Choosing an Outdoor Enclosure

Picking the right enclosure is one of the most consequential decisions in any outdoor LoRa build. A node that works flawlessly on your workbench can fail within weeks if rain, dust, or condensation reaches the electronics. This page walks through IP ratings, common product lines, material choices, sizing rules, and the real-world tradeoffs in the $5 - $50 price range.

IP Ratings Explained

The **Ingress Protection (IP)** rating system (IEC 60529) uses two digits to describe a enclosure's resistance to solids and liquids. For outdoor electronics you primarily care about the second digit (liquid protection). **This table is the canonical IP-selection reference for the DIY Build Guides — other weatherproofing and enclosure pages should defer to it rather than restate different thresholds:**

Rating	Protection level	Typical test	Use case
IP65	Dust-tight + water jet resistant	Water jets from any direction at 12.5 L/min, 3 m distance, 1 min per m²	Covered outdoor installation - under eaves, inside a vent enclosure, mounted on a wall with overhang
IP66	Dust-tight + powerful water jet	100 L/min jets, 3 m distance, 1 min per m²	Exposed outdoor with heavy rain, areas prone to power washing
IP67	Dust-tight + temporary immersion to 1 m	30 minutes at 1 m depth	Exposed outdoor - rooftop, pole-mount, anywhere water can pool on the lid
IP68	Dust-tight + continuous submersion beyond 1 m	Manufacturer-specified depth and duration (often 1.5 - 3 m for 30 - 60 min)	Marine installations, flood-prone areas, below-grade deployments

Practical rule of thumb:

- Sheltered / covered outdoor (under a roof, inside a weatherproof cabinet): **IP65 minimum**. IP54 is not recommended for any unattended outdoor node, even a sheltered one.
- Fully exposed outdoor (rooftop, field, ridge line): **IP66 or IP67 minimum**

- Marine, tidal, or flood-zone: **IP68 required**

Note that IP ratings are tested on a new, undamaged enclosure with its original gasket. A used enclosure with a compressed or cracked gasket may no longer meet its rated IP level. Inspect and replace gaskets annually.

Common Enclosure Options for LoRa Nodes

Polycase WC Series (Popular for Small Nodes)

The **Polycase WC-21** is a common choice in the hobbyist LoRa community. It is an IP65-rated polycarbonate enclosure measuring approximately 115 × 65 × 40 mm externally (interior roughly 107 × 57 × 35 mm) - large enough for a Heltec V3 or T-Beam with an 18650 battery. Key features:

- Impact-resistant polycarbonate body (gray) with clear or gray lid options, designed for outdoor use
- Stainless lid screws and a gasket-sealed lid
- Molded-on flanges available for surface mounting (the flanged "F" variants)
- DIN rail mounting clip available as an add-on
- Price: roughly $10 USD per unit direct from Polycase (Polycase sells direct rather than through Digi-Key/Mouser; verify current pricing at polycase.com). *Pricing as of 2026-06-08.*

For larger boards (T-Beam Supreme, RAK WisBlock with many modules) step up to the **WC-22** (external 115 × 65 × 55 mm) or **WC-27** (external 171 × 121 × 80 mm).

Hammond 1554 Series

Hammond Manufacturing's **1554** series (and the sealed-lid 1555 of the same footprints) is a step up in build quality with thicker walls and a more robust gasket track. The **polycarbonate** versions are independently tested to IP66, IP67, and IP68 (NEMA Type 4, 4X, 6, 6P) — the suffix letters (A, B, C, …) denote *size*, not an IP grade, so there is no "1554 = IP65 vs 1554N = IP67" split. (The ABS versions of the 1554 are rated to about IP66 and are intended for indoor use.) Common sizes for small-to-medium LoRa builds (lid footprint; box depth varies by box height):

- **1554A**: 52 × 50 mm - good for a bare LoRa module without display

- **1554B**: 65 × 65 mm - fits most single-board LoRa nodes
- **1554C**: 120 × 65 mm - solar builds with a battery management board

Hammond polycarbonate enclosures are available with gray, clear, or smoked lids; a clear or smoked lid allows LED status visibility without opening. Price range: roughly $15 - $30 depending on size (verify at a distributor such as Digi-Key or Mouser).

Bud Industries PTS and PN Series

Bud Industries offers a wide range of NEMA 4X (IP66 equivalent) polycarbonate enclosures at competitive prices, including compact options in roughly the 115 × 65 × 40 mm class. Bud enclosures typically include a captive lid with stainless hardware. Available from Digi-Key, Mouser, and Amazon; roughly $8 - $25. Confirm the exact model number and dimensions against the Bud datasheet at budind.com before ordering.

Weatherproof Outdoor Electrical Boxes (Home Depot / Lowe's)

For ultra-budget builds, standard weatherproof PVC electrical boxes (the gray or white boxes designed for exterior receptacles) are surprisingly capable. A 1-gang or 2-gang deep weatherproof box with a gasket cover runs **$3 - $8** at any hardware store and is rated IP44 - IP55 depending on the specific cover. Limitations: no clear lid option, cable entries require separate cable glands or conduit fittings, and most are only IP55 (not IP65). Acceptable for covered-outdoor deployments; not recommended for fully exposed installations.

