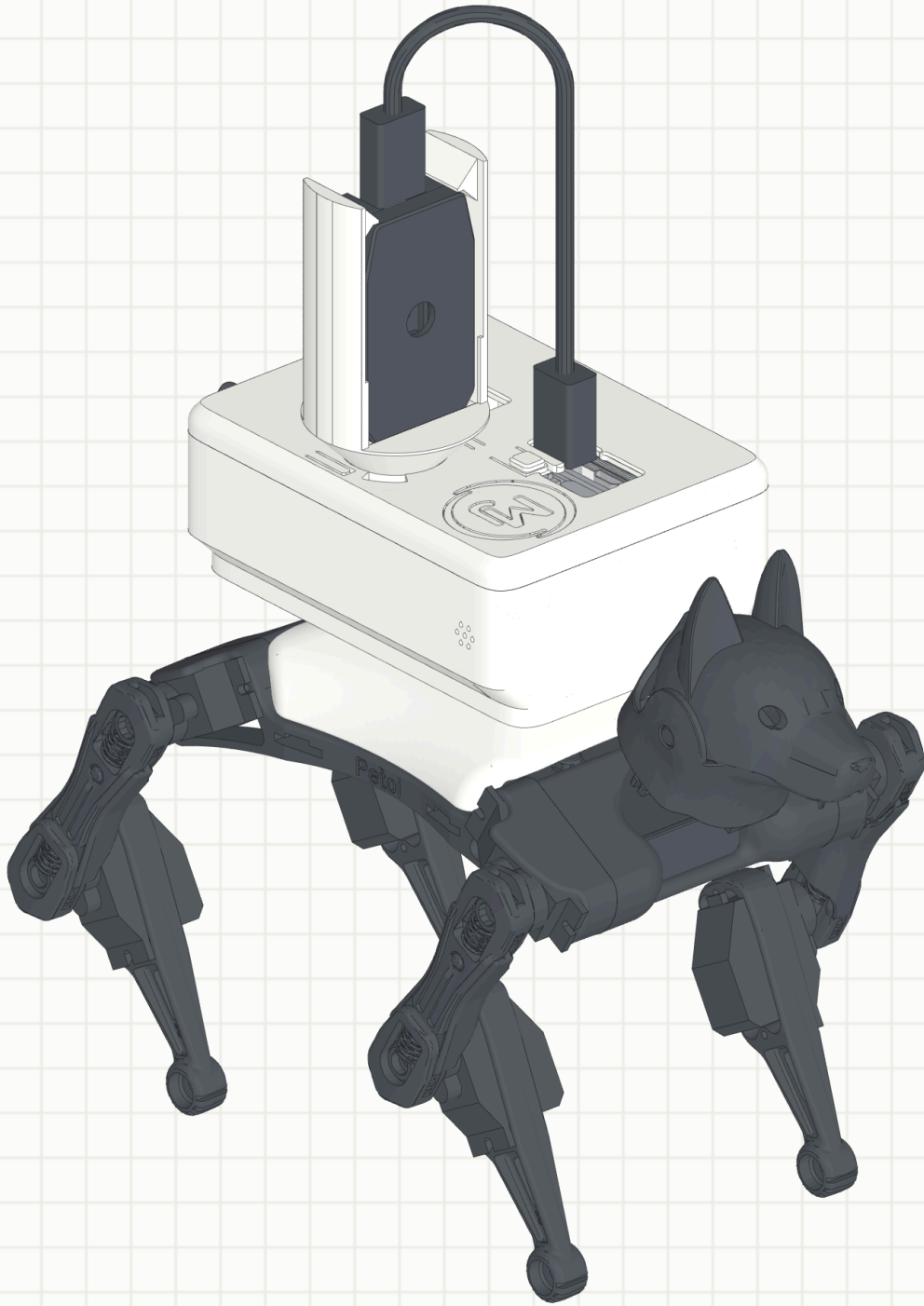




BUILD GUIDE

Bittle X Pi Add-on

A Raspberry Pi Zero 2 W with a battery, a speaker, a microphone and a camera, in one rounded box that clicks onto the back of the Peto Bittle X.

Add-on v0.24
2026-10-18

Platform v3.2
pegs on the stock cover

135 g
with the electronics

No supports
every part prints as is

What you build

The add-on is a body that clicks onto the platform pegs, a slide-on top panel and a camera mount. Every part goes into the body from the top, in the order of this guide. No tools are necessary, except a soldering iron for the two splices and a dab of glue for the amp.

