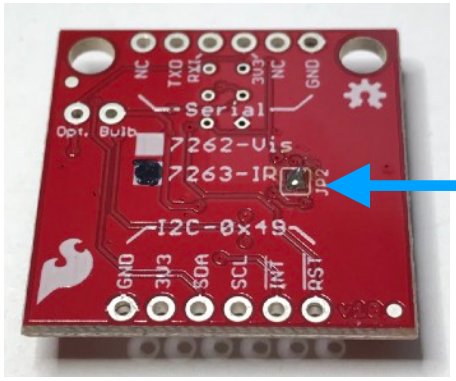


NIR Sensor front,
after desoldering JP1

B:



NIR Sensor rear
before soldering JP2



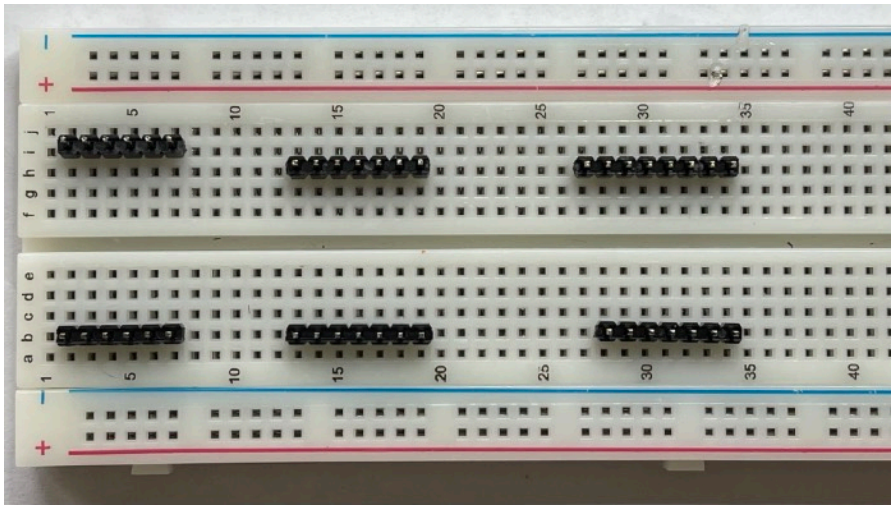
NIR sensor rear,
after soldering JP2

The solder on JP2 may bead up on the two pads and thus fail to connect them.

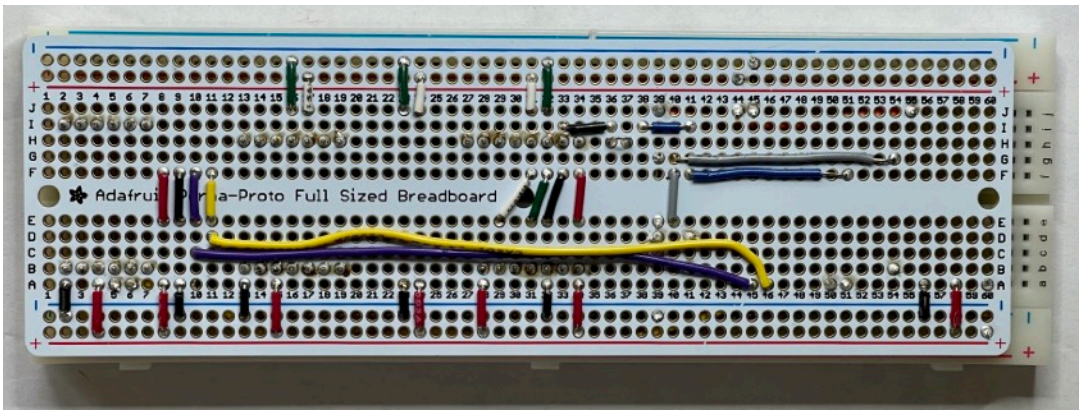
If the solder fails to close the gap between the two pads, solder a short length of wire across the two pads to securely connect them.

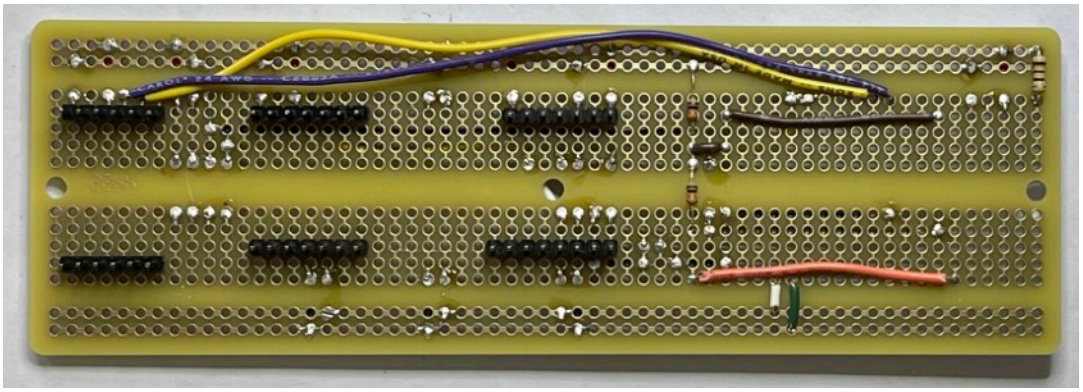
Part 3 — Step 11, Items 47 to 50.

Break pin header segments to the required lengths. Fixture the segments in a breadboard, at the listed locations, with the longer exposed pins inserted into the breadboard.



Place the STELLA main board on top of the fixture assembly, checking that the pins show in the correct locations on the board. Solder the pins in place, then carefully pry the board, with the attached pins, off of the breadboard fixture.

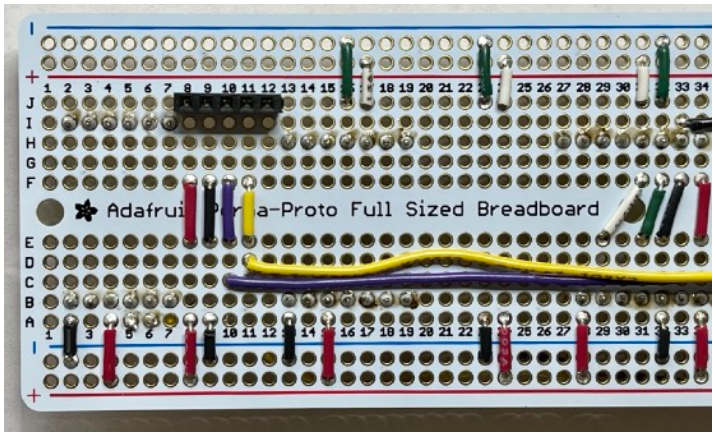


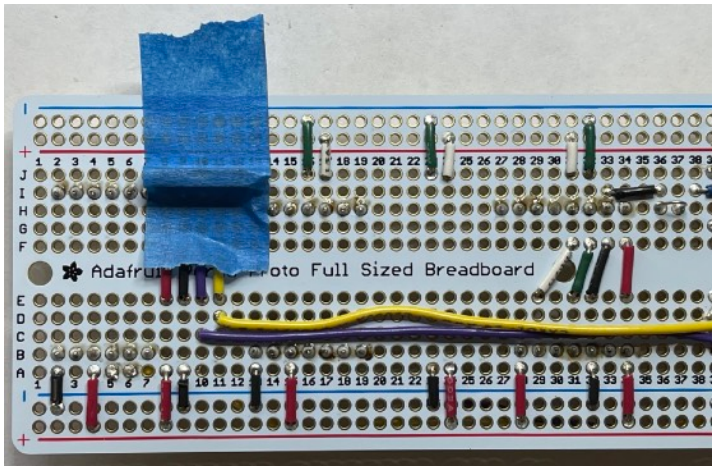


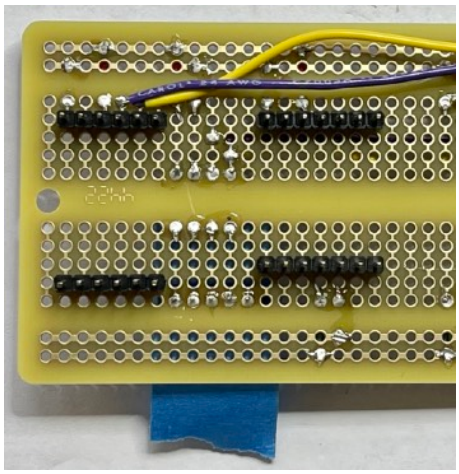
Part 4 — Step 11, Item 51.

Trim a segment of short socket header to 5 positions in length.

Secure on the front of the main board with a piece of tape, then solder the connections on the back of the board.

