Frequency Bands Explained

Frequency Bands Explained: 915 MHz vs 868 MHz vs 433 MHz

The single most common source of frustration for new LoRa mesh users - and the most easily avoided - is buying hardware on the wrong frequency band. A 868 MHz device purchased on AliExpress will not communicate with any 915 MHz nodes in a North American mesh network. This page explains the regulatory framework, how to identify what band your hardware is on, and why the problem occurs so frequently.

Regional Frequency Band Reference

Note on the power column: for the US/Canada 902-928 MHz band the figures are **conducted** output power (referenced to an antenna of ≤6 dBi gain), not EIRP. For the EU/UK they are **ERP**. These are not the same as EIRP. See the notes below the table for the antenna-gain rules.

Region	Correct Band	Frequency Range	Regulatory Body	Max Power (conducted / ERP - see notes)
United States	**915 MHz**	902 - 928 MHz	FCC (Part 15, Subpart C)	30 dBm (1 W) conducted, ref. ≤6 dBi antenna
Canada	**915 MHz**	902 - 928 MHz	ISED (RSS-210)	30 dBm conducted, ref. ≤6 dBi antenna
Mexico	**915 MHz**	902 - 928 MHz	IFT	30 dBm conducted, ref. ≤6 dBi antenna

Region	Correct Band	Frequency Range	Regulatory Body	Max Power (conducted / ERP - see notes)
Brazil	**915 MHz**	902 - 907.5 MHz (Meshtastic BR_902)	ANATEL	30 dBm conducted, ref. ≤6 dBi antenna
Australia / New Zealand	**915 MHz**	915 - 928 MHz	ACMA / RSM	30 dBm conducted, ref. ≤6 dBi antenna
European Union	**868 MHz**	863 - 870 MHz	ETSI (EN 300 220)	Most of band: 25 mW (14 dBm) ERP with duty-cycle limits. 500 mW (27 dBm) ERP only in the 869.4 - 869.65 MHz sub-band (10% duty cycle)
United Kingdom	**868 MHz**	863 - 870 MHz	Ofcom (IR 2030)	Mirrors ETSI: mostly 25 mW (14 dBm) ERP, duty-cycle limited; 500 mW (27 dBm) only in the 869.4 - 869.65 MHz sub-band
India	**865 MHz**	865 - 867 MHz	DoT / WPC	License-exempt SRD band (WPC GSR notification); up to ~1 W ERP with a spectral-density cap - verify the current WPC limit before deploying
China (mainland)	**470 MHz or 779 MHz**	470 - 510 MHz / 779 - 787 MHz	MIIT	Micro-power SRD limits per MIIT (Meshtastic CN uses ~19 dBm / ~79 mW) - verify against the current MIIT regulation
Japan	**920 MHz**	~920.8 - 927.8 MHz (AS923 / ARIB STD-T108)	MIC	Per ARIB STD-T108 (Meshtastic JP uses 16 dBm / ~40 mW) - verify the channel-specific limit
Korea	**920 MHz**	920 - 923 MHz	KCC / RRA	10 mW (verify against the current Korean RF-device standard)

Conducted power vs EIRP (US/Canada): Under 47 CFR 15.247, the 902-928 MHz limit is 1 W (30 dBm) *peak conducted* output power, referenced to an antenna with directional gain of ≤6 dBi. With a ≤6 dBi antenna this yields roughly a 36 dBm EIRP ceiling, but 36 dBm is a *derived* figure,

not a flat standalone limit. If the antenna gain exceeds 6 dBi, the conducted output power must be reduced dB-for-dB above 6 dBi. So a high-gain directional antenna (e.g. a 10-15 dBi Yagi) does not let you radiate more - it requires you to turn the transmitter down accordingly. The EU/UK figures above are ERP, which is a different reference again. 868 MHz is an EU band and is **not** a US unlicensed ISM band.

Why You CANNOT Use EU Hardware on a US Network

This is not a software restriction - it is a physical hardware limitation. Here is what happens:

1. The SX1262 radio chip itself can technically tune to a very wide frequency range. However, the matching network (a set of inductors and capacitors) on the PCB between the chip and the antenna is designed and tuned at manufacture for a specific frequency band.
2. A board built for 868 MHz has its antenna matching network optimized for 868 MHz. If you configure the firmware to transmit at 915 MHz, the mismatch between the matching network and the actual operating frequency results in:
   - Reduced transmit power (some energy is reflected back rather than radiated because of the impedance mismatch)
   - Reduced receiver sensitivity, because the front-end matching (and filtering, on boards that have it) is tuned for 868 MHz and attenuates the wanted 915 MHz signal
   - At these sub-watt power levels, a band offset of this size is far more likely to reduce performance than to damage the radio. A severe mismatch (e.g. transmitting with no antenna at all) can stress the PA, but the modest VSWR from a ~5% frequency offset is generally within the SX1262's load tolerance
3. In practice, a 868 MHz board configured for 915 MHz operation transmits at reduced power and receives with reduced sensitivity. The exact degradation depends on the board's matching network (often a few dB to several dB, dominated by the antenna mismatch), and in a real mesh it typically will not communicate reliably with other nodes.