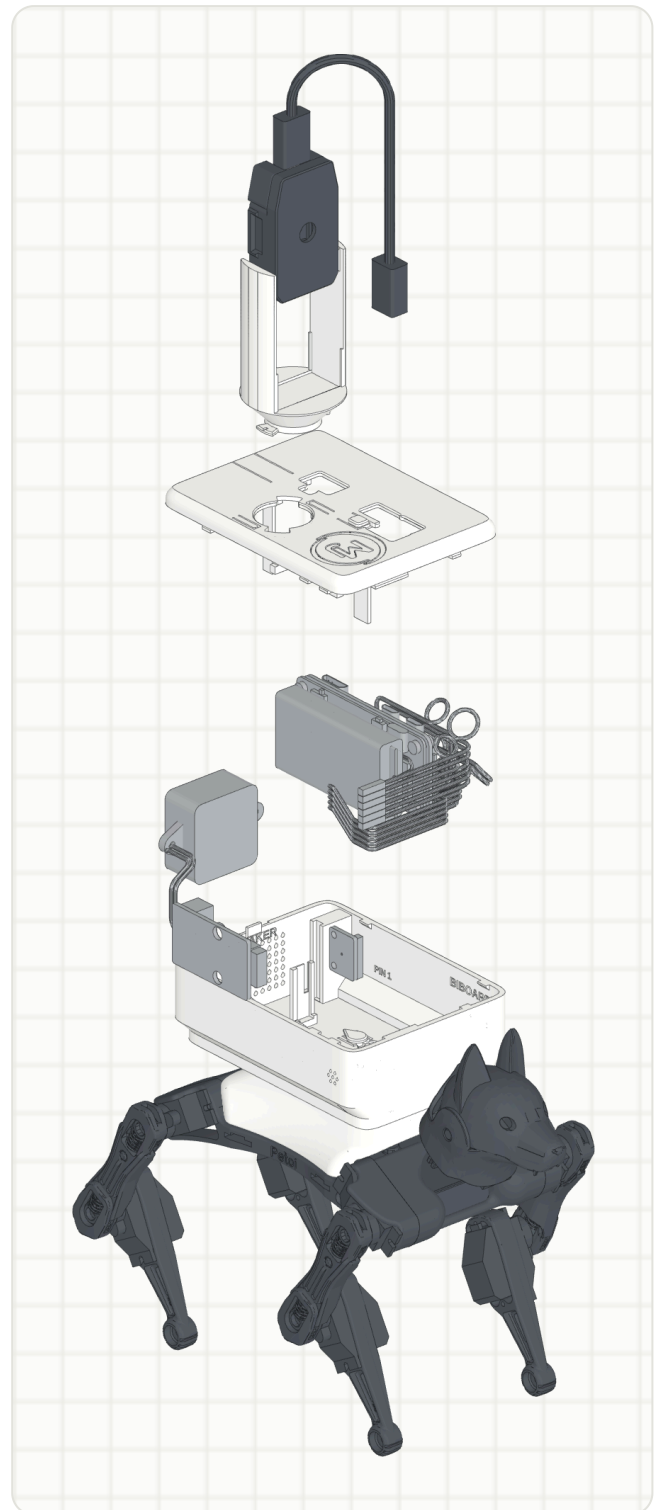
Directions in this guide

Front is the head end of the robot. Left and right are the robot's left and right. The Pi plugs and the BiBoard header are in the **left well**. The amp and the mic are on the **right wall**. The speaker is at the rear.

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The 3D viewer shows every step with animation:
<https://beetlebugorg.github.io/bittlex/viewer/>



Parts to print

Print every part without supports, in the orientation of its file in `stl/print/`. The platform cover is in the platform package (`cover_pegs_foot.stl`, with a break-off foot).

PART	MATERIAL	ON THE BED	MASS
Body <code>stl/print/pod_body.stl</code>	PLA, white	floor on the bed	40 g
Top panel <code>stl/print/pod_panel.stl</code>	PLA, second color	upside down: top on the bed	15 g
Button cap <code>stl/print/pod_button.stl</code>	PLA, white	upside down: top on the bed	< 1 g
Logo inlay, white <code>stl/print/pod_logo_white.stl</code>	PLA, white	top on the bed	< 1 g
Logo inlay, red <code>stl/print/pod_logo_red.stl</code>	PLA, red	top on the bed	< 1 g
Camera mount <code>stl/print/pod_camera_mount.stl</code>	PLA, second color	standing up, lugs on the bed (as in the STL)	14 g
Head-off camera mount (optional) <code>pod_camera_base_low</code> , <code>pod_camera_cradle_low</code>	PLA	as in the STLs	

Settings

0.2 mm layers, 0.25 mm first layer. Walls 2 mm: 4 lines of 0.5 mm. Small holes print about 0.2 mm under size: the fits allow for it.

The panel prints top down: its logo pocket and its openings are on the bed. Slice `stl/print/pod_panel.3mf`: it has a support blocker over the logo pocket. The body prints floor down: its labels and its route grooves face up.

Hardware

ITEM	COUNT	USE
Female-to-male Dupont jumper, 10 cm	3	BiBoard serial link
Female-female Dupont jumper, 10 cm	4 + 2	mic (4) and the Pi ends of the splices (2)
Female-female Dupont jumper, 15 cm	2	mic GND and 3V
Female-to-male Dupont jumper, 10 cm	2	the amp ends of the splices
Heat shrink, white	2	splice sleeves
USB-C to micro-USB cable, 15 cm or more	1	camera to Pi
Glue (a dab)		amp; logo inlays

Electronics and cables

Each cable below shows its two ends. Some have one plug at one end and many at the other: match each end before you plug it in.

Amp cable 1 plug → 5 sockets

Comes with the NULLLAB NS4168 amp: one 5-pin PH2.0 plug at the amp, five single female Dupont sockets at the other end. The wires are bonded flat. Keep the cable on edge: do not twist it.



BiBoard jumpers 3 single jumpers female → male

The female end goes onto the Pi pin. The male end goes into the BiBoard socket, which is female.



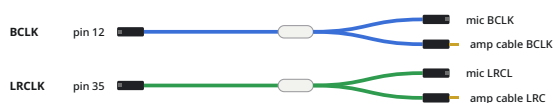
Mic jumpers 6 single jumpers female → female

One per mic pin. BCLK and LRCLK end in the free female ends of the splices; cut them to length when you make the splices.



Splices 1 → 2

Each clock signal feeds two boards. Make a Y from three jumper ends: solder, then cover with white heat shrink.



Speaker lead

The 2-wire lead of the speaker ends in a 2-pin PH2.0 plug: it goes into the rear end of the amp.

Camera USB cable

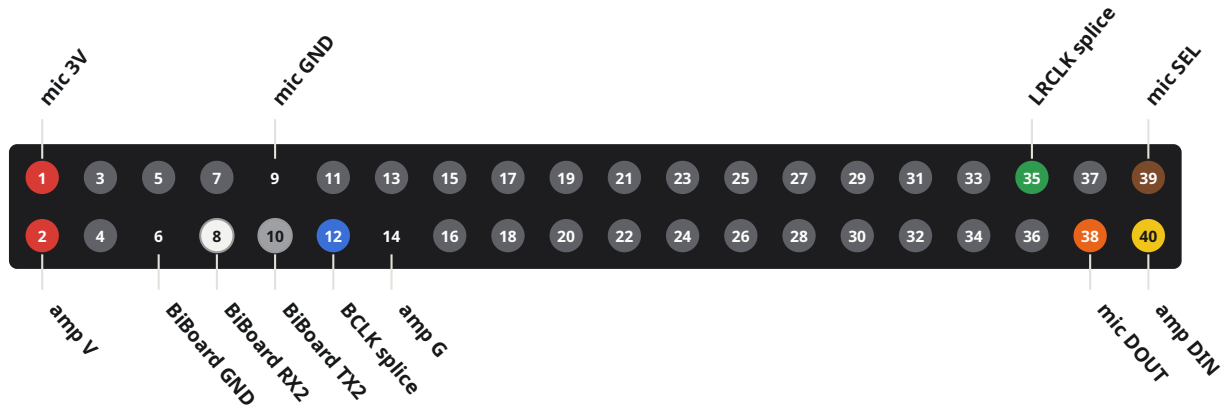
USB-C at the camera, micro-USB at the Pi data port.



Pin maps

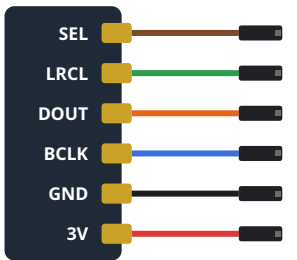
Every pin in use, in the color of its wire.

Pi Zero 2 W, 40-pin header



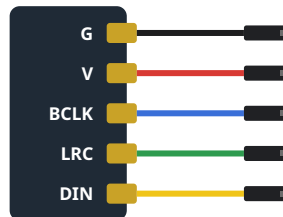
Pin 1 is at the SD card end (rear). Odd pins: inner row (top). Even pins: board edge (bottom).