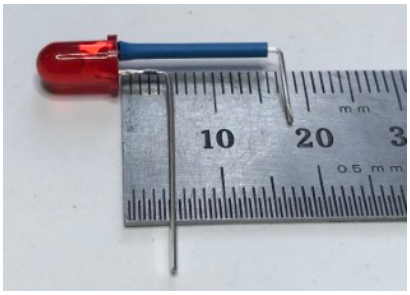


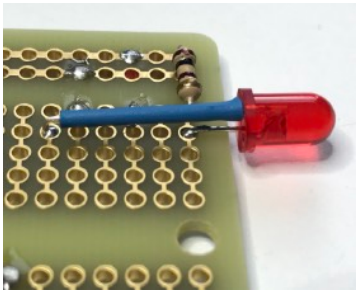


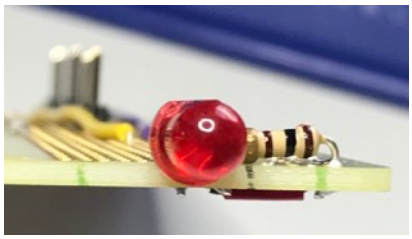


Part 5 —Step 12, Items 52 to 55.

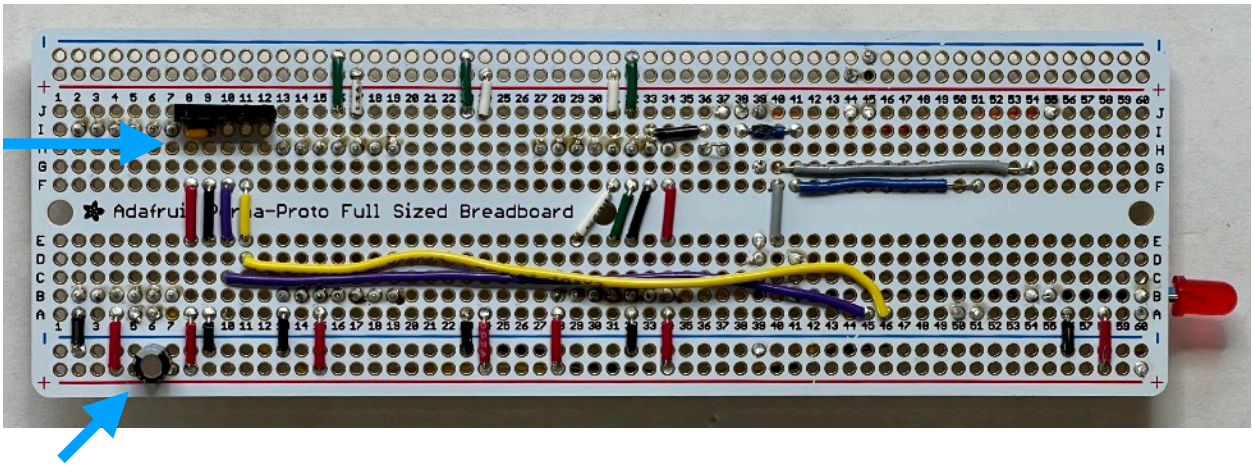
Bend the LED leads, and install a piece of tubing, as in the photo. Note that the longer, positive lead is the one that we bend at 5mm, and the negative lead, near the LED case flat, we bend at 18mm. Install the LED as listed.

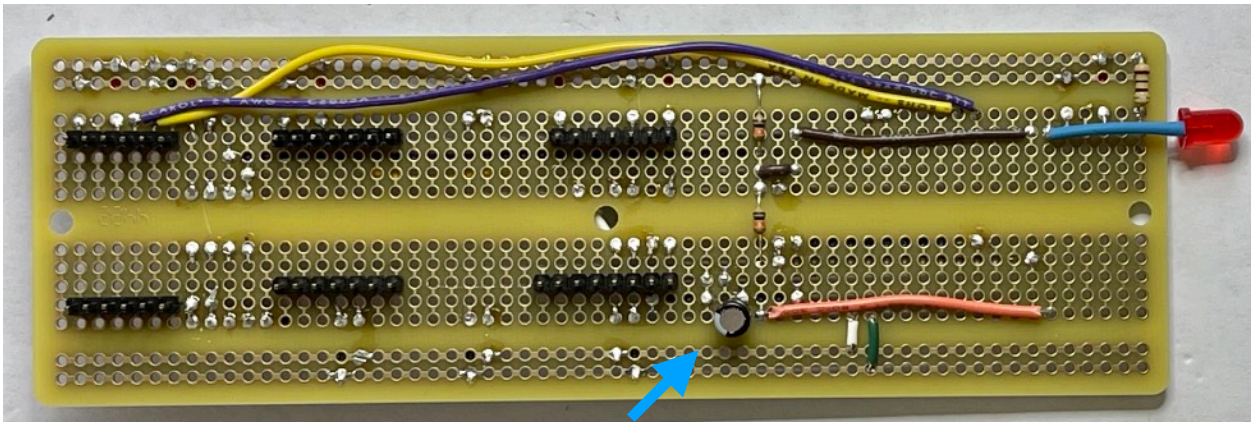






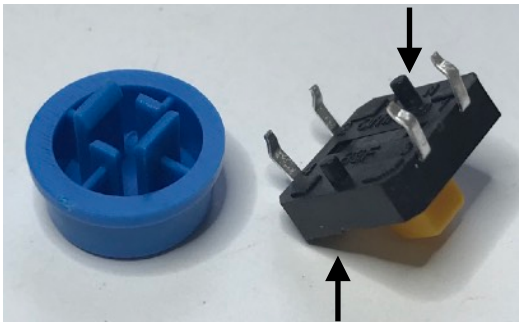
Install the three capacitors as listed. Note also that the electrolytic capacitors (10 uF) have a white stripe to indicate the negative lead, and that the positive lead is the longer of the two. Install them in the correct polarity according to the assembly list.

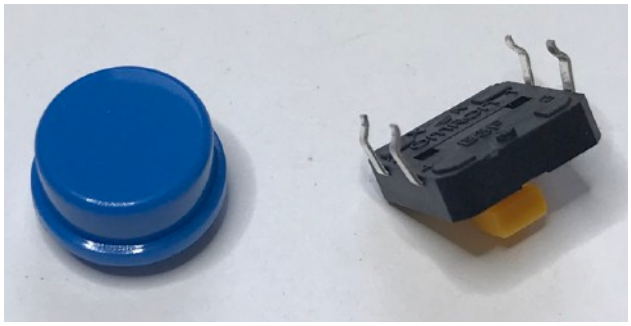




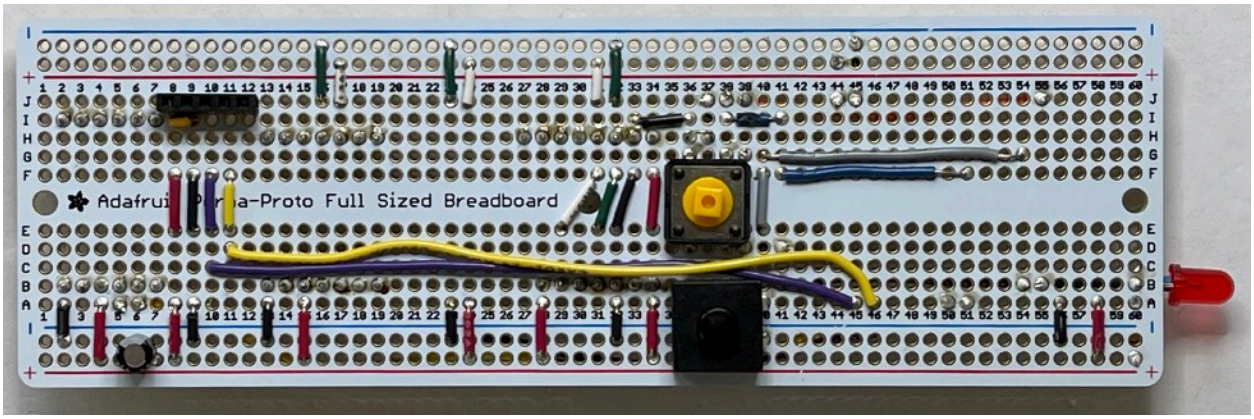
Part 5 —Step 12, Items 56 to 57.

Trim the posts off the rear of the pushbutton switch:





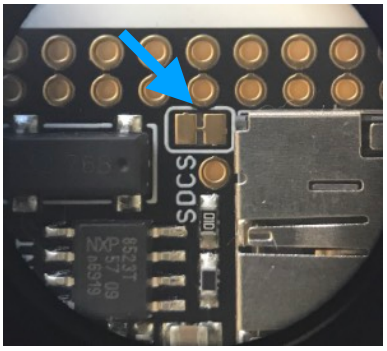
Place and solder the buttons, at the locations indicated in the Assembly List.



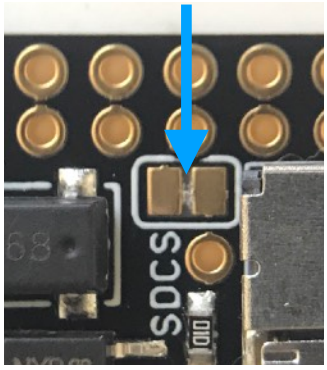
[This portion of this page intentionally left blank.]

Part 6 — Step 13, Item 58.