Material Choices and UV Resistance

Material	UV resistance	Impact resistance	Notes
Standard ABS	Poor - yellows and becomes brittle after a few years (roughly 2 - 5) of direct sun	Good	Avoid for exposed outdoor unless painted with UV-blocking paint
UV-stabilized ABS	Good - manufacturers typically rate it for many years (often 10+) outdoors	Good	Look for "UV-stabilized" or "UV-resistant" explicitly in the spec sheet
Polycarbonate (PC)	Excellent when UV-coated	Excellent - near-unbreakable	Most premium outdoor enclosures; naturally clear (can be tinted)

Material	UV resistance	Impact resistance	Notes
Glass-filled polyester (GRP)	Excellent	Excellent	Industrial standard; heavier and more expensive; overkill for most LoRa nodes
Aluminum	Excellent (anodized)	Excellent	Best thermal conductivity (useful as heatsink), poor RF transparency - a metal enclosure blocks/detunes RF, so do not mount the antenna inside

Recommendation: For any build that will see direct sunlight, use polycarbonate or explicitly UV-stabilized ABS. Do not use generic black ABS - it absorbs more solar radiation and degrades rapidly. (A dark enclosure is only worth considering for extreme-cold, unheated deployments that never see strong summer sun — see the Cold Weather Operation page.)

Sizing Your Enclosure

Measure your components in their final configuration (board + battery + cables routed) and follow this rule: **add 30% to each dimension for wiring clearance**. Cramming components into a too-small enclosure leads to pinched wires, forced cable bends that crack insulation, and difficulty accessing connectors during maintenance.

Worked example for a Heltec V3 build:

- Heltec WiFi LoRa 32 V3 board: 50.2 × 25.5 mm
- 18650 battery holder (single): approximately 78 × 22 × 20 mm (varies by maker)
- Combined footprint with standoffs and JST connectors: approximately 80 × 55 mm
- Add 30% → target enclosure interior: 104 × 72 mm minimum
- Good match: a Polycase WC-21 (internal ~107 × 57 mm - slightly narrow but workable) or a larger Hammond polycarbonate box such as the 1554C (120 × 65 mm footprint); check the internal dimensions on each manufacturer's datasheet before buying.

Gray vs. Clear Lids

Many polycarbonate enclosures are available with either an opaque gray lid or a clear (transparent) polycarbonate lid. The tradeoffs:

- **Clear lid advantages:** You can see LED status indicators, check battery indicator lights, and visually confirm the node is running without opening the enclosure and breaking the seal. This is especially valuable for hard-to-reach installations.

- **Clear lid disadvantages:** Slightly less UV resistance on the lid surface (though most reputable clear PC lids are UV-coated); greater solar heat gain through the transparent lid compared to a reflective gray lid.
- **Recommendation:** Use a clear lid when the node is hard to access; use an opaque white or light gray lid when the enclosure is in direct sun and thermal management is a concern.

Mounting Tabs and Options

Most IP-rated enclosures include integrated mounting flanges or tabs. Common configurations:

- **Flat wall tabs / flanges** (most common): drill through the tab and use an appropriately sized screw (M5 or M6 is typical) with stainless washers. Use stainless or galvanized hardware outdoors - standard zinc-plated steel screws rust quickly.
- **DIN rail clips**: available as accessories for many enclosure lines (Polycase, Hammond). Mount inside electrical panels or control cabinets.
- **Pipe/conduit clamps**: use a stainless hose clamp around a pole with the enclosure attached via its mounting tabs. Effective for antenna mast mounting.
- **Self-tapping screws into wood**: acceptable for temporary mounts; use stainless screws and pre-drill to avoid splitting.

Price vs. Quality Tradeoffs ($5 - $50)

Price tier	What you get	Suitable for
$3 - $8 (hardware store electrical box)	IP44 - IP55, PVC or ABS, no clear option, requires extra work for glands	Covered outdoor, short-term or prototype builds
$8 - $15 (Polycase WC, Bud PN)	IP65, polycarbonate, clear lid option, proper gasket track	Most covered and semi-exposed outdoor builds
$15 - $30 (Hammond 1554, quality PE boxes)	Polycarbonate tested to IP66/IP67/IP68, thicker walls, superior gasket, often IP-tested at the manufacturer	Fully exposed outdoor, IP67-required environments
$30 - $50 (larger Hammond 1554 sizes, specialty PC boxes)	IP67 - IP68, stainless hardware throughout, rated for industrial use	Marine, mountain-top, or critical infrastructure nodes

Do not cheap out on enclosures for permanent installations. A $5 savings on the enclosure is meaningless compared to the cost of re-climbing a pole or rooftop to replace water-damaged electronics.

Revision #3
Created 2026-05-03 05:49:39 UTC by Mesh America Admin
Updated 2026-06-08 23:30:14 UTC by Mesh America Admin