Mic (as mounted)



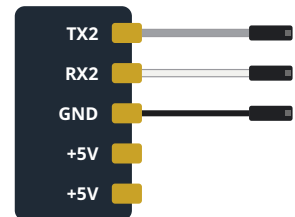
SEL at the top, 3V at the bottom

Amp I2S plug



G at the top (the amp stands upright)

BiBoard socket



male ends in; +5V stays empty

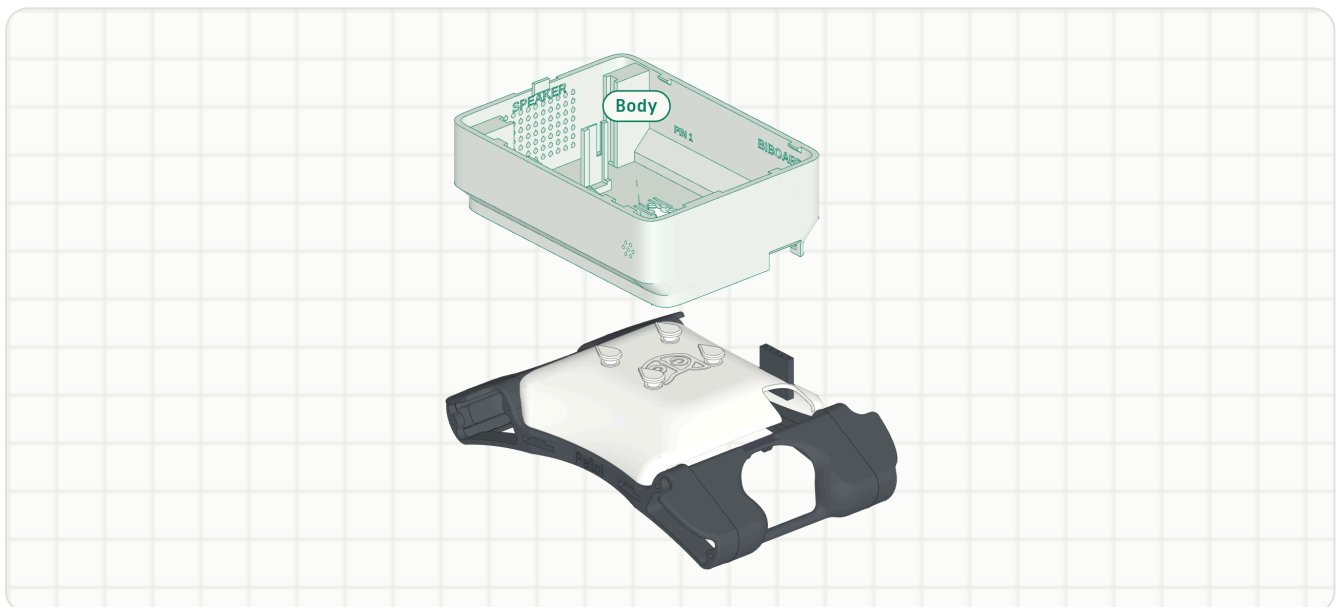
TX and RX cross: BiBoard TX2 goes to Pi RXD (pin 10), BiBoard RX2 to Pi TXD (pin 8). SEL to GND puts the mic on the left channel. The PiSugar S powers the Pi through its contact pins.

Assembly



1 Fit the platform cover

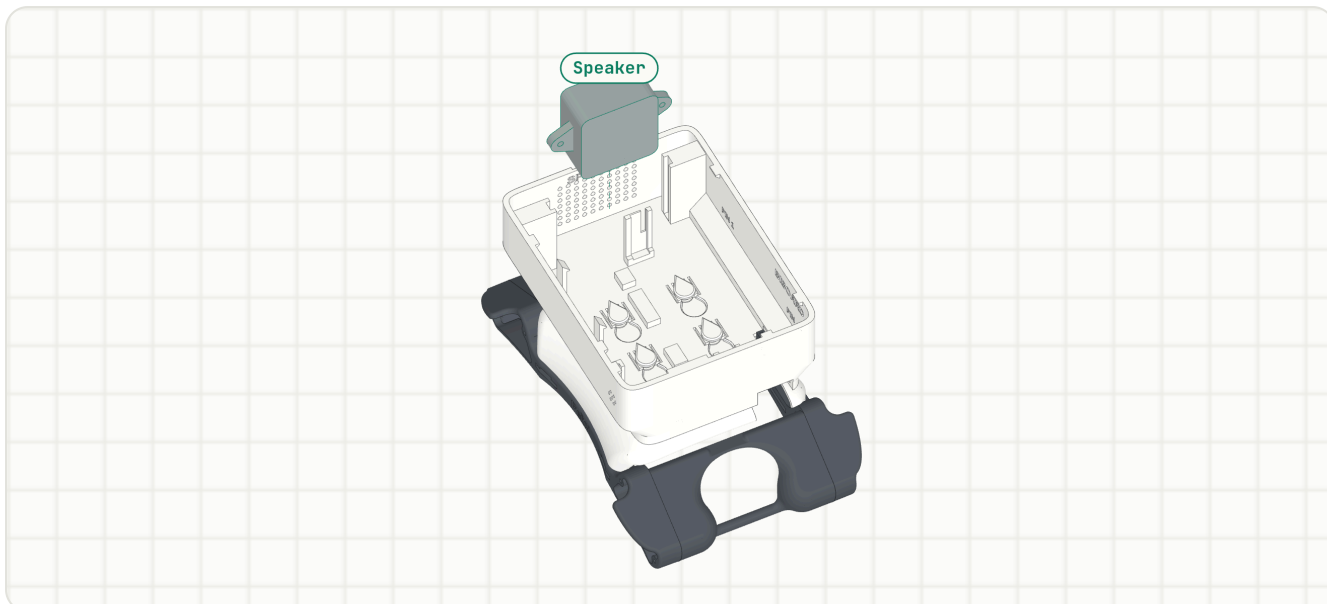
1. Remove the stock back cover of the Bittle X.
2. Put the platform cover in its place. The Pi slot and the BiBoard header are at the front left.
3. Pass the BiBoard header up through the slot.