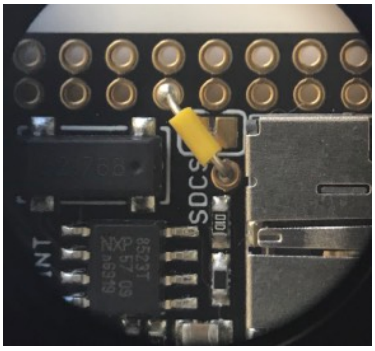
Modify the datalogger by cutting the circuit trace labelled SDCS, and adding a wire to connect the SDCS to a new location (D11).



Datalogger before trace cut.



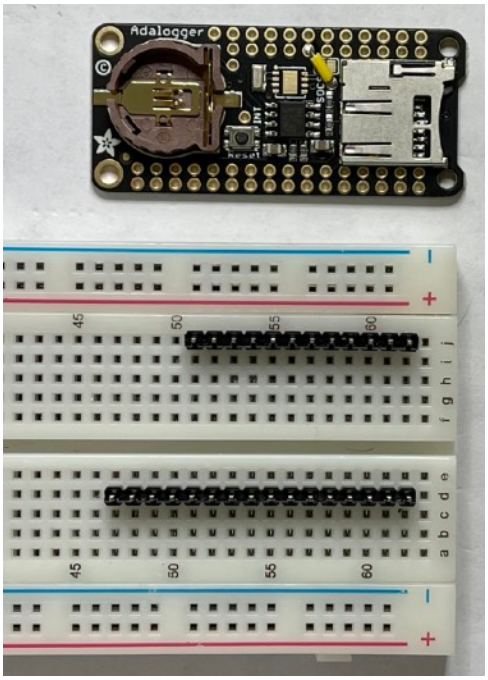
Datalogger after trace cut.

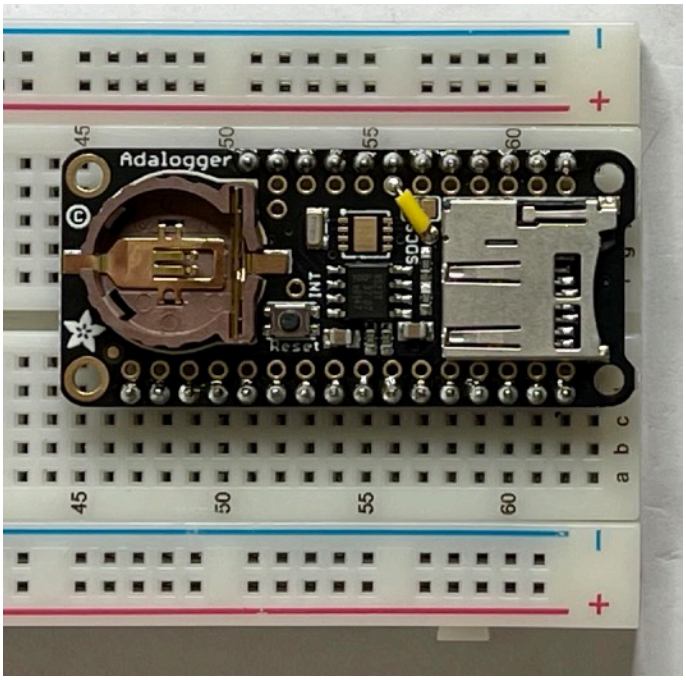


Datalogger with SDCS wire in place.

Par 6 — Step 14, Item 59.

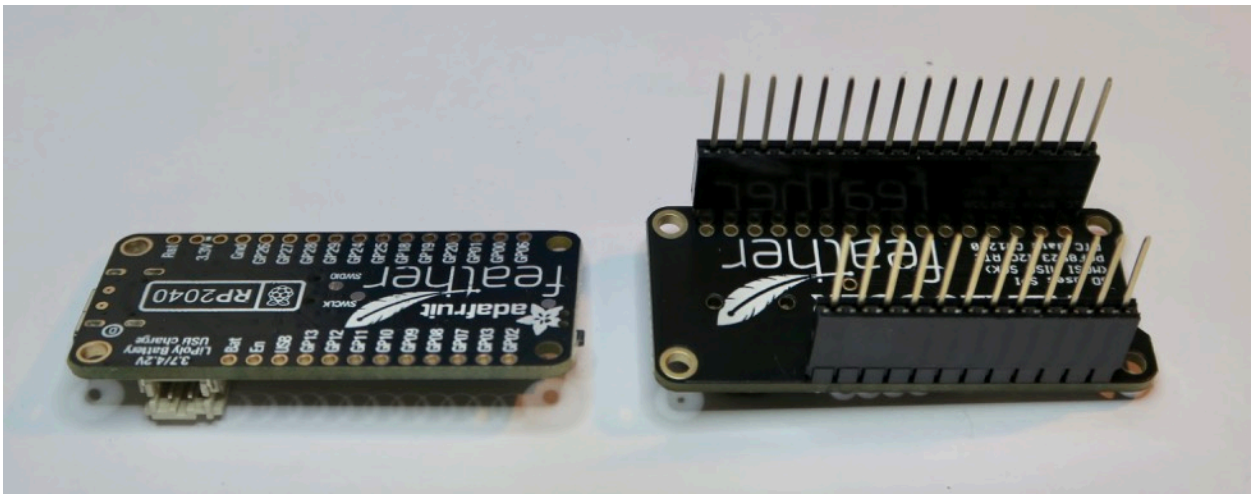
Using the breadboard as a fixture, install the header pins on the outer sets of holes on the datalogger.

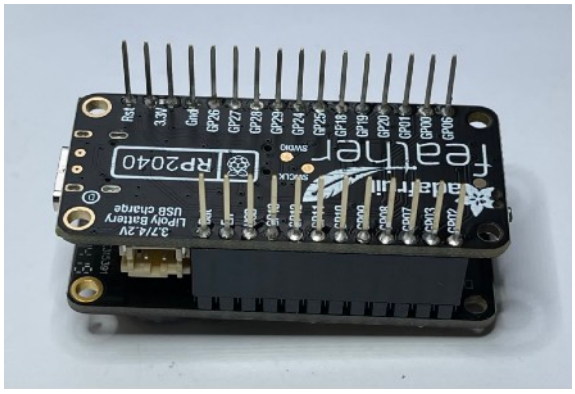




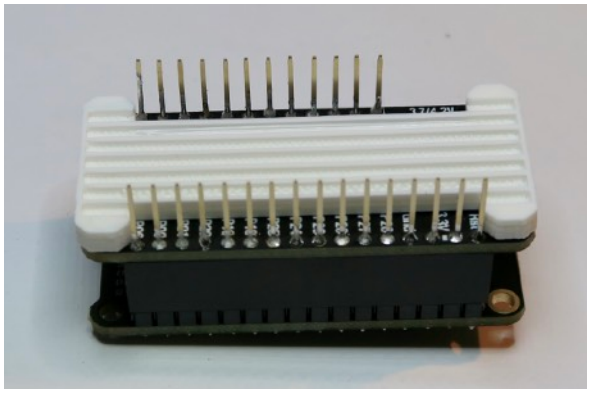
Part 7 — Step 14, Item 59.

Using the datalogger as a fixture, place the stacking headers and install and solder the Feather RP2040 microprocessor.





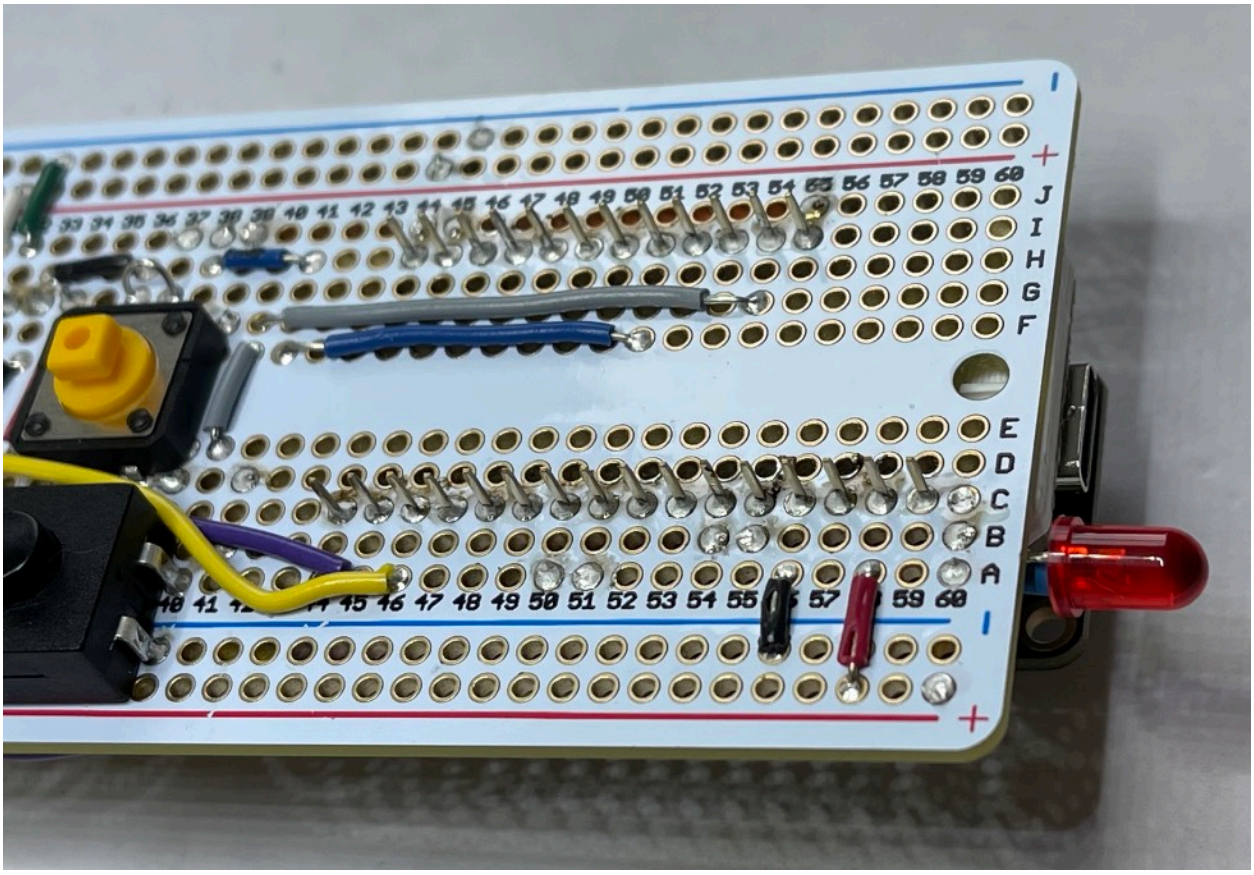
After soldering, place the 3D printed part “feather spacer” on the back of the microprocessor.



