Budget Solar Repeater Build (~$80)

This guide walks through assembling a low-cost, outdoor solar-powered LoRa repeater using the RAK4631 WisBlock platform. The build is weatherproof, low-power, and deployable on a single weekend afternoon. (Component prices below are approximate and volatile — verify with current retailer listings as of 2026-06-08.)

Parts List

Part	Approx. Cost
RAK4631 WisBlock Core (nRF52840 + SX1262) — RAKwireless store	~$18–24
RAK19007 WisBlock Base Board — see RAK19007 product page	~$15
5W 6V solar panel	~$10
CN3791 MPPT solar charger board (5V/6V in, 3.7V LiPo out)	~$8
3.7V 3000 mAh LiPo battery (flat pack) — rough estimate, cite a vendor SKU	~$10
Hammond 1554C enclosure (IP67 polycarbonate, 120×65×40mm)	~$15
M12 cable glands (×2)	~$3
SMA female bulkhead connector	~$2
5 dBi 915 MHz fiberglass antenna + SMA pigtail cable — cite a vendor SKU, price approximate	~$15
Misc: wire, shrink tubing, desiccant packet	~$5
Total	**~$108** as configured. A bare-bones ~$80 build is only reachable by omitting the fiberglass antenna (~$15) and substituting cheaper parts for the enclosure and battery; the antenna alone does not close the gap. Treat ~$108 as the realistic figure and ~$80 as a minimal variant.

Assembly Steps

1. **Flash firmware.** Connect RAK4631 to your computer via USB. **Double-tap the RESET button to enter the bootloader**; the board then appears as a USB drive named `RAK4631`. Drag the MeshCore repeater `.uf2` firmware file (a UF2 firmware image — a flashable binary the bootloader recognizes) onto that drive; the board reboots automatically when flashing completes.
2. **Wire the CN3791 charger board.** Connect the solar panel leads to the `IN+` / `IN-` pads. Connect the LiPo battery to `BAT+` / `BAT-`. Run the charger output (labeled `OUT+` / `OUT-` or VCC/GND) to the RAK19007 5V and GND supply pads. Double-check polarity before applying power. **Add an inline fuse on the battery positive lead.**
3. **Prepare the enclosure.** Mark and drill two M12 knockouts in the enclosure: one in a side wall for the antenna SMA pigtail, one for the solar cable entry. An M12 gland threads into a ~12 mm hole and accepts cable ODs of roughly 3–6.5 mm; if your solar lead is thicker, step up to an M16 gland and hole. Deburr holes cleanly.
4. **Install cable glands.** Thread M12 glands into both holes, finger-tight plus a quarter turn. Route the SMA pigtail through one gland and the solar cable through the other. Apply 2–3 wraps of PTFE thread tape on the gland threads before tightening fully (PTFE tape, not thread-sealant compound, to match the cable-glands page and avoid plastic-incompatible sealants).
5. **Mount the RAK19007.** Attach M2.5 brass standoffs to the enclosure floor using self-tapping screws or nuts. Secure the RAK19007 to the standoffs. Affix the LiPo battery to the enclosure wall with double-sided foam tape, away from the standoff hardware. **Battery safety:** use a quality LiPo with built-in protection. Do not let the charger charge the cell below 0°C (use a low-temp-cutoff charger, or a LiFePO4 pack with an appropriate charger, in cold climates) or while the sealed enclosure is baking above ~45°C in direct sun — both can damage the cell or cause a fire. Shade or use a white/light-colored enclosure and keep the inline fuse on the battery lead.
6. **Route the SMA pigtail.** Connect the SMA pigtail's u.FL end to the RAK4631 antenna port. u.FL/IPEX connectors are fragile — align the plug directly over the board socket and press straight down until it clicks; never pull on the cable, and never solder near it. A mis-seated u.FL means no antenna connection and can damage the radio. Route the cable through the gland to the external SMA bulkhead connector and tighten the bulkhead nut.
7. **Seal and protect.** Apply silicone RTV around all cable-gland entry points and the bulkhead fitting flange. Drop a desiccant packet into the enclosure before sealing.
8. **Test charging.** Connect the solar panel externally and expose it to light. The CN3791 module has two indicator LEDs: one for charging, one for charge-complete (confirm against your specific module's manual, as silkscreen and LED behavior vary by board variant). Verify both states cycle correctly.
9. **Configure the node.** The *Repeater* role on MeshCore is set by flashing the Repeater firmware (step 1) — the companion app/CLI is used to set the node name, coordinates, and admin password, not to switch roles. Power on the board. Using a phone or laptop, open the MeshCore app and connect via Bluetooth. Confirm the device is in the Repeater

role, enter your callsign or node name, and input the GPS coordinates of the deployment site (or enable GPS fix if a GPS module is attached). Also confirm the region is set to US (915 MHz) so firmware TX power stays within the FCC Part 15 limit; the 5 dBi antenna and ~22 dBm SX1262 radio are compliant.

10. **Deploy and mount.** Close the enclosure lid and engage the IP67 latches. Mount the enclosure at the chosen site using UV-stable zip ties or a small bracket. Attach the external antenna to the SMA bulkhead and angle the solar panel toward the equator. A good year-round tilt is approximately equal to your latitude; steeper (latitude +15°) favors winter and sheds snow. (See the Solar & Power book for the full tilt guidance rather than a single fixed range.)

Expected Performance

- **Average current draw:** roughly 8–15 mA for the RAK4631 in repeater mode, depending heavily on whether the receiver is always on versus duty-cycled and on transmit frequency. Measure your own build for an accurate figure rather than relying on this estimate.
- **Battery runtime without sun (ideal upper bound):** 3000 mAh ÷ ~10 mA ≈ 300 hours ≈ 12+ days. This is an idealized ceiling. After derating for ~70–80% usable capacity, converter efficiency, self-discharge, transmit spikes, and cold, plan for roughly 60–70% of this figure in practice.
- **Solar recharge time:** with roughly 4–5 peak-sun-hours per day in clear conditions, a 5W panel can replace a small repeater's daily consumption with margin. Actual recharge depends on peak-sun-hours and load, not a fixed number of days.
- **RF range:** a higher-gain antenna and greater mounting height improve range. A 5 dBi antenna adds roughly 3 dB over a typical 2 dBi stubby, but the resulting distance depends on terrain, line-of-sight, spreading factor, and noise floor — it cannot be stated as a fixed number of kilometers.

Tips & Troubleshooting

- If the CN3791 does not charge, verify the solar panel open-circuit voltage is within the 4.5 - 6.5V input range of the board. (That 4.5–6.5V figure applies to the 6V-panel CN3791 module variant; modules configured for a 12V panel use a higher MPPT setpoint.)
- Use self-amalgamating tape over the SMA bulkhead nut as an extra moisture barrier.
- If Bluetooth pairing fails, confirm the firmware was flashed correctly — on typical MeshCore RAK4631 builds a solid blue LED indicates the BLE stack is running, but LED behavior depends on the specific firmware build, so verify against your firmware's documented behavior.
- For areas with heavy frost, consider replacing the LiPo with a LiFePO4 cell; LiPos lose significant capacity below 0°C. **Important:** if you switch to LiFePO4 you must also switch to a LiFePO4-rated charger — the CN3791 charges to 4.2V and will overcharge a LiFePO4

cell (LiFePO4 needs ~3.6V/cell). And regardless of chemistry, do not charge LiPo, Li-ion, OR LiFePO4 below 0°C (32°F) without a charger that has a low-temperature charge cutoff (or a self-heating LiFePO4 pack). Note that low-temperature limits apply to charging; discharge works to much lower temperatures.

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