2 Click the body on

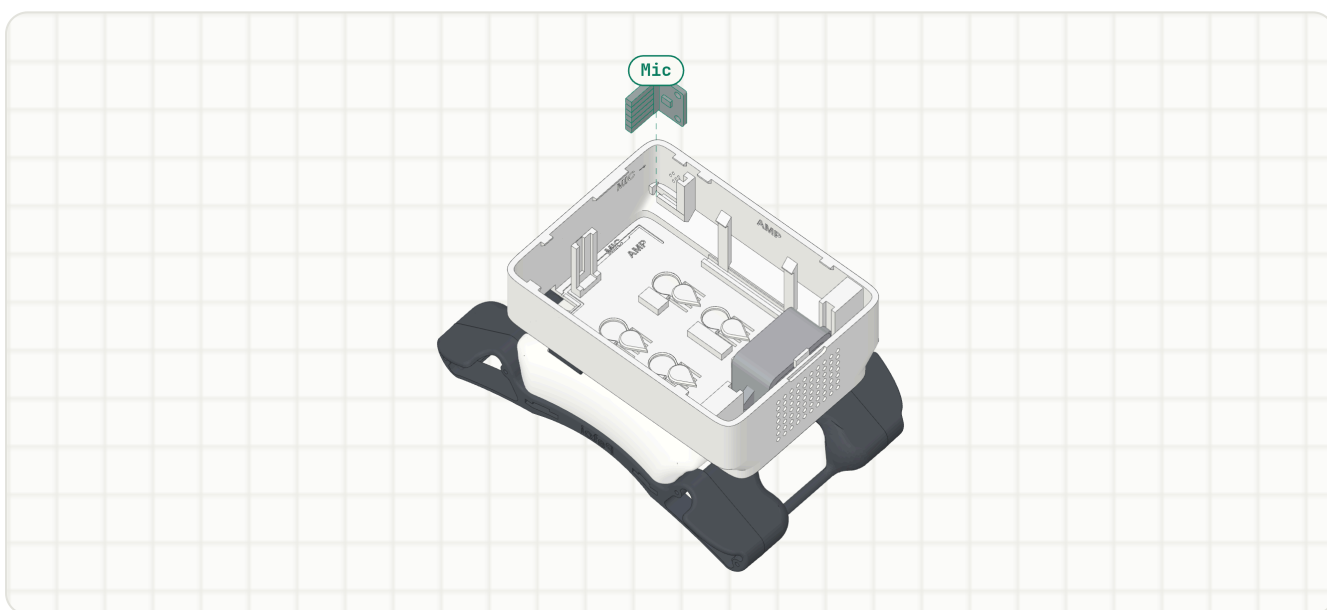
1. Put the empty body on the pegs, 7 mm behind its place, the grille to the rear.
2. Push it 7 mm forward until it clicks (about 3.2 N).
3. The BiBoard header now stands in the notch at the front of the left well.

Turned the wrong way, the body does not go down onto the pegs.



3 Speaker

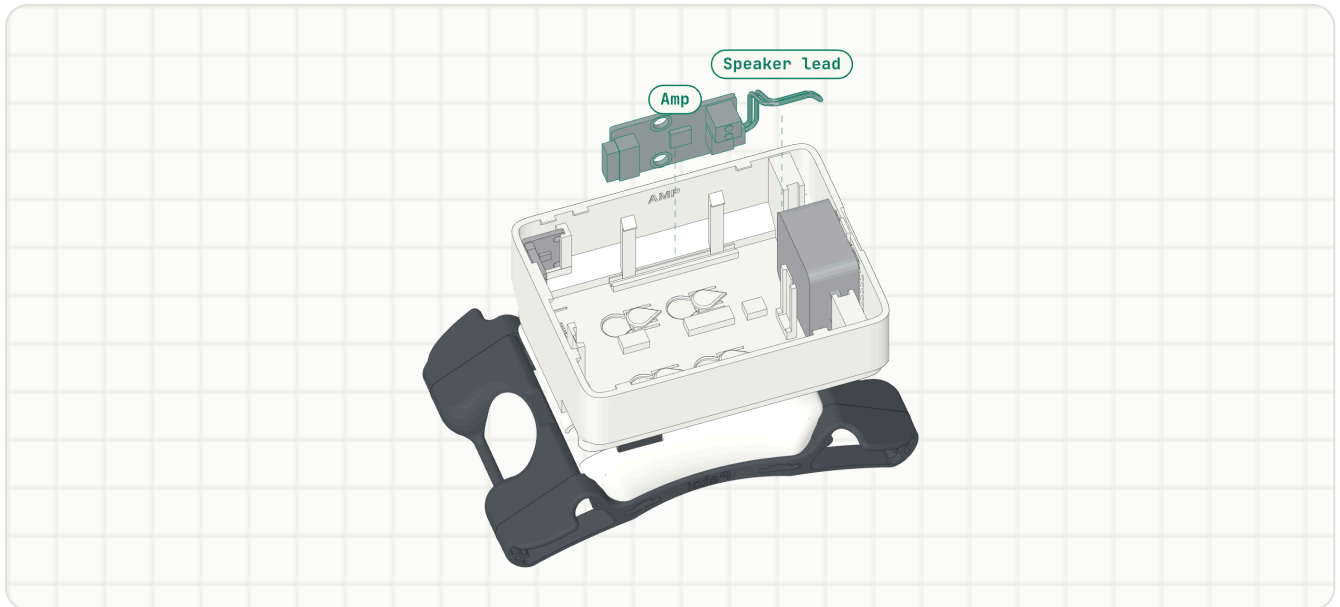
1. Push the two wings of the speaker down into the side grooves at the rear.
2. The speaker body goes to the rear, toward the grille.



4 Mic

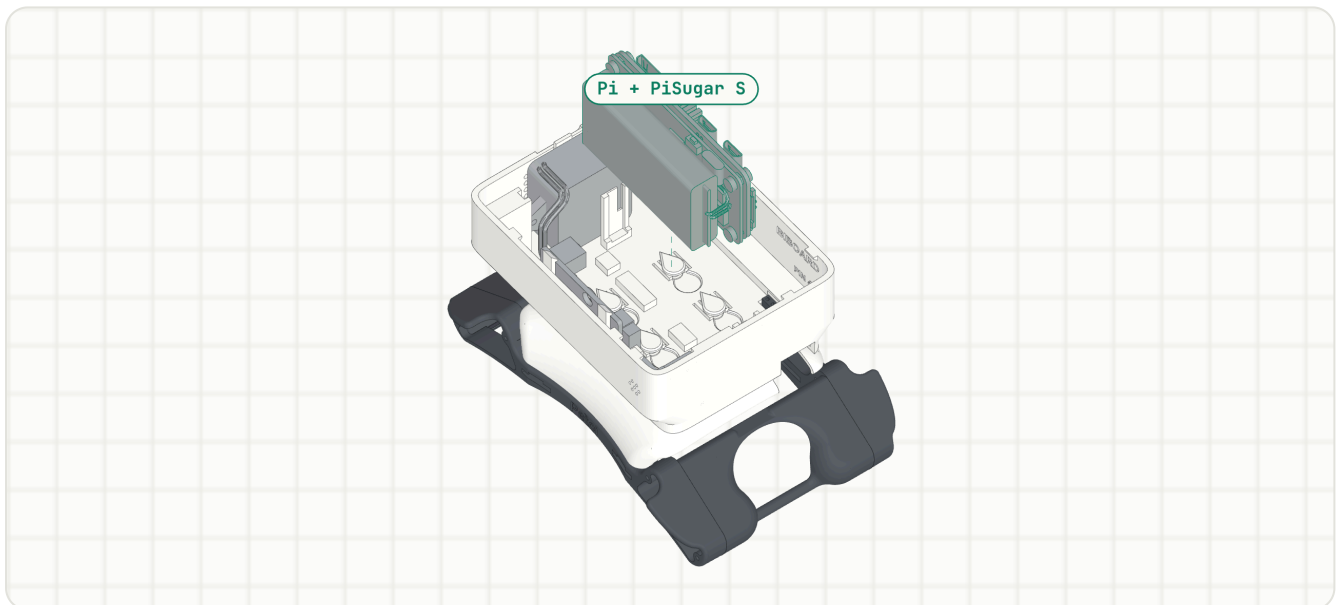
1. Plug the six mic jumpers onto the mic header. Use 15 cm jumpers on GND and 3V.
2. Drop the mic into the slots in the post and the ledge on the right wall, near the front.
3. The port faces the wall. The header is at the front edge, the plugs point into the body.