Part 7 — Step 16, Items 60 and 61.

Mount the microprocessor to the main board assembly and solder the pins in place.

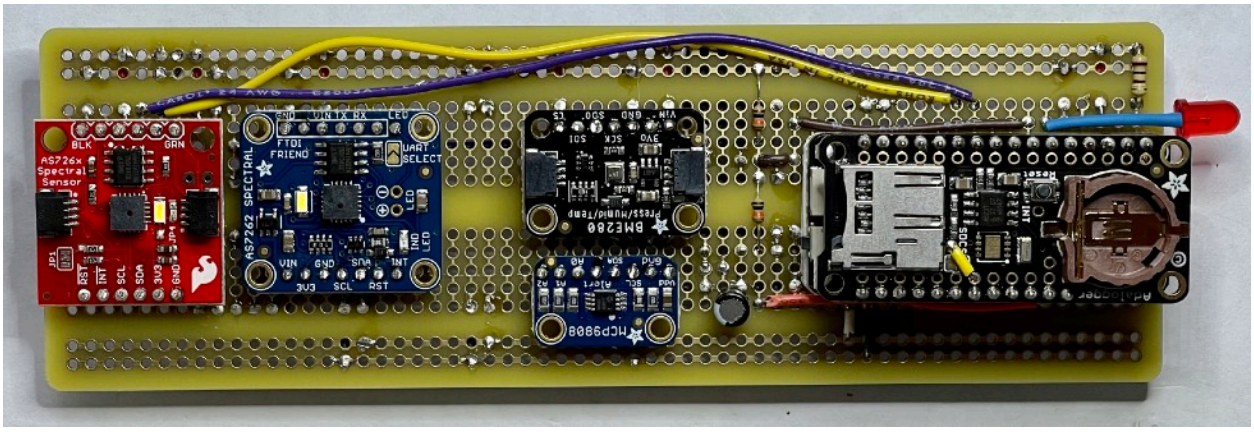
Solder these joints with extra care, to avoid getting solder on the tips of the exposed pins. Those pins will be used to connect to the display, and that connection will be more reliable if it is not corrupted by stray solder.



[This portion of this page intentionally left blank.]

Part 8 — Step 16, Items 62 to 65.

Mount the breakout board style sensors in the orientations shown here:

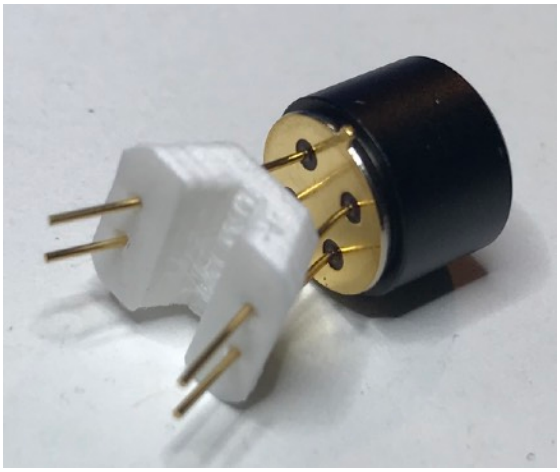


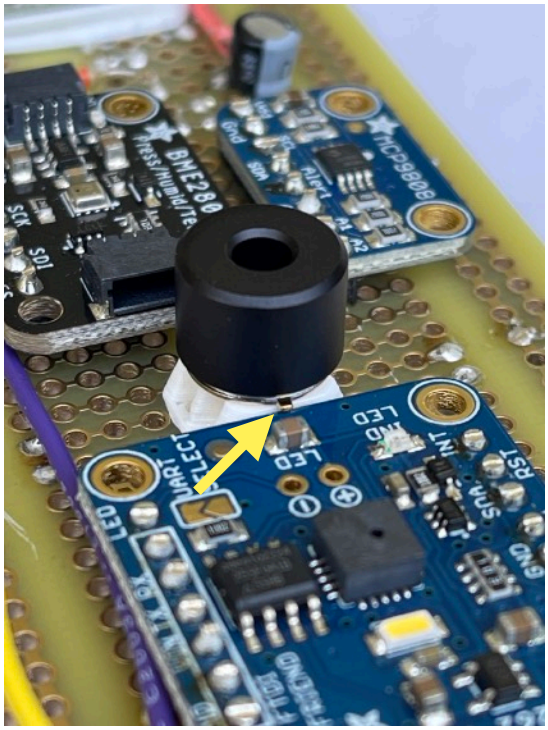
Solder the connections, and then trim the pins to remove the excess length above the sensor boards.

[This portion of this page intentionally left blank.]

Part 8 — Step 16, Item 66.

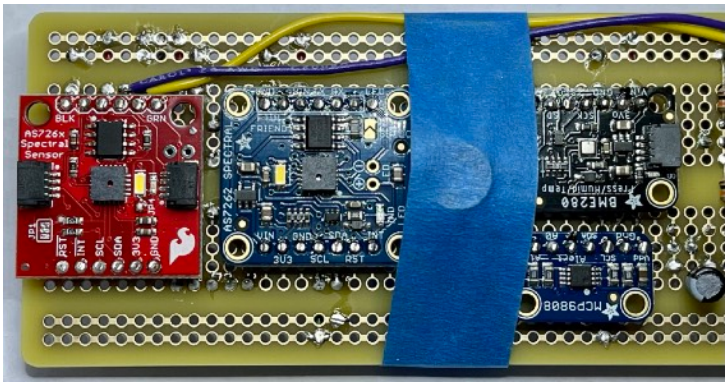
Install the Thermal Infrared (TIR) sensor on the 3D printed part “TIR sensor holder” before installing it on the main board. The orientation tab must align with the flat face of the spacer.

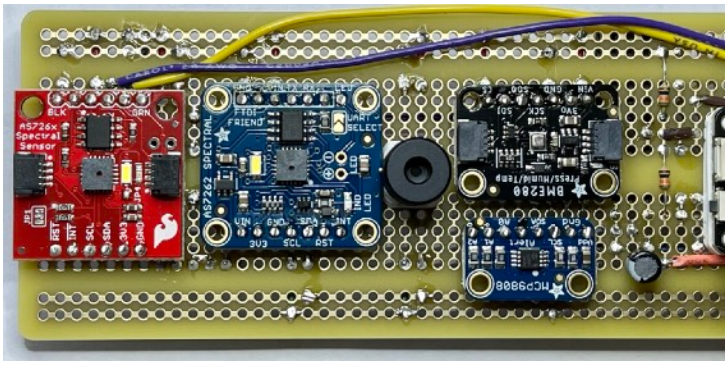




Install the sensor so that the orientation tab is towards the VIS Spectral Sensor.

Secure the sensor with tape so that it remains flat against the board, then solder the leads on the front of the board.

