LIGHTWEIGHT, ENERGY EFFICIENT SOLAR XIAO nRF52840 REPEATER



A long-range, lightweight, energy efficient / solar-charging optimized, and durable repeater DIY kit for Meshcore / Meshtastic based on the Seeed Studio's XIAO nRF52840 & Wio-SX1262 kit, which eliminates the problem of battery depletion in cloudy days, and makes installation a breeze (product designed by an Industrial Engineer expert in solar).

What is included:

- Weather-proof enclosure built with ABS parts, easy to maintain, light weight, and ready to be raised using a 1/2 inch galvanized electric conduit, easily available at hardware stores for ~$20 the 10 ft pipe.
- Good quality, user replacable Li-ion 3200mAh battery.
- 5V 250mA solar panel plus a buck-boost converter module allowing the battery to be charged in cloudy days.
- Maintenance on/off switch to safelly disconnect the battery power when replacing antenna/components.
- Energy efficient Seeed Studio's XIAO nRF52840 & Wio-SX1262 microcontroller kit for 862-930MHz Lora devices, w/BlueTooth. The onboard charging circuit on the XIAO nRF52840 & Wio-SX1262 kit is designed to charge the battery from a 5V USB-C input (charging current: 50/100 mA).
- Included ABS pipe connector for easy mounting the repeater with a standard 1/2" electrical galvanized conduit.

Additional charging/maintenance optimization

A Buck-Boost converter module is connected to the battery allowing the solar cell to charge the battery with a constant 4.15V even when the input voltage is considerably lower / higher than 5V. A BMS with auto disconnect on low-voltage and over-voltage protection is added for peace of mind, to protect the 18650 Li-ion battery and extend its lifespan.

AVAILABLE OPTIONS*

- Complete DIY kit (requires soldering components during assembly. Step-by-Step instructions included).
- Assembled repeater (ready to be flashed/mounted).

Note: (*) Simplified design, with the goal of allowing an easy replacement of any component, for maintenance purposes.

For ordering & signing up for free monthly DIY repeater assembly workshops, e-mail: repeaters@ecosol.ca

MAIN COMPONENTS' SPECS

18650 LI-ION BATTERY

ITEM		SPECS.	NOTES
Rated Capacity (Minimum)		3200mAh	0.64A discharge at 20°C
Nominal Capacity (Minimum)		3250mAh	0.65A discharge at 25°C
Nominal Capacity (Typical)		3350mAh	Reference only
Nominal Voltage		3.6V	0.65A discharge at 25°C
Discharging End Voltage		2.5V	
Charging Current (Std.)		1.625A	
Charging Voltage		4.20 +/- 0.03V	
Charging Time (Std.)		4.0 hours	
Continuous Discharging Current (Max.)		4.875A	0°C ~ +45°C
Internal Resistance		less than 48mΩ	AC impedance 1 kHz
Weight		less than 47.5g	
Operating Temperature	Charge	0°C ~ +45°C	
	Discharge	-20°C ~ +60°C	
Storing Conditions	less than 1 month	-20°C ~ +50°C	Percentage of recoverable capacity 80% (discharging time after storage/Initial dischargeing time) x100
	less than 3 months	-20°C ~ +40°C	
	less than 1 year	-20°C ~ +20°C	

SEEED STUDIO'S XIAO NRF52840 & WIO-SX1262 MICROCONTROLLER KIT

This kit combines the XIAO nRF52840 and Wio-SX1262, supporting BLE5.0 and LoRa (862-930MHz), and operates with low-power consumption. It can be applied in various fields such as Meshtastic, Meshcore, sensor networks, environmental monitoring, asset tracking, education, and innovation.

Features

- Versatile Microcontroller: Incorporate the Nordic nRF52840 chip with FPU, operating up to 64 MHz, mounted multiple development ports, supported by Arduino / CircuitPython / Micropython.
- Powerful LoRa Performance: Long-range LoRa on Semtech SX1262, supports 868/915 MHz bands.
- Dual-core communication: It supports both Bluetooth and LoRa dual modes, enabling cross-domain interconnection.
- Dimensions: 8mm × 22mm × 23mm. It features an antenna connector for internal and external antenna options.

ITEM	SPECS.
XIAO nRF52840	Nordic nRF52840
	ARM Cortex M4 with FPU running up to 64MHz
Wio-SX1262	Based on Semtech SX1262, supports 862-930MHz
Wireless	BlueTooth 5.0/NFC
Interface	XIAO nRF52840: 1x UART, 1x IIC, 1x SPI (connects to SX1262), 1x NFC, 1x SWD, 11x GPIO (PWM), 6x ADC
	Wio-SX1262: 1x User button, 1x SPI (connects to XIAO nRF52840)
Power	Input Voltage (Type-C): 5V Input Voltage (BAT): 4.2V
	Charging battery current: 50mA/100mA
	Standby power consumption: < 5μA
Working temperature	-40°C ~ +65°C
Dimensions	21 x 17.8 mm

AVERAGE POWER CONSUMPTION (24 HOUR CYCLE) FOR THE XIAO NRF52840 + WIO-SX1262 KIT ACTING PURELY AS A LORA REPEATER

Key Hardware Figures

- **Sleep / deep idle** (radio off or warm-start sleep): **10–16 µA** total for the kit (optimized).
- **Continuous RX** (listening): **~8–12 mA** typical (SX1262 RX ≈ 4.6–7.6 mA + nRF52840 overhead). Real-world measurements on this exact kit in repeater/idle mode cluster around **9.5–10.5 mA**.
- **TX**: 45–125 mA depending on output power (optimized ~45 mA at 14 dBm; ~80–125 mA at higher settings). Airtime per packet typically 50–300 ms (depends on SF, BW, payload).