The board sits in both slots. A fork under the panel holds its top edge later.



5 Amp and speaker lead

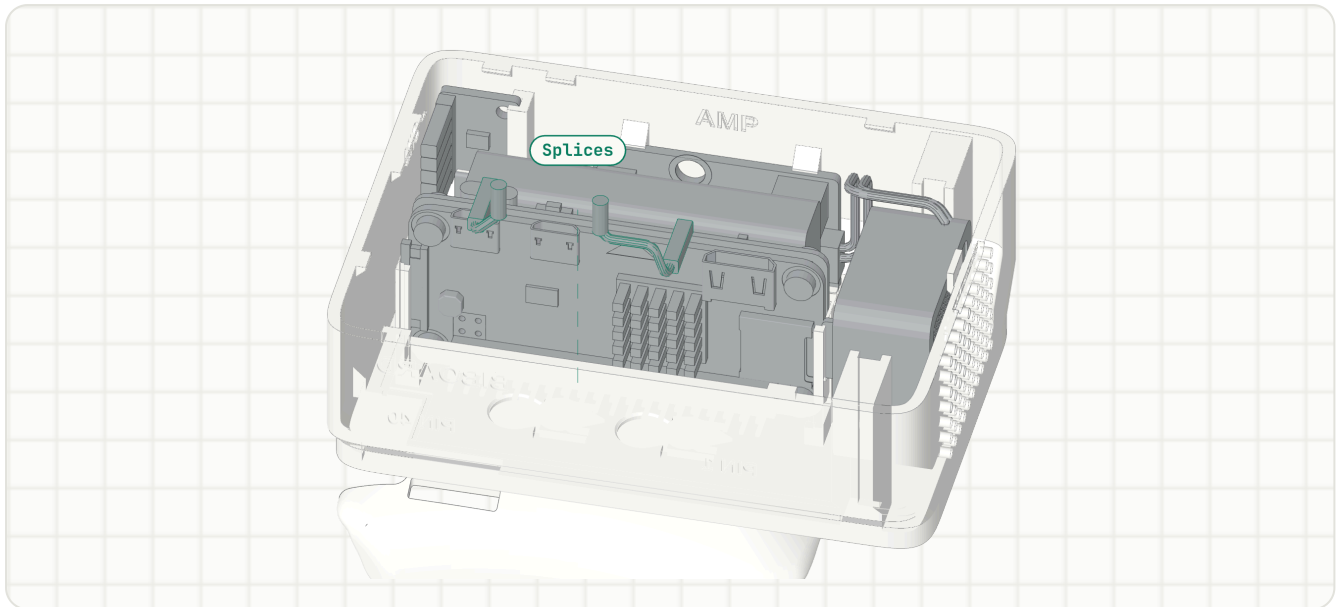
1. Plug the speaker lead into the 2-pin connector at the rear end of the amp.
2. Plug the flat amp cable into the 5-pin connector at the front end. G is at the top.
3. Put the bottom edge of the amp into the slot along the right wall, parts to the inside.
4. Tilt the top edge under the two nubs. Set it with a dab of glue.
5. Let the amp cable hang out of the top. It goes in after the BiBoard jumpers.



6 Pi + PiSugar S stack

1. Set the PiSugar AUTO switch first: it is under the cell.
2. Push the stack down into the grooves of the two end posts until it stops.
3. The ports are up, the 40-pin header down and toward the left wall, the SD card at the rear.

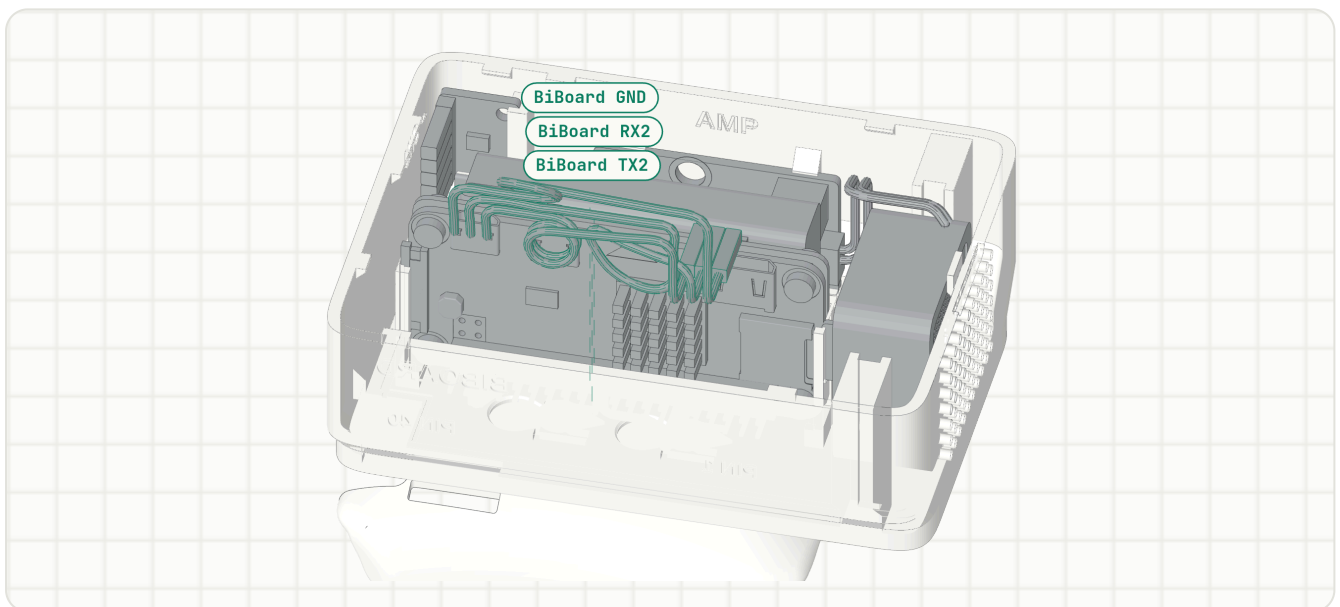
If the stack is not fully down, the panel does not slide on later.



