01 · MEET YOUR PARTS

Battery and power basics

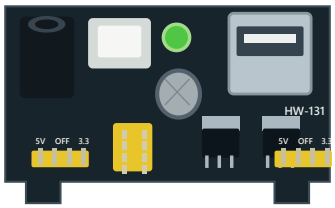
01

Before switching from USB to a battery, learn what each part does and what to check.



Green C2C cable

C2C means USB-C at both ends. A compatible cable carries power and data.



Breadboard power module

Changes a suitable input voltage to a lower output. Its selectors are marked 3.3 V and 5 V.



Battery-to-DC lead

Joins a battery to a DC plug. The lead carries the battery voltage; it does not reduce it.

Two power sources to recognize

USB power

The computer or a suitable USB supply powers the board through a compatible cable.

Battery power

A battery needs a suitable power path. Match voltage and polarity before using it.

Three things to remember

Match the voltage. Allow enough current. Unplug before changing connections. A load is the device using the power.

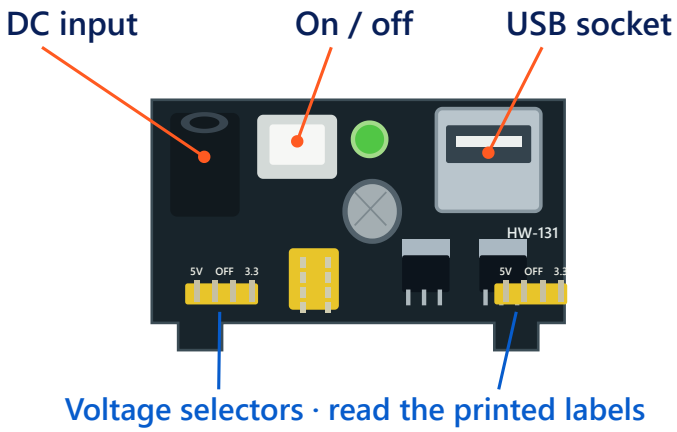
Start here: find all three parts. Keep the battery unplugged while you learn and check the labels.

02 · FIND THE CONTROLS

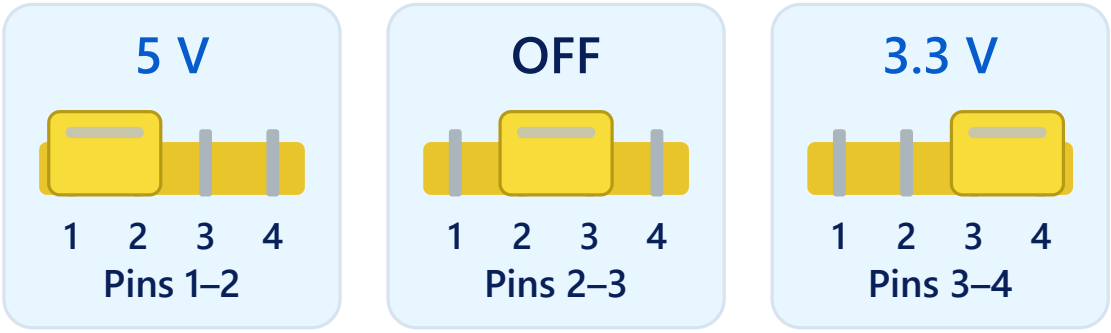
Meet the power module

02

Find the socket, switch, and selectors before using a power module.



Unplug the source before moving a jumper or changing wires.



Four pins, three positions. View the component side with the DC socket upper left and USB socket upper right; count each selector row from left to right. OFF is the middle jumper position.



The contact shape does not tell you its polarity.

Polarity tells you which contact is positive and which is negative.

> **Before using the battery:** ask for the input voltage and DC polarity to be checked. A plug that fits can still be electrically wrong.

03 · WORK THROUGH AN EXAMPLE

Match voltage. Add the current. 03

Voltage (V) must suit the device. **Current (A or mA)** is how much electricity flows while it works. 1 A = 1,000 mA.

Practice load: 3.3 V only

3.3 V	5 V	9 V
500 mA	2 A	battery
✓	✗	✗

More current capacity cannot fix the wrong voltage.

Practice example: the load accepts 3.3 V. Check the current rating only after the voltage matches.

What if all the loads work at once?

Practice numbers below: all three loads use the same 3.3 V supply.

Controller	+	Sensors	+	Lights
250 mA		40 mA		20 mA

Peak total = 310 mA

Example capacity: 400 mA



Add the peak currents: the largest currents that can occur together.

Leave spare capacity

The total is 310 mA. An example 400 mA output leaves some room. Startup peaks, voltage stability, and heating still need checking.

A rating is available capacity

A healthy 100 mA load does not automatically draw 2 A from a 2 A supply. The load draws what it needs.