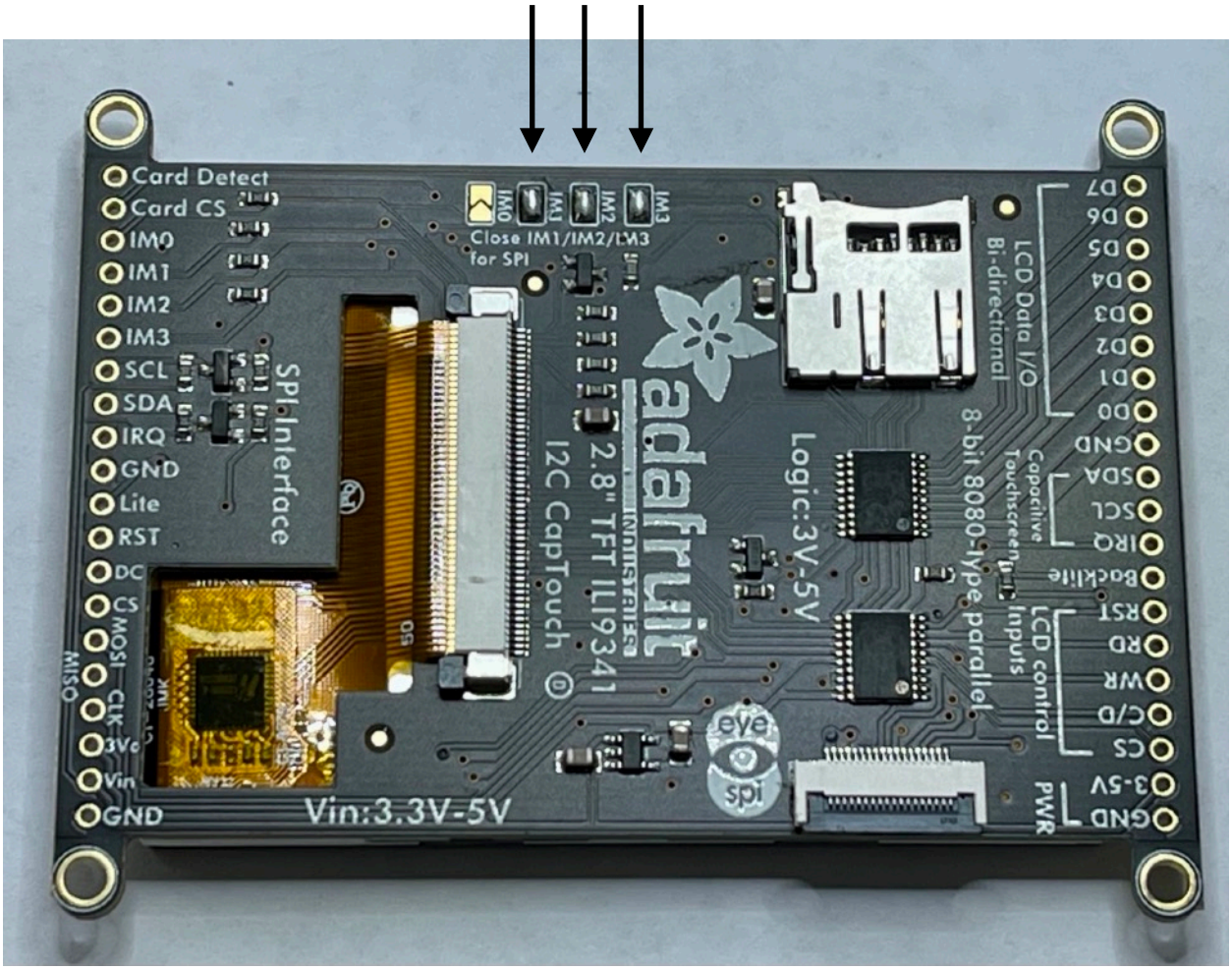




Part 9 — Step 17, Item 67.

Modify the display: close the jumpers IM1, IM2, IM3. Do Not close jumper IM0.

The solder on the jumpers may bead up separately on the two pads and thus fail to connect them. If the joint fails to close, solder a short length of wire across the two pads to securely connect them.



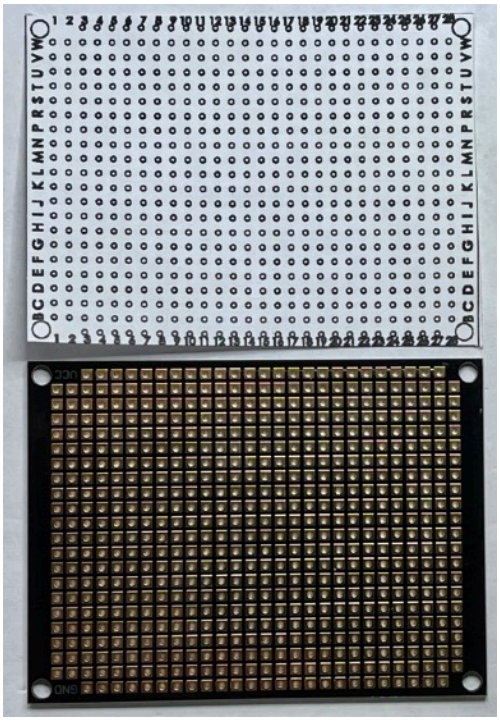
[This portion of this page intentionally left blank.]

Part 9 — Step 18, items 68 to 70.

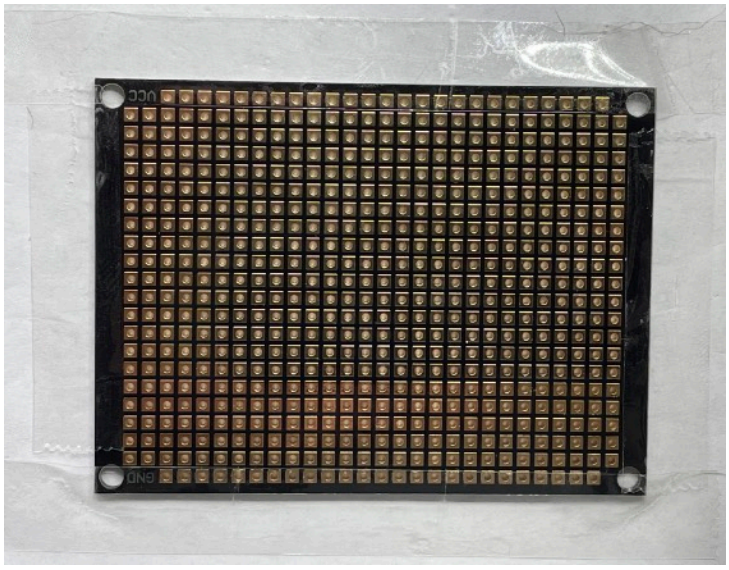
Prepare the display wiring board:

On an ordinary office paper printer, print the file “protoboard DFRobot FIT0203 print” at full scale. Cut out one of the coordinate panels from the print.

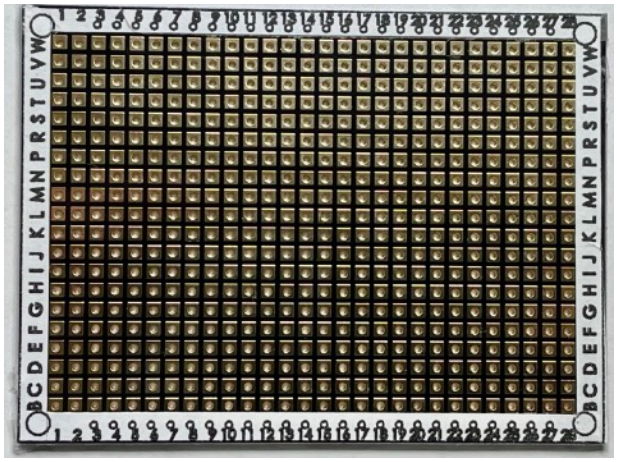
Arrange the board so that the VCC mark is upside down in the upper left corner, where W1 will go. GND will be in the lower left corner, also upside down.