7 Splices (BCLK and LRCLK)

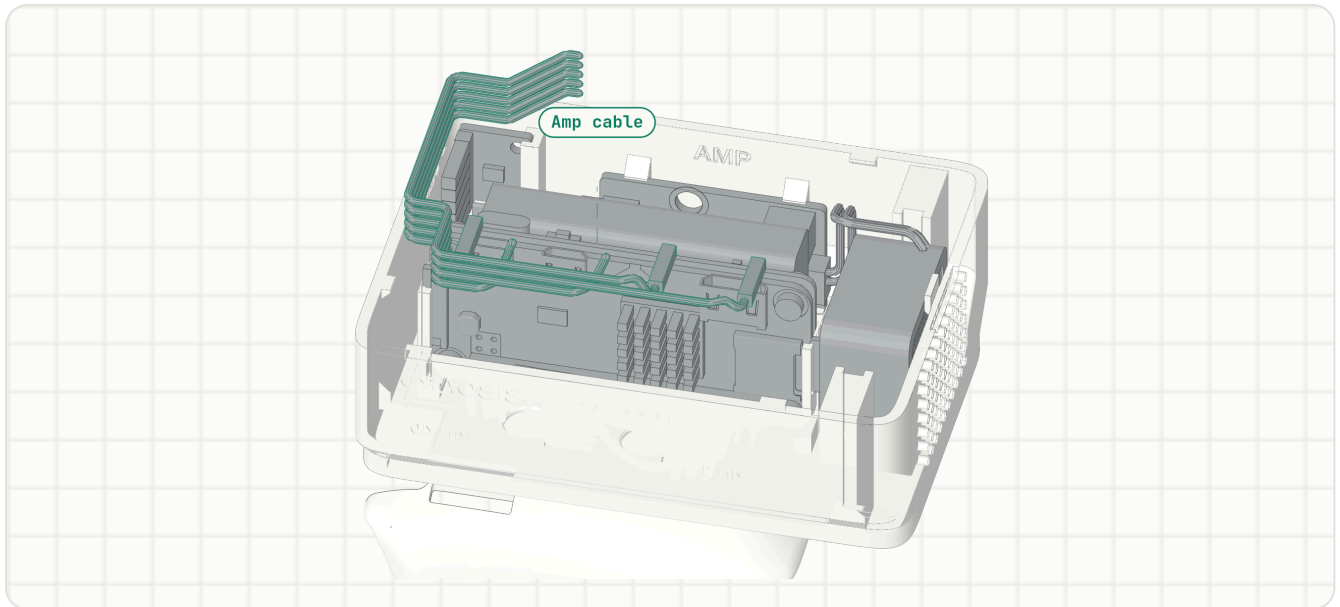
1. Plug the Pi end of each splice: BCLK on pin 12, LRCLK on pin 35.
2. The LRCLK sleeve stands beside the BiBoard plugs, the BCLK sleeve at the middle of the left well.

Each splice is a Y: one Pi end, one mic end, one amp end. See the cable cards.



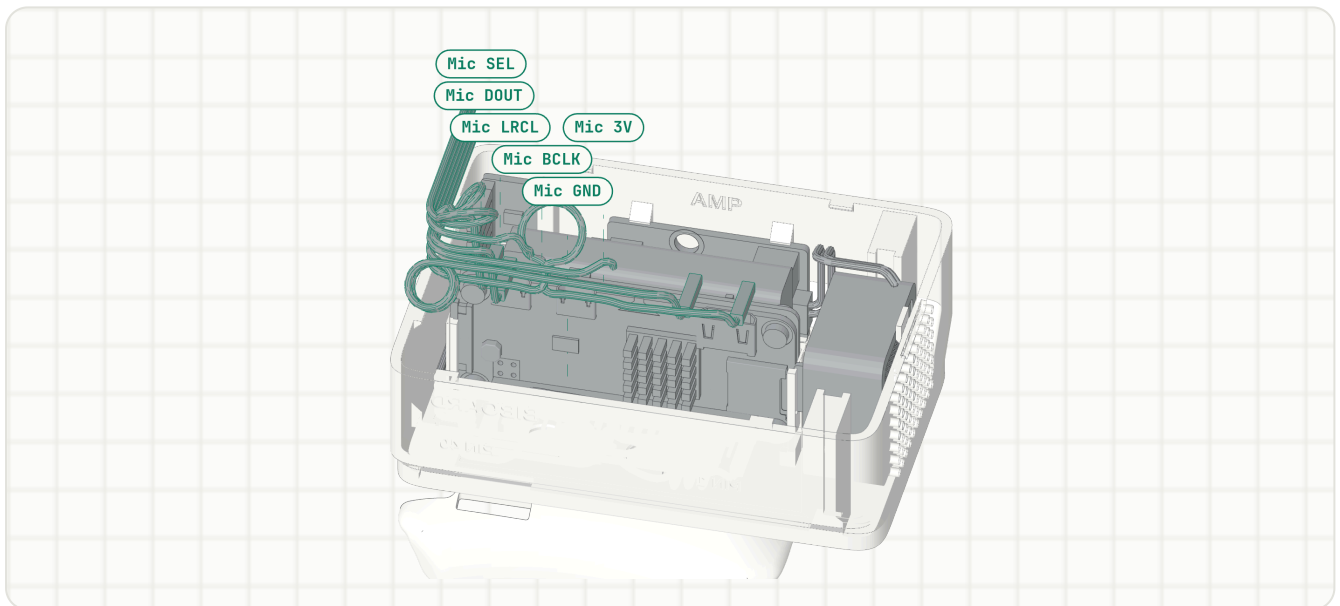
8 BiBoard jumpers: Pi ends

1. Push the female end of each BiBoard jumper onto the Pi: TX2 (gray) on pin 10, RX2 (white) on pin 8, GND (black) on pin 6.
2. Lay the excess of each one in a loop by the left wall.
3. Leave the male ends free. They go onto the BiBoard last.



