

Mains Power for Permanent Installations

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Where mains (AC grid) power is available, it is convenient and low-maintenance for routine operation: it provides essentially unlimited energy day-to-day, avoids battery-cycling wear, and simplifies the build. **But for emergency communications, this framing has a critical caveat: in a disaster the grid is usually the first thing to fail.** A node that depends solely on mains power will go dark in exactly the incidents the mesh exists to serve. For any node that must survive a grid-down event, treat mains as *primary-with-battery-backup at best*, and prefer solar + battery for nodes whose whole purpose is grid-down resilience. Mains is "reliable" only for normal-day uptime, not for disasters.

Safety: Any work on the 120/240 V AC side - adding a circuit, an outdoor outlet, or hard-wiring a supply - can be lethal and almost always requires a licensed electrician. Permit requirements vary by jurisdiction; check your local code. AC branch-circuit conductors must be sized per NEC (14 AWG for a 15 A circuit, 12 AWG for a 20 A circuit) regardless of the small load the node draws - never use thin wire on a branch circuit. The low-voltage DC guidance below applies only downstream of a listed AC adapter or power supply.

When to Use Mains Power

- Rooftop or building-mounted nodes where a power run is feasible
- Nodes at locations with existing power (communications towers, buildings, facilities)
- High-power nodes like the Station G2 (requires 15V PD - impractical with solar)
- Room Server nodes that are expected to be always-on for message storage

For any of the above that has an emergency-communications role, pair mains with battery backup sized for the expected outage (see Battery Backup, below) - a node's value during a disaster is exactly when grid power is most likely gone.

Power Supply Requirements by Device

Input requirements below follow each board's published documentation (Meshtastic hardware docs and the respective vendor datasheets, as of 2026-06-08). The current figures are minimums for a single node; confirm against your specific board revision.

Device	Input	Power Supply Needed
Heltec V3, V4	5V USB-C	Any 5V USB-C charger, minimum 1A
LilyGo T-Beam, T-Deck	5V USB-C or Micro USB	Any 5V USB charger, minimum 1A
RAK WisBlock (RAK19007)	5V USB or battery	5V USB-A charger or 5V regulated supply
Station G2	15V USB-C PD	USB-C PD charger supporting 15V, $\geq 20W$ output (e.g. 15V/2A)
Any node with LiPo	Battery + charger	Power the charger circuit; see device documentation

Station G2 Power Requirements

The Station G2 requires 15V USB-C Power Delivery. This is a specific PD negotiation - the charger must support 15V PD output, not just 5V. The manufacturer specifies a USB-C PD adapter that supports the 15V PD protocol with a maximum output power of 20W or more (i.e. $\geq 20W$, e.g. 15V/2A). Compatible chargers include:

- Most 65W+ USB-C laptop chargers (verify 15V output in spec sheet)
- Anker 65W or 90W USB-C GaN chargers
- Any charger explicitly listing "15V/2A" or "15V/3A" in its PD output specs

A 5V USB charger plugged into the Station G2 will not provide enough power. The device may appear to power on but will behave erratically or fail to transmit at full power.

Battery Backup for Mains Installations

For mission-critical nodes on mains power, a battery backup (UPS function) maintains operation during power outages. **Match the backup capacity to the outage you actually need to survive:** small UPS modules give only a few hours, which covers brief utility blips but NOT disaster-length outages, which routinely run days to weeks after major storms, wildfires, or earthquakes. For genuine grid-down resilience, size battery backup in *days*, or use solar + battery so the node self-recharges. Options:

- **Small UPS:** A compact DC UPS module (available from AliExpress for \$10 - \$20, price as of 2026-06-08) passes through 5V USB power and switches to battery automatically on

outage. Battery runtime of a few hours is typical for small units - adequate for short utility interruptions only, not for a multi-day disaster.

- **Battery + charge controller:** Some boards with a battery connector and an onboard charge/power-path IC can charge a LiPo or 18650 from USB and run from battery when USB power is removed, giving automatic failover. **This is not universal:** many cheap boards cannot safely charge while running or may overcharge, so check your specific board's documentation before relying on it for UPS failover. Also note that on-board USB chargers (TP4056-class) have no temperature sensing - in a cold or hot outdoor enclosure they will happily charge a lithium cell below 0 °C or at high temperature, which causes lithium plating and a hidden fire risk. For an outdoor backup battery exposed to sub-freezing or high temperatures, use a charger or BMS with a low-temperature charge cutoff, put an inline fuse on the battery lead, and prefer LiFePO4 with a low-temp-cutoff BMS over a bare LiPo.
- **Full UPS:** For the Station G2 and other high-power nodes, a proper UPS with 15V PD output is required. These are less common but available from server hardware suppliers.

Weatherproofing Mains-Powered Outdoor Nodes

If the node is outdoors on mains power, weatherproofing requirements are the same as for solar nodes:

- Use an IP65+ enclosure
- Route mains wiring through appropriate weatherproof conduit (AC wiring and connections should be installed by a licensed electrician per local code)
- Use a weatherproof outdoor power outlet or a sealed junction box for the power entry
- Keep the power supply (transformer/adaptor) inside the weatherproof enclosure or in a separately housed waterproof enclosure. **Watch enclosure heat:** an AC adapter dissipates heat, and a sealed box traps it - co-locating a hot adapter against a lithium battery can drive internal temperatures into the cell's charge-derating range (typically above ~45 °C) or damage the cells. Separate the power supply from the battery, provide thermal mass or ventilation, and monitor enclosure temperature; do not press a hot adapter against a lithium pack.
- If using a standard USB charger adapter, note that most USB chargers are not rated for outdoor use - enclose them in an additional weatherproof housing or use an industrial-rated outdoor power supply

Cable Run Considerations

For nodes mounted at height (rooftop, tower, pole), the cable run from power to the node may be significant. At 5V, voltage drop over long cables is a real concern. The voltage-drop figures below assume a modest node load of about 500 mA; drop scales with current, so a higher-draw node (e.g.

~1A during Wi-Fi/transmit) sees roughly double these values:

Cable Run	Cable Gauge	Voltage Drop at ~500mA	Action
<5m	24 AWG USB cable	Negligible (at ~0.5-1A)	Standard USB cable fine
5 - 15m	22 AWG or better	0.3 - 0.9V (at ~0.5-1A)	Use thicker cable or boost supply voltage
>15m	18 AWG or higher, or 12V supply	Significant with 5V	Run 12V and use a 12V→5V DC-DC converter at the node

For long cable runs, running 12V DC (lower current for same power, less voltage drop) and using a small buck converter at the node end is more efficient than running 5V USB over a long distance. (This 12V/24V/18V guidance is for low-voltage DC runs only - not AC mains branch circuits, which must follow NEC conductor sizing.)

Lightning Protection for Mains-Powered Sites

Mains-powered outdoor nodes are vulnerable to both direct lightning strikes and power line surges. Protect with:

- A quality surge protector or transient voltage suppressor (TVS) on the mains input
- A DC-grounded lightning arrestor on the antenna feedline
- Ground the enclosure and mast to an earth ground rod
- Consider a whole-circuit surge protector at the breaker panel for critical sites (installed by a licensed electrician)