ProofGuard — Men's Shed worksheet

Wednesday 26 August 2026 · Paul Cowen · the job is **connecting a battery to the XIAO ESP32-S3**

> **The one-line ask**
>
> "I need to solder two fine wires onto two small pads on the underside of this board, so it can run off a rechargeable battery. The battery stays disconnected while we solder. Can someone with steady hands help?"

1 · Before you leave the house

- [ ] **Charge a cell** on the Adafruit Micro Lipo. **Red LED = charging, green LED = full.** That is the only indicator and it is enough — no meter needed. From half-charged expect 2–3 hours at 100mA.
- [ ] **Meter the polarity** of the battery lead *and* the JST pigtail, and mark `+` on both with a dab of paint or tape. JST polarity is **not standardised between suppliers** — the two may not agree even though the plugs mate.
- [ ] **Run the C3 range test at home** (see §5) so the Shed visit is only about the battery.
- [ ] **Photograph the C3 next to the China sample with a ruler** for the size comparison.

Pack

ITEM	WHY
XIAO ESP32-S3 (POC board)	The board being wired
2–3 × 500mAh LiPo, one charged	Spares matter — a botched cell ends the session
2 × JST-PH pigtails	One to fit, one spare
Multimeter	Polarity and continuity — the critical tool
Micro Lipo charger + USB-C cable	Charging and power
LiPo bag	Transport, and a visible precaution to point at
Kapton or electrical tape	Strain relief and insulating bare ends
Laptop	Reflash and read serial output on the spot
The diymore C3 board	For the regulator check in §4

2 · Safety brief — say this before anyone picks up an iron

> **Never apply heat to a battery tab.** Cell tabs are spot-welded, not soldered. Our cells come with leads already fitted, so nobody needs to go near the cell with an iron. This is the single rule that matters.
>
> **Nothing is soldered with a cell connected.** The battery is plugged in last, after the meter checks pass.
>
> The cell holds about **1.9 Wh — roughly a tenth of a phone battery**. Real hazard, manageable scale. Charging happens at home, not here, so the Shed is only being asked for the soldering.

3 · Main task — fit the JST socket to the XIAO

The XIAO has **bare solder pads** on the underside, not a socket. We fit a pigtail so the battery becomes plug-in and keyed, rather than soldering the cell on permanently.

> **Polarity — from Seeed's own documentation:**
>
> **Negative (–) = the pad on the side closest to the USB-C port.**
> **Positive (+) = the pad on the side away from the USB-C port.**

1. **Cell disconnected.** Keep it in the bag, on the other side of the bench.
2. **Tin both pads** with a small amount of solder. Fine tip, 300–330 °C, in and out quickly — the pads are small and close together.
3. **Tin the pigtail's bare wire ends**, trimmed short (3–4 mm of exposed copper, no more).
4. **Tack each wire** to its pad, matching the polarity above and the mark made at home.
5. **Strain relief** — a small tab of Kapton tape over the joints and along the wire so a tug pulls on tape, not on the pads. Ripped-off pads are the usual way these boards die.
6. **Meter it, still with no cell:**
   - Continuity from each pad to the correct pin of the JST socket
   - **No continuity between + and –** — this is the check that prevents a short across a live cell
7. **Now plug the cell in.**

Immediate tests once the cell is in

TEST	EXPECTED	RESULT
Unplug USB — does the board still run?	Yes. It should boot and keep advertising on battery alone	
Plug USB back in	Red charge LED lights or flashes	
Leave on USB until charged	Red LED goes out when full	

Measure voltage across the cell	3.7–4.2 V. **Below 3.0 V = retire the cell, do not recharge**	
5 V pin while on battery	Dead — this is normal and documented, not a fault	

3b · Small extra job — make a "measurement pigtail" (5 minutes)

Ask for a **second JST-PH pigtail with the RED wire cut**, and both cut ends brought out to small loops or pin ends. This drops the multimeter straight into the battery's positive line, so measuring current is a plug-in job rather than a soldering job every time.

> **Why it is worth five minutes:** M0 needs a deep-sleep current figure, and every future battery-life measurement needs the same connection. Without it, each measurement means unsoldering something.
>
> Your **CHY A830L will read this fine** — full procedure in §3c below.

3c · Measuring current with the CHY A830L

This is the other half of M0. Range tells you whether the radio reaches; current draw tells you how long a cell will last, and it is the number that decides how small the production battery can be.

YOUR METER	FIGURE	GOOD ENOUGH?
DC current ranges	200µA · 2mA · 20mA · 200mA · 10A	Yes — the 200µA range is the one
Resolution on 200µA	0.1µA (1999-count display)	Yes
DC current accuracy	±1.8%	Fine — you are telling 14µA from 300µA, not calibrating
Meter battery	9V PP3 (6F22 / NEDA1604)	Carry a spare — a dying 9V drifts rather than dies

Setup

1. **Flash the sleep sketch** (see commands below) and confirm the banner on serial.
2. **Unplug USB.** The board must run from the battery alone, or you measure the USB rail instead.
3. **Meter in series on the POSITIVE lead**, using the measurement pigtail from §3b. Red probe to the battery side, black probe to the board side.
4. **Dial to DC current, 200µA range.** Probes in the **mA/µA** sockets — *not* 10A.
5. **Wait 2–3 seconds** for the boot burst to finish. It will over-range briefly; that is expected.
6. **Read it** once the number settles.