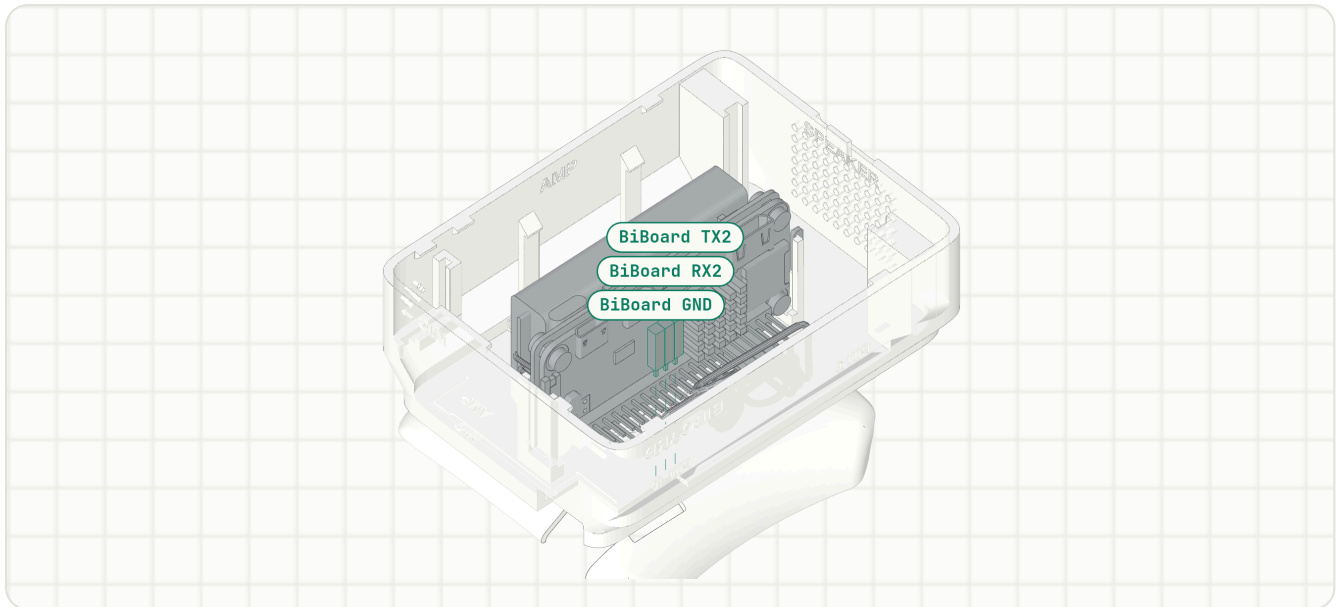
9 Amp cable

1. Lay the flat amp cable on edge, as it leaves the plug, G on top. Do not twist it.
2. It steps down, runs forward to the front wall and across under the mic plugs. Past the front post it turns rearward, runs across behind the front-left notch, and turns rearward along the left well.
3. Peel off each wire at its own height: DIN onto pin 40, LRC and BCLK into the free sockets of their splices, G onto pin 14, V onto pin 2.



10 Mic jumpers

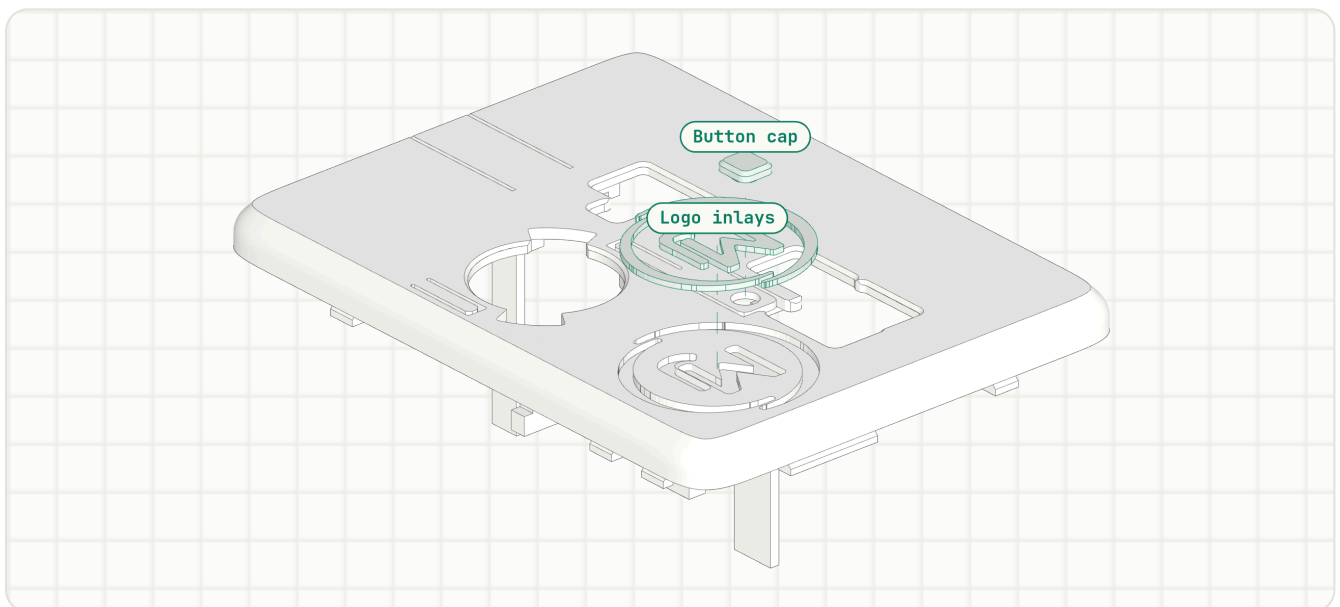
1. Run the mic jumpers straight across behind the front wall, then rearward along the left well.
2. Plug them from the lowest up: 3V on pin 1, GND on pin 9, BCLK and LRCL into their splices, DOUT on pin 38, SEL on pin 39.



11 BiBoard ends

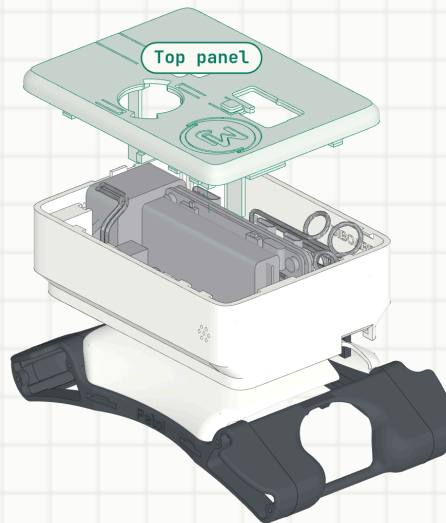
1. Push the male ends of the three BiBoard jumpers into the BiBoard socket: TX2, RX2, GND.
2. The two +5V sockets stay empty: the PiSugar powers the Pi.