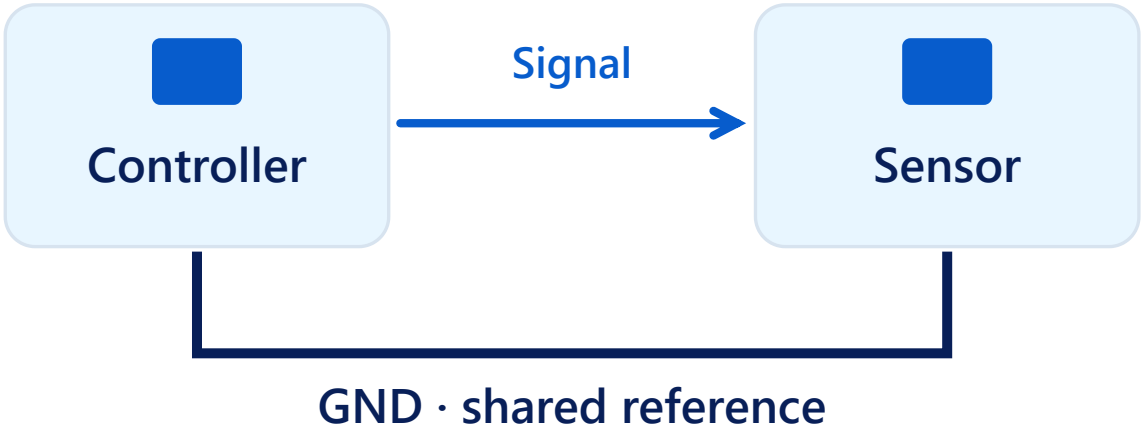
Your turn: add another 80 mA load. The new total is **390 mA**—almost all of that 400 mA capacity. Choose more headroom and repeat the checks.

04 · FOLLOW THE RETURN PATH

Follow the shared ground

04

A signal is a changing voltage. The receiving device needs a reference to understand it.



Keep different positive-voltage rails separate.

A shared reference for a simple DC signal circuit.

GND is the reference

GND means ground. Here it is the circuit's zero-volt reference and return path—not automatically earth ground.

Signals still need to match

A shared ground does not reduce a 5 V signal to 3.3 V. Check the receiving input's voltage limit.

1 Trace the signal

Point from the sending device to the receiving device along the blue arrow.

2 Trace the reference

Follow the GND path. Keep different positive-voltage rails separate.

Quick check

Will adding GND make a 5 V signal safe for a 3.3 V-only input?

No. The reference is shared, but the signal is still too high. Use a compatible signal or suitable level conversion.

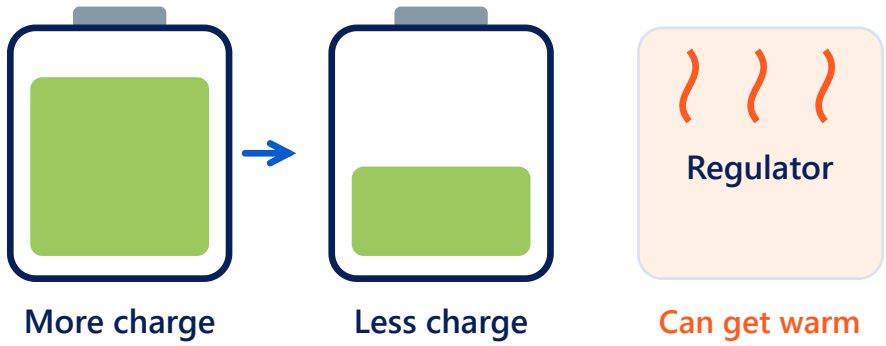
Follow your build's connection diagram. Check unclear pin labels with a helper before connecting wires.

05 · USE A SAFE SEQUENCE

Switch power safely

05

A battery runs down as you use it. A regulator can become warm while lowering voltage.



Battery voltage can fall. Stop if parts overheat.

If a board resets when the load rises, check battery condition, voltage drop, connections, and supply capacity.

Before switching from USB to a battery

1 · Unplug

USB and battery

2 · Check

Voltage + polarity

3 · Measure

Before the board

4 · Observe

Voltage + behavior

Disconnect again before changing connections or returning to USB power.

One source at a time

Unplug USB before using external power unless the exact board instructions permit a defined combination. A USB data cable can still carry power.

Stop and check

Wrong voltage, repeated resets, unusual heat, or odor mean disconnect promptly and investigate before another attempt.

Voltage is measured across two points using the meter's voltage mode and correct sockets. Never put a meter in current mode across a battery. Ask for help if you have not used a meter.

06 · PRACTICE BEFORE POWER

Try it, then check your plan

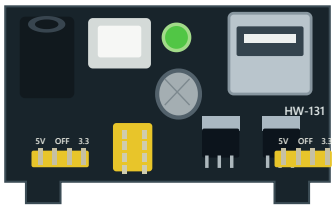
06

Use the pictures to explain your choice. Keep the battery unplugged during these exercises.



USB cable

Power and compatible data.



Power module

Select and verify the output.



Battery lead

Carries voltage without reducing it.

A · Choose a source

A 3.3 V-only load needs 310 mA peak. Choose one to check further: 3.3 V / 500 mA, 5 V / 2 A, or a direct 9 V battery lead.

3.3 V / 500 mA. Its voltage matches and its current capacity is above 310 mA. Check polarity, stability, and heat next.

B · Check a fitting plug

The barrel plug fits, but you do not know its polarity. Should you connect it?

Wait. Have the plug and socket polarity checked first. Fit and wire colors do not prove the connection is right.

My power plan

Device voltage:
_____

Total peak current:
_____

Chosen source and polarity:
_____

What needs checking first?
_____

- ☐ I can name all three parts.
- ☐ I can reject the wrong voltage.
- ☐ I can find the GND reference.
- ☐ I unplug before changing power.