RF Connector Types Guide

Choosing the wrong connector is one of the most common causes of installation failure and wasted money. LoRa devices and antennas use several different RF connector types, and they are not all interchangeable.

The critical SMA vs. RP-SMA distinction

SMA and RP-SMA (Reverse Polarity SMA) look nearly identical but are incompatible. The difference is which part has the center pin. The canonical identification rubric uses both the center contact and the thread location: **SMA male = center pin + external (outside) thread; SMA female = center socket + internal thread.** RP-SMA reverses the center contact only (the threads stay the same):

Connector type	Center contact & thread	Typical use
SMA male	Center pin + external thread (on the plug)	Antenna end; cable end that plugs into a device
SMA female	Center socket + internal thread (device/bulkhead)	Panel mount on enclosures; device ports
RP-SMA male	Center socket + external thread (center is hollow)	Wi-Fi router antennas; also legitimately used on some LoRa boards
RP-SMA female	Center pin + internal thread	Wi-Fi devices; some LoRa enclosures (e.g. certain RAK WisBlock revisions)

For LoRa 915 MHz devices: standard SMA is the more common convention, but RP-SMA is not an error — it originated in the Wi-Fi industry as a way to satisfy FCC § 15.203 (which requires a unique antenna coupling so users can't easily fit a non-compliant antenna). It is not FCC-mandated, and some LoRa products legitimately use RP-SMA. Because boards vary by revision, always verify which connector your specific device has — against the manufacturer's product page — before ordering antennas and pigtails.

How to tell them apart visually: look at the center of the connector. If the plug (male) has a visible pin sticking out, it's standard SMA male. If the male plug has a hole in the center (no pin), it's RP-SMA male.

Common connector types in LoRa deployments

Connector	Where you'll see it	Max frequency	Notes
SMA	Most LoRa devices; most antennas	18 GHz	Standard for LoRa. Verify SMA vs RP-SMA.
u.FL / IPEX	Board-level connector on many LoRa modules (RAK4631, Heltec boards)	6 GHz	Tiny, fragile. Use pigtail adapter to reach external SMA.
N-type	Outdoor antennas; cable-to-antenna junction	~11 GHz (precision versions to 18 GHz)	Weatherproof, preferred for outdoor permanent installs over SMA.
BNC	Some test equipment	4 GHz	Rarely used for LoRa; easy to connect/disconnect.
MCX / MMCX	Some compact boards	6 GHz	Smaller than SMA; uncommon in LoRa community.

Pigtail adapters

A pigtail is a short cable that adapts between two connector types, e.g., u.FL to SMA bulkhead. Used to bring a board's internal u.FL port out to an external SMA connector through an enclosure wall.

Key rules for pigtails:

- Keep them as short as possible - 10 - 15 cm is ideal. Even "low-loss" pigtails add measurable loss at 915 MHz.
- Use RG316 or LMR-100A for short pigtails. Avoid thin RG178 (high loss) or cheap no-name coax.
- Handle u.FL connectors carefully - they're rated for ~30 insertion cycles. Don't repeatedly attach and detach.

Coaxial cable selection

The figures below are at 915 MHz, expressed both per 100 ft (the standard datasheet reference length) and per 10 ft. They are reconciled with the rest of this book's coax tables and with the

Times Microwave / manufacturer datasheets.

Cable type	Loss at 915 MHz (per 100 ft)	Per 10 ft	Use case
LMR-100A	~3.9 dB	~0.4 dB	Pigtails only (under 1 m); too lossy for longer runs
LMR-200	~9.9 dB	~1.0 dB	Short runs (1 - 5 m); rooftop pigtails; default outdoor choice
LMR-400	~3.9 dB	~0.39 dB	Longer runs (5 - 20 m); tower installations; weatherproof
RG58	~10.6 dB	~1.1 dB	Avoid - too lossy for outdoor 915 MHz runs
RG8X	~4.4 dB	~0.44 dB	Acceptable for short outdoor runs; more flexible than LMR-400

Cable loss adds directly to your system's signal attenuation. At 915 MHz a 10-foot LMR-400 run costs about 0.4 dB; the same run in RG58 costs about 1.1 dB - a difference of roughly 0.4-0.7 dB over 10 ft. The gap is small at this length but widens with longer runs, which is where cable quality really matters: a 50-foot RG58 run loses ~5.3 dB versus ~2 dB for LMR-400.

Weatherproofing connections

All outdoor connector joints must be weatherproofed to prevent water intrusion and oxidation:

- **Self-amalgamating (self-fusing) tape:** Wrap from connector body up the cable. Stretch to 50% its width as you wrap - it fuses to itself and creates a waterproof seal. Best for most outdoor installations.
- **Weatherproof connector boots:** Slip-on rubber boots for N-type and SMA connectors. Less reliable than self-amalgamating tape but reusable.
- **Coax seal putty:** Moldable putty for irregular shapes and added protection under tape.

Never use standard electrical tape for weatherproofing RF connectors - it dries out, shrinks, and allows water to track along the adhesive.

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