The other wires are not shown here, for a clear view into the front-left corner.



12 Button cap and logo

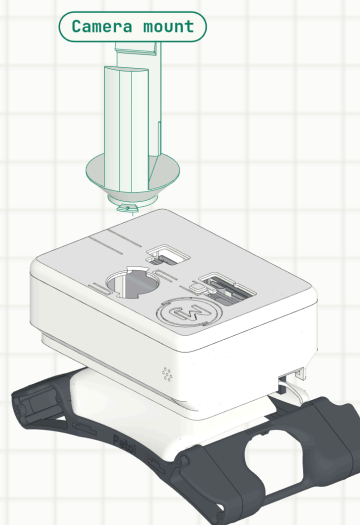
1. Press the post of the white button cap into the round hole in the panel tongue until the cap sits flat.
2. Glue the two logo inlays into the pocket in the front right corner of the panel top: the white ring and M at the left, the red ring and J at the right.



13 Panel

1. Put the panel down 5 mm behind its place.
2. Slide it forward until the latch at the rear clicks (about 5.7 N).
3. The PiSugar power switch is under the window beside the HDMI opening. Move it with a fingernail.

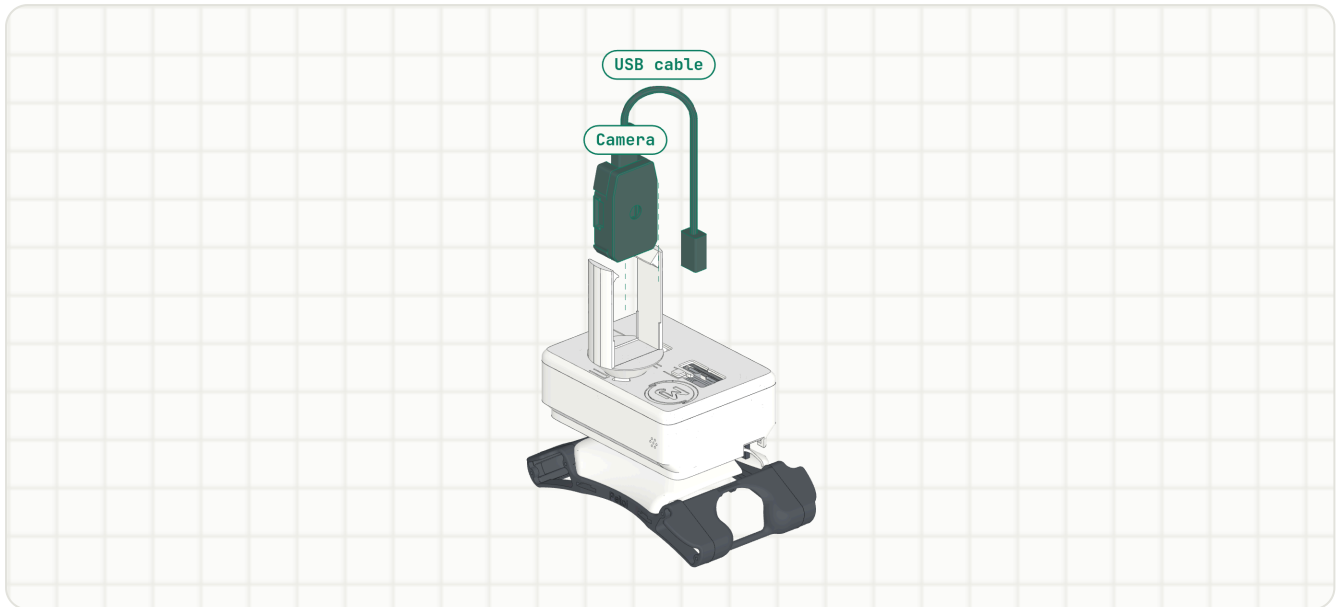
To open: lift the rear edge at the finger notch and slide the panel rearward.



14 Camera mount

1. Turn the camera mount 40 deg counterclockwise (seen from above). Put it down into the round socket: the lugs go down through the keyways.
2. Turn it 40 deg clockwise until it clicks and stops.
3. To point the lens to the rear, turn the mount end for end first. It locks the same way.

To remove: turn it counterclockwise and lift it.



15 Camera and USB cable

1. Push the camera case down between the brackets, lens forward, USB port up, until the hooks click over its top.
2. Plug the USB-C end into the top of the camera and the micro-USB end into the Pi data USB port.

Wire table

Every wire, from end to end. Lengths are between the housings, as modeled; a jumper longer than the route lays its excess in the loop shown.

FROM	TO	GROUP	LENGTH	EXCESS
 BiBoard TX2	pin 10	uart	100 mm	2-turn loop
 BiBoard RX2	pin 8	uart	98 mm	arch
 BiBoard GND	pin 6	uart	99 mm	1-turn loop
 amp G	pin 14	amp	116 mm	
 amp V	pin 2	amp	130 mm	
 amp BCLK	BCLK splice	amp	109 mm	
 amp LRC	LRCLK splice	amp	95 mm	
 amp DIN	pin 40	amp	81 mm	
 BCLK splice	pin 12	splice	16 mm	
 LRCLK splice	pin 35	splice	7 mm	
 mic 3V	pin 1	mic	148 mm	1-turn loop on a 5 mm stem
 mic GND	pin 9	mic	149 mm	2-turn loop
 mic BCLK	BCLK splice	mic	76 mm	cut to length
 mic DOUT	pin 38	mic	97 mm	1-turn loop on a 5 mm stem
 mic LRCL	LRCLK splice	mic	62 mm	cut to length
 mic SEL	pin 39	mic	100 mm	1-turn loop
 amp speaker +	speaker +	speaker	43 mm	
 amp speaker -	speaker -	speaker	44 mm	
 camera USB-C	Pi data USB	camera	120 mm	

Checks, opening and removal

What the model checks

- No printed part and no board touch, except where a fit is meant to touch.
- Every part goes in from the top, in the order of this guide.
- No two wires pass through each other. No designed bend is tighter than 2 mm.
- The head turns from -85 to 85 deg without contact.
- Platform click: about 3.2 N on, 3.2 N off. Panel latch: about 5.7 N.
- Mass 135 g; center of mass 9.3 mm from the robot center.

Open the panel

Lift the rear edge at the finger notch (about 3.1 N), slide the panel 5 mm rearward and lift it.

Remove the add-on

Open the panel. Pull the three BiBoard plugs off. Slide the body 7 mm rearward and lift it.

Change the SD card

Open the panel and lift the speaker out of its grooves; the card is at the rear end of the Pi.

Files

stl/print: the parts to print. cad/: STEP files.

README.md: the full reference. Designs CC BY 4.0, code MIT; see LICENSE.md and ATTRIBUTION.md.