Apply clear double stick tape to the outer 0.1” = 2.5mm of the protoboard

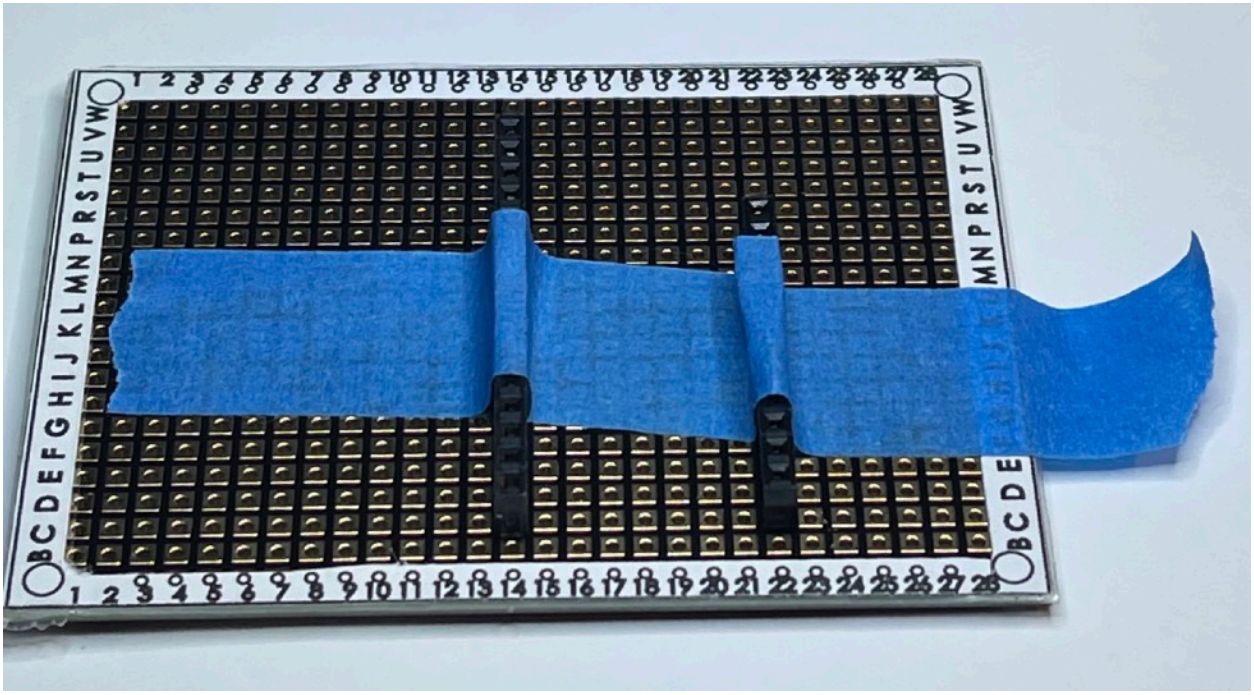


Stick the printed coordinate panel to the board, and then trim the center of the panel out, exposing rows B through W.



Part 9 — Step 18, Items 68 and 69.

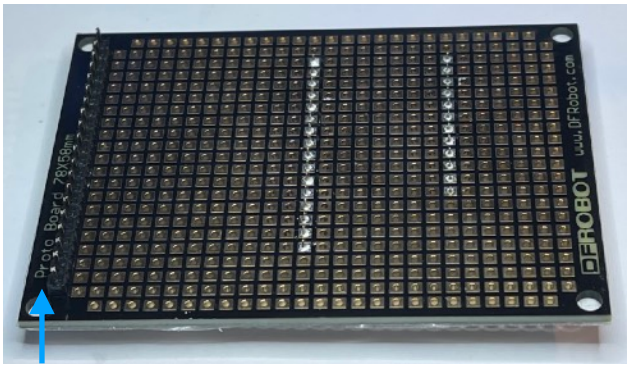
Place the short header sockets, 12 pin and 16 pin, on the labeled (front) side of the board. Secure them temporarily with tape and solder them on the back of the board.

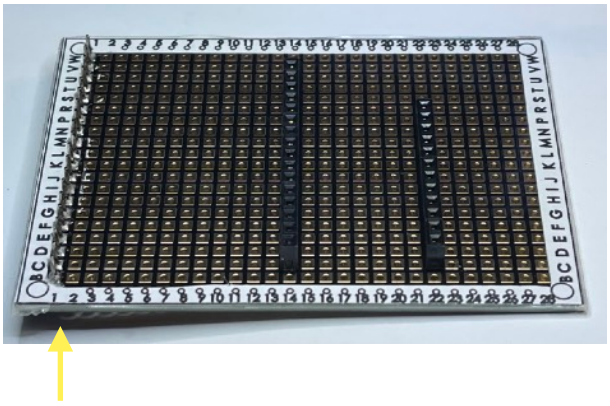


Part 9 — Step 18, Item 70.

Install a 20 position pin header from the back of the board (blue arrow). Place it so that the long ends of the pins are poking through the board.

Solder the pin header to the board on the front (yellow arrow)

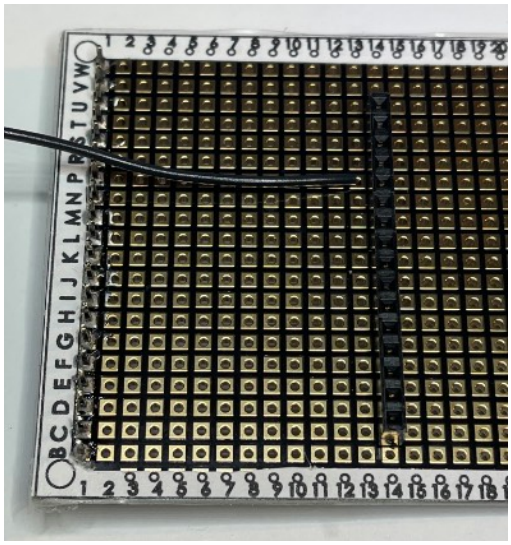


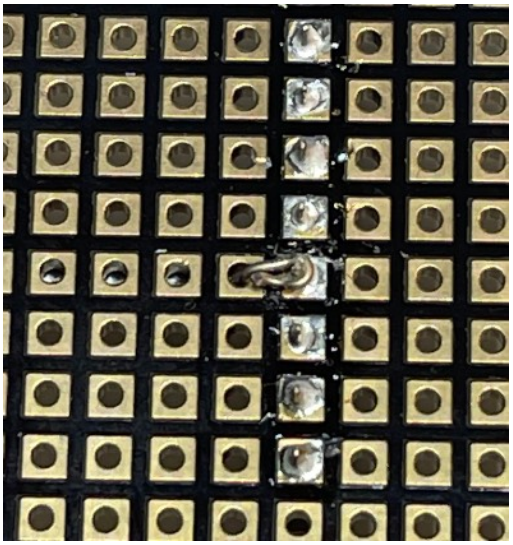


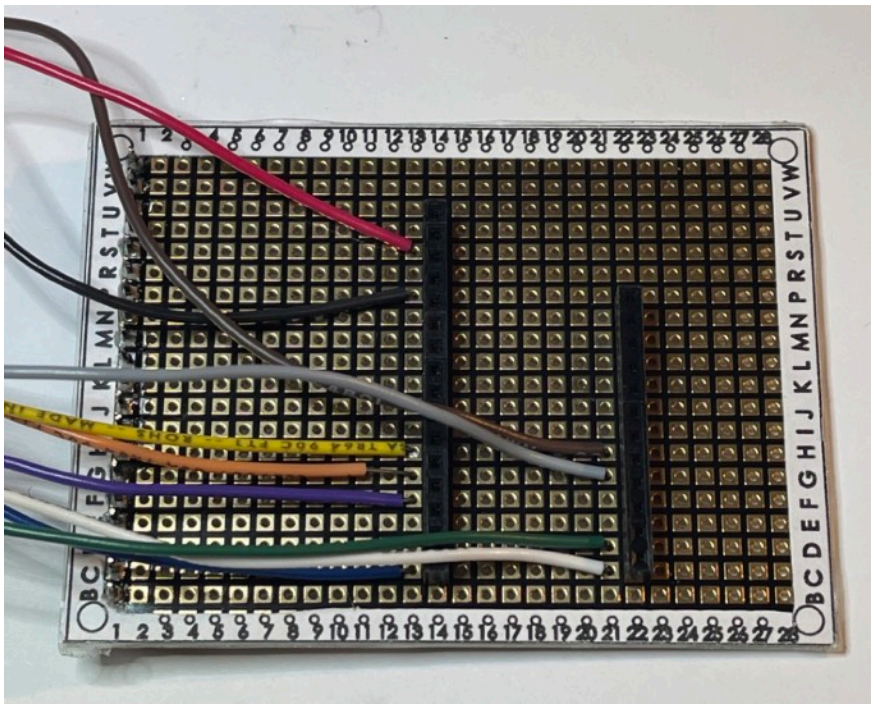
Part 9 — Step 18, Items 71 to 80.

If finer gauge wire AWG 26 to AWG 30 is available, use that wire for this step. Where the wires cross on this board, they can stick up enough to interfere with installing the housing. Use the finer wire to lower the height of the crossing, and/or distribute the crossings so that they don't pile up.

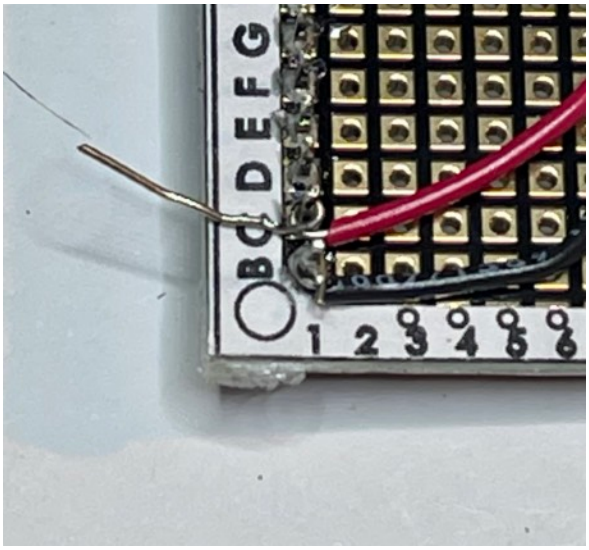
Connect wires to header socket positions. Since the board does not have traces that connect any hole to any other hole, we must make the connections ourselves. Here we show the black wire, poking through P13 from front to back, and then we see the back of the board where we bend the wire around the pin at P14. Make connections like this for each wire.