A dedicated repeater keeps the radio in RX almost continuously (or uses short CAD/duty-cycled RX) and only transmits when relaying a packet.

Estimated Average Current / Power (24 h)

Urban Density	Approx. Relayed Packets / Hour	Extra TX Contribution	Average Current	Average Power (at ~3.6 V)
Light urban	1–5	< 0.2 mA	**~10.0–10.5 mA**	**~36–38 mW**
Moderate urban	10–40	0.3–1.0 mA	**~10.5–11.5 mA**	**~38–41 mW**
Heavy urban	50–200+	1.5–5 mA	**~12–15 mA**	**~43–54 mW**

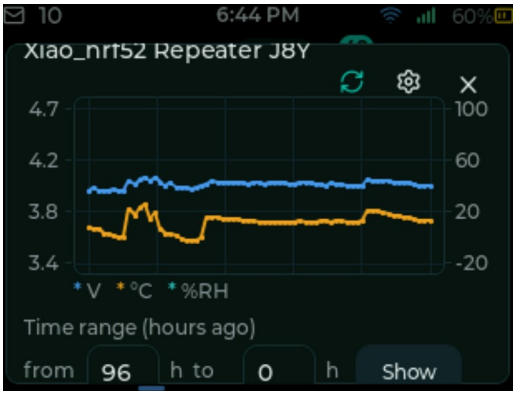
Notes / assumptions used

- Base continuous RX ≈ 10 mA (realistic measured value for this kit).
- Average TX current ≈ 80 mA, average airtime ≈ 100 ms per relayed packet.
- Heavy urban figures assume a congested mesh with frequent nodeinfo, telemetry, and message traffic (common in dense city deployments).
- No Bluetooth, GPS, screen, or other peripherals active (LoRa radio only).
- Values are at typical 3.3–3.7 V battery voltage. Convert to mW by multiplying current (mA) × voltage (V).

Practical Takeaways

- In all urban scenarios the **RX current dominates**. TX activity only becomes noticeable in heavy traffic.
- With good firmware optimization (SPI sleep, RF switch management, warm-start radio sleep when possible) the kit can stay under ~11 mA in moderate urban conditions.
- Daily energy use is roughly **0.9–1.3 Wh** (light to heavy). This is very compatible with small solar + 18650 setups.

These are engineering estimates based on datasheet values, community measurements of the exact XIAO nRF52840 + Wio-SX1262 kit, and typical Meshtastic/MeshCore repeater behaviour. Actual numbers vary with firmware version, exact LoRa preset (SF/BW), TX power setting, and real packet rate.



***ScreenShot**: Telemetry of Ecosol Repeater deployed in Gatineau, QC (taken on Nov 3rd, 2026)*

AVERAGE DAILY YIELD IN WINTER IN GATINEAU/OTTAWA FOR A 5V 200MA SOLAR CELL

Assumptions

- Panel: 5 V × 200 mA = **1 W** at STC (1 000 W/m²).
- Location: Ottawa (~45.3° N), fixed south-facing, **60° tilt**.
- Converter: 80% efficiency, set to constant 4.15V output into the 18650.

Calculation

With a 60° tilt, the winter average daily yield is approximately 0.119 W continuous (or ~**2.86 Wh/day** delivered to the battery).

NASA SSE long-term avg. daily plane-of-array insolation (kWh/m²/day = peak-sun hours) @ 60° tilt:

Month	kWh/m²/day
December	≈ 2.84–2.92
January	≈ 3.43–3.57
February	≈ 4.18–4.45

Winter (Dec–Feb) average ≈ 3.57 peak-sun hours/day.

Yield numbers

- Panel output: 1 W × 3.57 h ≈ **3.57 Wh/day**
- After 80 % converter efficiency: 3.57 × 0.80 ≈ **2.86 Wh/day** into the battery
- Continuous average power: 2.86 Wh / 24 h ≈ **0.119 W**

HOW MANY DAYS OF AUTONOMY WOULD PROVIDE A 3200MAH 18650 LI-ION BATTERY?

Around 9–13 days of autonomy on a 3200 mAh 18650 Li-Ion battery, depending on urban density.

Calculation

Using the average currents from the previous analysis for the XIAO nRF52840 + Wio-SX1262 kit in pure LoRa repeater mode:

Scenario	Average Current	Theoretical Hours	Days (100 % depth)	Realistic Days*
Light urban	10.0–10.5 mA	305–320 h	12.7–13.3	**10–11**
Moderate urban	10.5–11.5 mA	278–305 h	11.6–12.7	**9–10.5**
Heavy urban	12–15 mA	213–267 h	8.9–11.1	**7–9**

*Realistic estimate assumes ~80 % usable capacity (typical limit to protect the cell and account for voltage conversion losses, aging, and cold-temperature derating). This is a common conservative figure for continuous low-power IoT use.

Formula used

$$\text{Days} = \frac{3200\,\text{mAh} \times 0.80}{\text{Average current (mA)} \times 24}$$

Notes

- These figures assume optimized firmware (radio mostly in continuous RX, Bluetooth/GPS/screen off, good sleep management when possible).
- Expect variations due to exact LoRa preset (SF/BW), TX power, packet rate, Temperature, and battery quality/age.
- For solar-assisted operation (as in the earlier questions), even a small panel easily covers the daily ~0.9–1.3 Wh consumption in most conditions, making the 3200 mAh cell mainly a buffer for multi-day cloudy periods.