What the reading means

READING	VERDICT	IMPLIED STANDBY ON

		500MAH
~14µA	Correct — matches Seeed's spec for the S3	Years in theory; months in practice
50–200µA	Acceptable, some leakage	~3–12 months
~43µA (C3, LED removed) / ~400µA (C3, as shipped)	**Expected for the C3 SuperMini** — documented, not a fault. See §4	Weeks to months / days
Hundreds of µA to mA	**Something is leaking** — usually the power LED or a lazy regulator. Fixable by desoldering the LED, or gone entirely on a bare production module	Days to weeks — not viable

Record the figure for **both boards**. The C3 vs S3 sleep-current gap is the second half of the board decision, alongside range.

> **Two rules.** *Never probe a voltage while the meter is still in current mode* — in current mode the leads are a near short through the shunt, and that is how these meters die.
>
> *You cannot measure a board that wakes up and transmits.* On the 200µA range a BLE burst is a thousand times over-range; the burden voltage collapses the rail and the board resets, so you would be measuring a reset loop. That is the entire reason for the dedicated sleep sketch.

Flash commands

Sleep test — sleeps 5 minutes at a time so the reading settles:

```
arduino-cli compile --fqbn esp32:esp32:esp32c3:CDCOnBoot=cdc --upload -p /dev/cu.usbmodemXXXX "POC Firmware/06_deep_sleep_test"
```

Back to the range/app sketch afterwards:

```
arduino-cli compile --fqbn esp32:esp32:esp32c3:CDCOnBoot=cdc --upload -p /dev/cu.usbmodemXXXX "POC Firmware/05_ble_range_test"
```

For the XIAO S3 swap the FQBN to `esp32:esp32:XIAO_ESP32S3`. Always use `compile --upload` as one command when switching between boards — a bare `upload` can pick up the other board's image from the build cache (it fails on chip ID, 5 vs 9, but only after wasting a flash).

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4 · Second task — the C3's power design (2 minutes, needs a magnifier)

The board is marked **SuperMini**, and that design is documented by the community: it carries an **ME6211 LDO**. That is a *low-dropout* regulator, so it can hold 3.3 V as a LiPo sags toward 3.0 V. **The fear that the C3 simply could not run from a cell looks unfounded.**

diymore is a reseller and clones vary, so the job here is now *confirmation, not discovery*. Borrow a magnifier and read the marking on the small 3-pin SOT-23 chip near the USB-C connector. Photograph both sides of the board while you have the loupe out.

IF THE MARKING READS…	IT MEANS
`ME6211` *(expected)*	Confirms the documented design. Low dropout — a LiPo works

`XC6206`, `662K`, `SGM2212` or similar	Also low dropout — fine
`AMS1117` or `1117`	Unexpected. ~1.1 V dropout, so it could not hold 3.3 V from a sagging cell. Would rule the board out for battery use

> **The question that actually matters now is the power LED, not the regulator.** The SuperMini is documented at roughly **43µA in deep sleep — but only with the POW LED physically removed**. As shipped, with the LED in place on the 5 V rail through a 5.1k resistor, community reports put it nearer **400µA**.
>
> Against the XIAO S3's specified **14µA**, that is around **3× worse at best and roughly 30× worse as shipped**. On a 500mAh cell that is the difference between months of standby and days. So if the C3 reads in the hundreds of µA tomorrow, **that is the documented behaviour of the board, not a fault to debug** — record it and move on.
>
> Worth keeping in proportion: at production neither board is used as-is. A bare module has no power LED and no dev-board regulator, so this particular penalty disappears. It still counts against the C3 for the MVP units, which *are* built on dev boards.

While the magnifier is out, also note whether the board has a **U.FL / IPEX socket** for an external antenna. The XIAO S3 has one; if the C3 does not, that is a real difference for a device that has to work inside a pocket or bag.

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5 · The C3 range test — do this at home, not at the Shed

The C3 is already flashed and advertising as `PG-ESP32-C3`. It needs **no buttons and no second person**.

1. Install **nRF Connect** (Nordic, free) on your phone.
2. Leave the **board** plugged in at a fixed spot. Walk away with the **phone** — the phone has the screen, so you can see the moment it drops.
3. Record where RSSI falls and where the link drops. Mark the spot, pace it or drop a map pin.
4. Repeat with the S3 flashed with the same sketch — **same day, same places**, or the comparison is worthless.

RUN	C3 RESULT	S3 RESULT
Bedroom → kitchen (through walls) — the product case		
Open street, distance at drop-out — the antenna comparison		
Phone locked, app backgrounded — still receiving?		

> Transmit power is **pinned in the sketch** so both boards transmit at the same level. Don't change it between runs — otherwise you measure the setting, not the antenna.

6 · Worth asking while you are there

- **Can anyone do or review a PCB layout?** A simple two-layer carrier board. If yes, it could remove the design cost from the funding application entirely.
  - Follow the module vendor's **reference layout exactly** for antenna keep-out — radio layout is not general electronics knowledge.
  - **Agree ownership in writing before work starts**, however informally. An unassigned contribution becomes a problem the moment the business is transferred or seeks lending.
- **Requirement to hand them:** the carrier must include a **battery voltage divider to an ADC pin**. The XIAO has no GPIO wired to the battery, so without this the device cannot tell its user it is nearly flat — unacceptable in a safety product.

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7 · Do not do these tomorrow

- **Do not solder anything to the C3.** Nothing is decided about it yet and it needs no battery for its tests.
- **Do not charge cells at the Shed** unless you have checked their insurance covers it. Charge at home, bring them charged.
- **Do not cut the connector off a battery.** If you ever must, cut **one wire at a time** — both at once shorts the cell across the cutter blades.

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8 · Notes