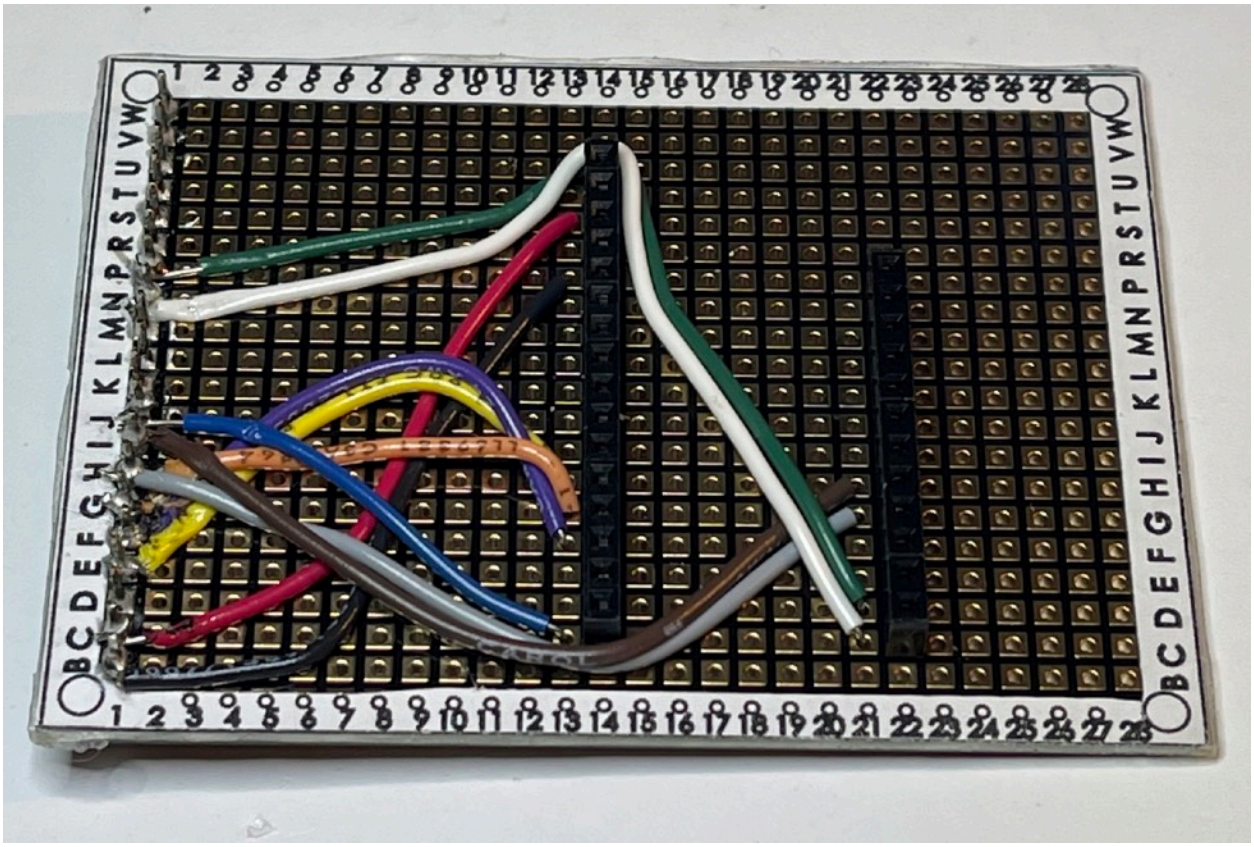






Connect wires to the header pin positions. Here we show the black wire already soldered and trimmed, and the red wire placed, wrapped around the pin, ready for soldering. Make these connections for each wire to the positions listed in the wiring list.



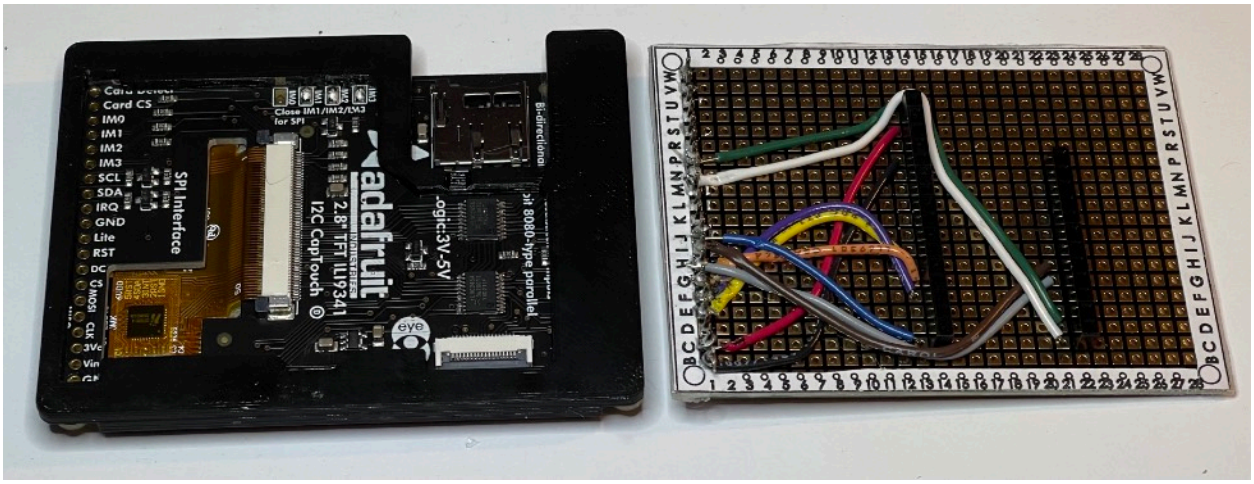


Part 9 — Step 18, finishing up.

On the display spacer, 3D printed part “STELLA-1.1 screen spacer”, add clear double stick tape to the side with the four protruding posts. Trim the excess tape with a craft knife.

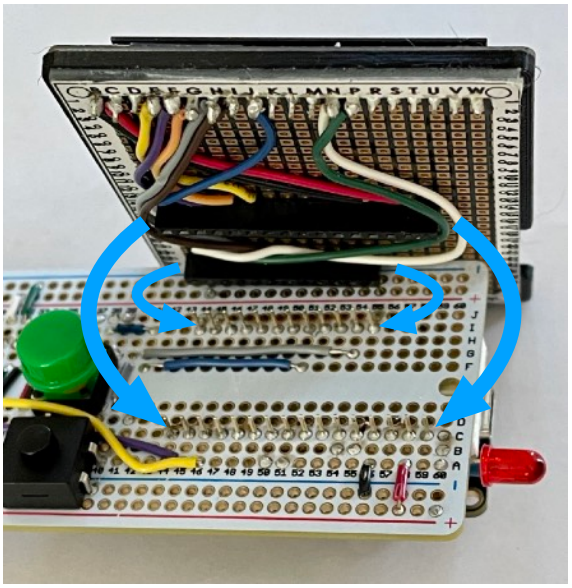
Line the posts up with the holes in the display, on the back of the display, and press them gently together. Trim off excess tape from around the display.

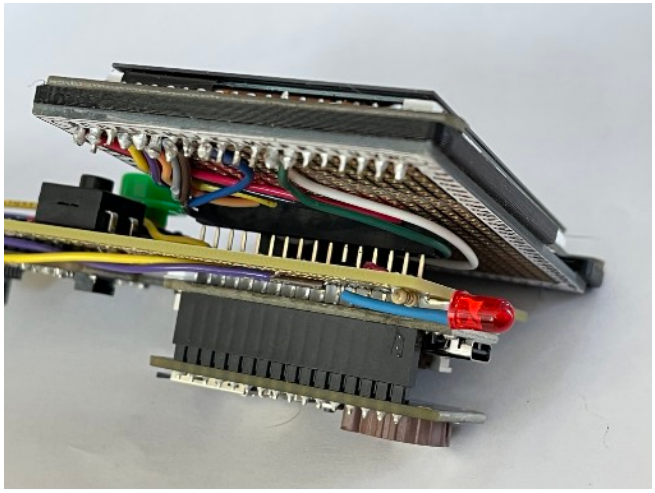
Apply more double stick tape to the remaining exposed face of the spacer.



