

# 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

Region	Correct Band	Frequency Range	Regulatory Body	Max Power (EIRP)
United States	<b>915 MHz</b>	902 - 928 MHz	FCC (Part 15, Subpart C)	30 dBm (1W)
Canada	<b>915 MHz</b>	902 - 928 MHz	ISED (RSS-210)	30 dBm
Mexico	<b>915 MHz</b>	902 - 928 MHz	IFT	30 dBm
Brazil	<b>915 MHz</b>	902 - 928 MHz	ANATEL	30 dBm
Australia / New Zealand	<b>915 MHz</b>	915 - 928 MHz	ACMA / RSM	30 dBm
European Union	<b>868 MHz</b>	863 - 870 MHz	ETSI (EN 300 220)	27 dBm (500 mW); duty cycle limits apply
United Kingdom	<b>868 MHz</b>	863 - 870 MHz	Ofcom (IR 2030)	27 dBm
India	<b>865 MHz</b>	865 - 867 MHz	DoT / WPC	27 dBm
China (mainland)	<b>470 MHz or 779 MHz</b>	470 - 510 MHz / 779 - 787 MHz	MIIT	50 mW
Japan	<b>920 MHz</b>	920 - 928 MHz	MIC	20 mW

Region	Correct Band	Frequency Range	Regulatory Body	Max Power (EIRP)
Korea	920 MHz	920 - 923 MHz	NIA	10 mW

# 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:
  - Significantly reduced transmit power (energy reflected back into the chip rather than radiated)
  - Significantly reduced receiver sensitivity (the band-pass filter rejects the in-band signal)
  - Possible damage to the PA (power amplifier) from reflected power over time
3. In practice, a 868 MHz board configured for 915 MHz operation will transmit at substantially reduced power and may receive at  $-20$  to  $-30$  dB below specification. It effectively will not communicate reliably with other nodes.

**Additionally:** Transmitting on a frequency outside your regional allocation is a regulatory violation. In the US, operating on 868 MHz with a standard LoRa node is not authorized by the FCC, and operating on 915 MHz with a CE-marked 868 MHz device violates its CE certification.

# Why AliExpress Listings Default to 868 MHz

Most LoRa hardware manufacturers are based in China. Their largest international markets are the EU and UK, where 868 MHz is the standard band. When a generic AliExpress seller lists "LoRa32 development board" without a clear frequency specification, it is almost always 868 MHz because:

- 868 MHz is the more 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

**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" or "RAK4631-R".
- **Module label:** On RAK WisBlock modules, the part number suffix indicates band: "R" suffix = 915 MHz (e.g., RAK4631-R)
- **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 used in some regions (parts of Asia and occasionally Europe for specific applications). For North American community mesh networking, 433 MHz is not used. If you accidentally purchase a 433 MHz board, it is completely unusable in a 915 MHz mesh network - not just degraded, but transmitting and receiving on an entirely different part of the spectrum. Additionally, 433 MHz requires a physically larger antenna (approximately 17 cm for a quarter-wave whip vs 8 cm for 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", "IN865"	European band - wrong for North America	No
"433MHz", "433M", "AS433"	Asian 433 MHz band - wrong everywhere for mesh	No
No frequency mentioned	Assume 868 MHz unless confirmed otherwise	Assume No - verify first
RAK4631-R	RAK notation: "-R" suffix = 915 MHz	Yes
RAK4631 (no suffix)	RAK notation: no suffix = 868 MHz	No

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