Additionally: Transmitting on a frequency outside your regional allocation is a regulatory violation. US unlicensed sub-GHz ISM operation under Part 15.247 is the 902-928 MHz band; 868 MHz is not an unlicensed ISM band in the US, so operating a standard LoRa node on 868 MHz there is not authorized. Conversely, reconfiguring a CE-marked 868 MHz device to 915 MHz operates it outside the band its CE/RED conformity (Directive 2014/53/EU) was declared for, voiding that conformity.

Why AliExpress Listings Default to 868 MHz

Most LoRa hardware manufacturers are based in China. 868 MHz is the standard band for the large EU/UK market. When a generic AliExpress seller lists "LoRa32 development board" without a clear frequency specification, it is very often 868 MHz because:

- 868 MHz is a common export configuration for the European market
- Many sellers do not understand the regional band requirements and list boards without specifying frequency
- Products are often labeled simply "LoRa" with no frequency mentioned - defaulting to whatever batch was ordered (often 868 MHz)
- The price difference between 868 and 915 MHz versions is typically zero, so sellers don't bother distinguishing (as of 2026-06-08; pricing varies by vendor and is not guaranteed)

The rule: If the listing does not explicitly say "915MHz" or "915M", assume it is 868 MHz and do not buy it for North American use.

How to Identify Your Hardware's Frequency Band

Before Buying

- Check the product title for "915MHz", "915M", "US915", or "AU915"
- Check the product description for frequency specification
- Look at photos of the PCB - many boards have the frequency printed on the silkscreen near the antenna connector
- Check the seller's other listings - if they sell both 868 and 915 versions, make sure you selected the right one

After Receiving

- **PCB silkscreen:** Look near the SMA/U.FL connector or on the module itself. Common markings: "915", "868", "433", or a product code like "SX1262-915".

- **Module label / SKU:** On RAK WisBlock modules, frequency is set by the region-specific variant ordered (e.g. a US915 SKU), not by a letter suffix. Note that the "-R" suffix (as in RAK4631-R) denotes the RUI3 firmware build - it does **not** indicate a frequency band. Always check the SKU/listing for the band.
- **Firmware frequency:** If the device has already been flashed, connect via serial or BLE and check the configured region. In Meshtastic: Radio Config → LoRa → Region. The configured region should be US (or AU for Australia) for 915 MHz operation.
- **RF spectrum verification (advanced):** Using an RTL-SDR or similar receiver, you can observe the actual transmit frequency when the node sends a packet. This is the definitive test.

The 433 MHz Band

A third band - 433 MHz - is a defined, legitimate region option in several jurisdictions (Meshtastic has EU_433, ANZ_433, UA_433, MY_433, PH_433, and others), where it is a valid if lower-bandwidth mesh band. For North American community mesh networking, 433 MHz is not used. If you accidentally purchase a 433 MHz board for a 915 MHz network, it is completely unusable in that network - not just degraded, but transmitting and receiving on an entirely different part of the spectrum. Additionally, 433 MHz requires a physically larger antenna (a quarter-wave whip is approximately 17 cm at 433 MHz vs about 8 cm at 915 MHz).

Frequency Band Identification Quick Reference

What You See	Interpretation	US/Canada Compatible?
"915MHz", "915M", "US915", "AU915"	Correct band for North America/Australia	Yes
"868MHz", "868M", "EU868"	European 863-870 MHz band - wrong for North America	No
"IN865"	India's 865-867 MHz band - a separate allocation from EU868, also wrong for North America	No
"433MHz", "433M"	433 MHz - a valid band in some regions (EU_433, ANZ_433, etc.) but not used for North American mesh	No
No frequency mentioned	Assume 868 MHz unless confirmed otherwise	Assume No - verify first

What You See	Interpretation	US/Canada Compatible?
RAK4631-R	The "-R" suffix means the RUI3 firmware build, NOT a frequency. Band is set by the region SKU - check the listing	Depends on SKU - verify
RAK4631 (no suffix)	No suffix does not imply a band. The RAK4631 ships in region-specific SKUs (US915, EU868, etc.) - check the listing	Depends on SKU - verify

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