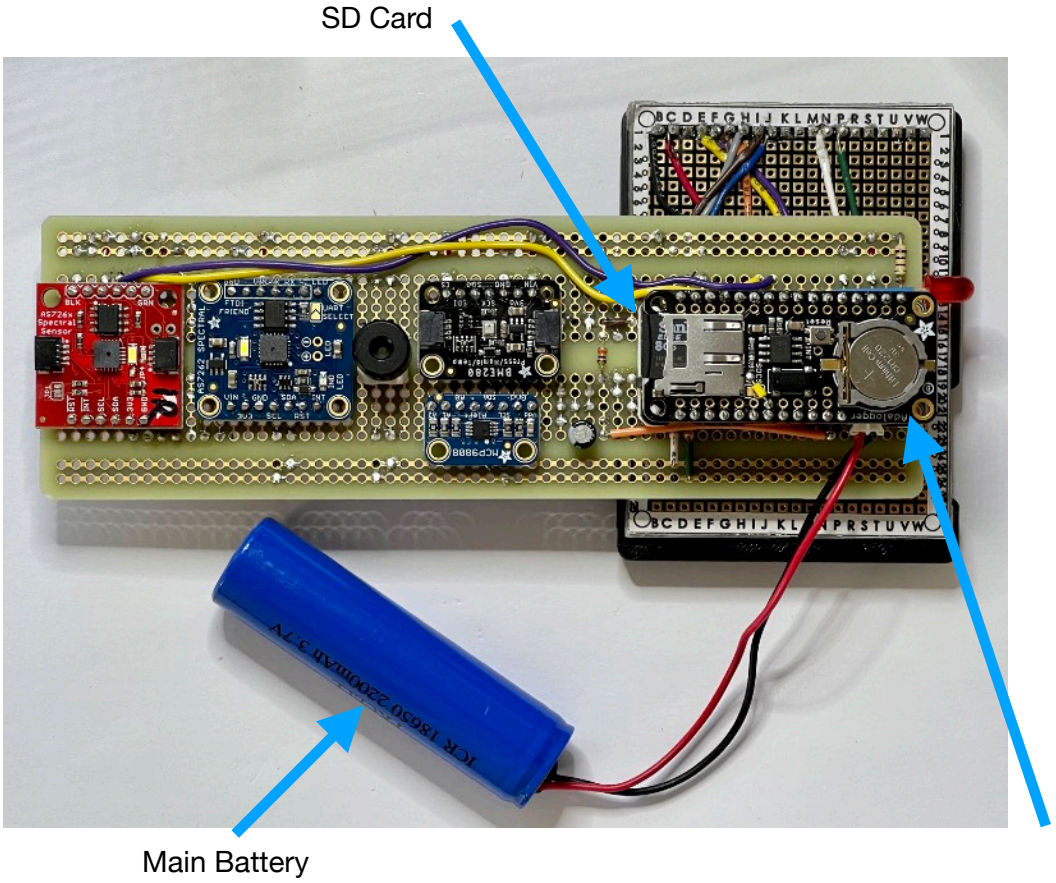
Align the wiring board pins with the holes on the display, and solder the pins to the front of the display board. Trim off the excess tape, and, on the back of the board, trim off the excess length of the pins.

Align the sockets on the display board with the pins on the main board, so that the 16 pin socket connects to the 16 pins, and the 12 pin socket connects to the 12 pins. Gently settle the board onto the pins so that the display is securely mounted.

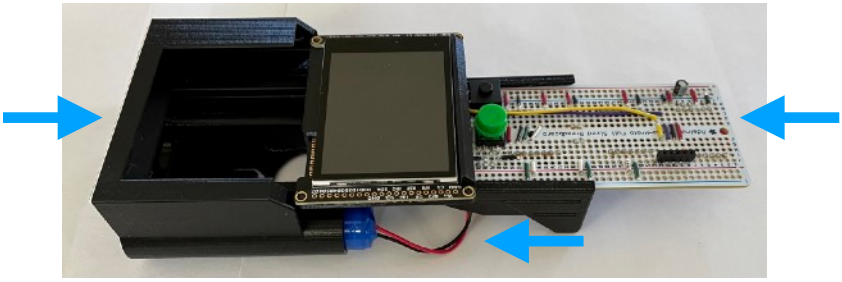


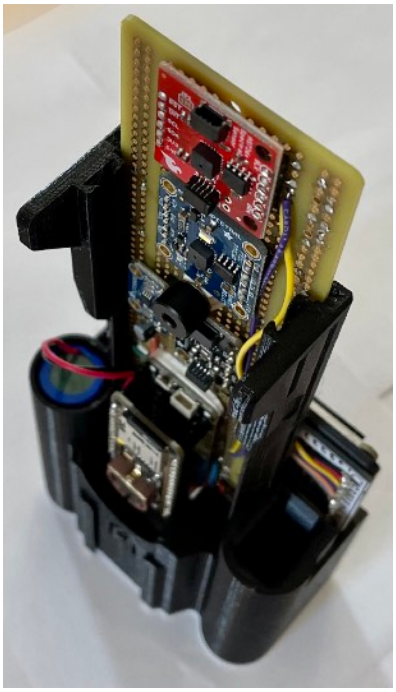


Connect the main battery to the power connector.
Install the clock battery, and insert the SD card.

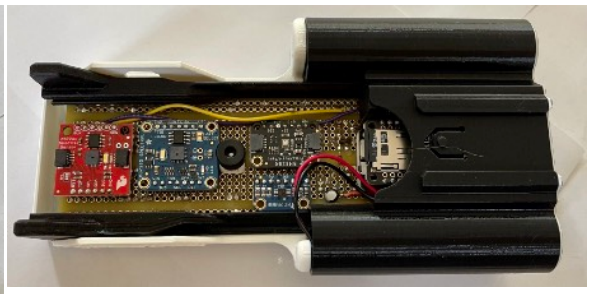


Slide the STELLA assembly into the long grooves of the lower housing, while sliding the main battery into the cylindrical battery holder tube. You may need to press gently on the display to get it to slide easily into the housing recess.





Install Upper Housing: Align the upper housing with the buttons, and press it onto the lower housing so that it snaps into place.



Slide the STELLA into the protective holster.

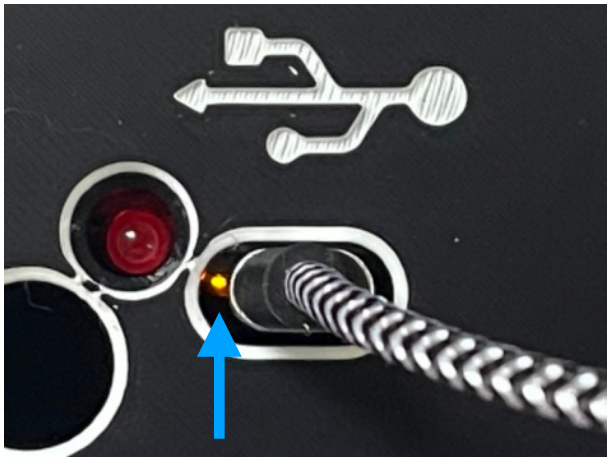
Slide the belt clip onto the holster, centering the locking pin in the belt clip hole.

Charge the main battery:

Connect a USB-C cable to the microcontroller port on the STELLA.

Note the small amber light inside the housing, just to the left of the cable.
When that light is on, the battery is charging.
When the battery is fully charged, the light goes out.

If the amber light is flashing, that indicates that the main battery is unplugged and thus can't be charged.



It takes about 12 hours to fully charge the battery (from empty).

A fully charged battery will operate the STELLA for about 12 hours.

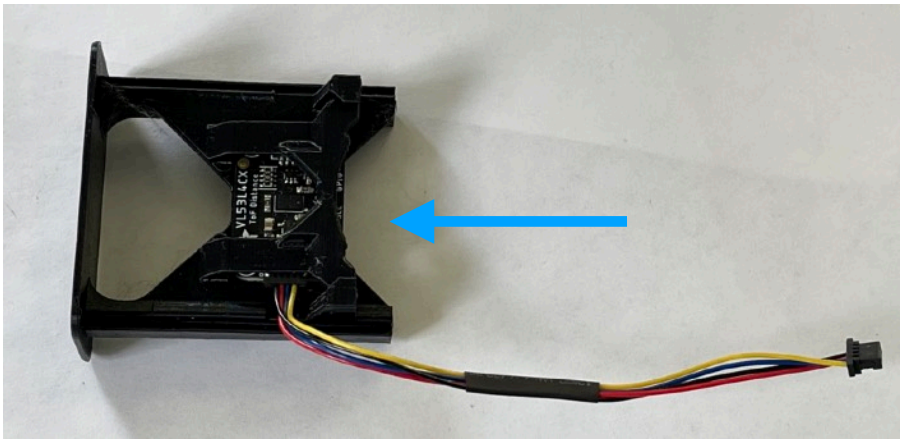
The power control and charging circuitry is available whether the STELLA is on or off.
The power circuitry controls the charge rate, discharge rate, and charge amount, so that the lithium ion rechargeable battery is protected against damage.

Part 10: Optional LiDAR distance-to-surface measurement. (Light Detection and Ranging)

The STELLA-1.1 can be fitted with an optional laser rangefinder, which measures from ~0 to 6.0 m range.

A. The LiDAR sensor is shipped with a piece of amber polyamide tape that covers the source and sense apertures. Remove that piece of tape.

B. Slide the sensor into the 3D printed part “STELLA-1.1 LiDAR mount print coordinates”, and then connect the qwiic cable to either side of the sensor.



C. Remove the white upper housing.

D. Slide the mount into the dovetail grooves in the STELLA lower housing.

[TBD photo]

E. Connect the cable to the qwiic port on the end of the microprocessor.

[TBD photo]

The STELLA-1.1 software automatically recognizes the presence of this ranging sensor, displaying and recording the range measurement.