

# 4x4 MIMO External Antennas

by WAVEFORM

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## PLEASE READ THIS FIRST:

We know, reading manuals isn't always fun. But we promise it's worth it.

We've helped thousands of customers improve signal to their cellular routers. We've compiled everything we've learned in this manual.

Give it a read before you start: it'll save you time and help you get the best performance out of your MIMO External Antenna.

### About Waveform

Your MIMO External Antenna is designed, sold, and supported by Waveform and our team of Signal Specialists.

We've helped over 20,000 customers improve their signal since our company was founded in 2007. We've installed and configured thousands of devices in buildings across the country, and **we're here to help**. If you have any issues at all, please don't hesitate to reach out.



52 Maxwell,  
Irvine, CA 92618



+1 (800) 761-3041



[www.waveform.com](http://www.waveform.com)  
[help@waveform.com](mailto:help@waveform.com)

# What's in the Box

## Antennas

Depending on what you purchased, your package will contain either a *single 4x4 MIMO Panel Antenna* or *four Log Periodic Antennas*. We recommend using the Log Periodic Antennas if you have line-of-sight to your nearest cell towers. Our 4x4 MIMO Panel Antenna may perform slightly better if you're surrounded by trees, buildings, or hills.



4x Log Periodic Antennas

or



1x 4x4 MIMO Panel Antenna

## Cables and Adapters (optional, only included with complete kit)

If you purchased a complete antenna kit, the parts listed below will also come included.



Optional: 4x Lightning Protector Kits  
Clear bag



J-Mount Bracket and Hardware  
Red bag



J-Mount Antenna Mount



Quad RS240 N-Male to SMA-Male Cables



4x N-Male to SMA-Male Adapters  
Clear bag



Pigtail Adapters (4x U.FL & 2x TS9)

# Install Manuals, Who Needs 'Em?

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**Heads up:** using MIMO antennas to improve your signal can take a bit of patience.

**We'd be surprised if you saw better data rates immediately upon connecting the antennas.**

Be prepared to spend an hour or two to find the right location and direction for your antennas.

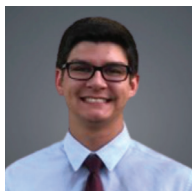
This manual is based on feedback from hundreds of customers like you. We've revised it dozens of times based to make it as helpful as possible and make the process of getting better data rates as easy as we can.

We promise you'll be glad if you read it from start to finish before you get started. It'll help you save time, avoid the most common pitfalls, and ensure your system works as well as possible.

## Who We Are

Hi! We're Waveform. We've been around since 2007, and while we've grown a bunch since then we're still a small team. There's just a handful of us answering texts, and picking up calls.

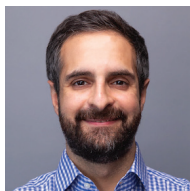
The four of us pictured below lead support and product development. Feel free to reach out to us at any time; our emails are all just our first names @waveform.com



Ian (Support)



Marcus (Product)



Sina (CEO)



Harry (Support)

## Stuck? Have Questions? *Please:* Contact Us!

We're a small team, but we *really* care about helping you get the best results.

If you're having issues, please contact us. Sometimes a small tweak we suggest can make all the difference.

Even if everything goes smoothly, please let us know how your system is performing. We love getting feedback: is there's any way we could make the install process or this manual better?

**Call us at (800) 761-3041 or email [help@waveform.com](mailto:help@waveform.com).** We're available from 9am-5pm PT, Monday to Friday.



# Before You Start

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It's important that there's at least some 4G LTE or 5G signal outside or on the roof of the building where you're installing the MIMO antennas, and ideally it should be "usable." If you don't have usable signal outside, proceed with caution, and consider giving us a call.

## What Do We Mean by "Usable"?

When you take your cellular router or hotspot outdoors, you should have a reliable data connection even without connecting your new external MIMO antennas. When running a speed test, you should have at least 0.1 Mbps download and upload speed.

MIMO antennas will help condition the outdoor signal and get you better data rates. But if the signal outside your building isn't usable to begin with, MIMO antennas might not help.

You can certainly still give the MIMO antenna a shot, but you may still be unable to connect.

## Compatibility

First, a quick reminder: our 4x4 MIMO Panel and Log Periodic Antennas support almost every 3G, 4G LTE, and low/mid-band 5G service in use in the US and across the world. Here are the bands that each antenna covers:

 **AT&T** B2/n2, B4, B5/n5, B12, B17, B29, B30, B46, B66/n66, n77

 **verizon** B2/n2, B4, B5/n5, B13, B46, B48/n48, B66/n66, n77

 **T-Mobile** B2, B4, B5, B12, B25, B26, B41/n41, B46, B66, B71/n71

CBRS, B48/n48

**All supported LTE Bands:** Band 1-10, Band 12-20, Band 23-30, Band 33-41, Band 46-48, Band 65-77, B85

**All supported 5G Bands:** n1, n2, n3, n5, n7, n8, n12, n14, n18, n20, n25, n26, n28, n29, n30, n34, n38, n39, n40, n41, n65, n66, n70, n71, n80, n81, n82, n83, n84, n86, n89, n90, n95

## How Much Improvement Should You Expect?

In short: it's hard to say. Many people see an increase in data rates of between 50% and 200%. But some people only see 10%. Our CEO often says that despite all the science, wireless signals often work in "strange and magical" ways.

One thing is for sure: the more patient you are and the more locations and directions you try, the more likely you are to see a big increase in data rates.

If you've gone through this manual and aimed the antennas as we suggest, but you're still not seeing much improvement, reach out to us for help. We're generally available from 9 am to 5 pm PT, Monday to Friday, and we love helping solve tricky install problems.

# 01 Install Process Overview

This is the process that we suggest using for installing your MIMO External Antenna:

- 1 Read this manual.** Ideally from start to finish so that you understand the whole process before you begin.
- 2 Assemble your antennas to a mount.** Start by assembling your mount and attaching your cross-polarized Log Periodic Antennas.
- 3 Find the best antenna location and direction, using just two of your antennas.** This step is the most time-consuming, but it's worth the effort. Getting it right has a huge impact on your system's performance. Make notes of your readings on the table in section 4.
- 4 Verify performance and hard-wire everything.** Without making any holes in your roof or walls, temporarily run the cable indoors to your hotspot or router and run speed tests. If everything looks good, it's time to finalize cable runs and hard-wire everything.
- 5 Tell us how your system is doing.** We really love hearing how our customers' systems are performing. Send an email or give us a call and let us know how things look.

# 02 Assembling the Antennas

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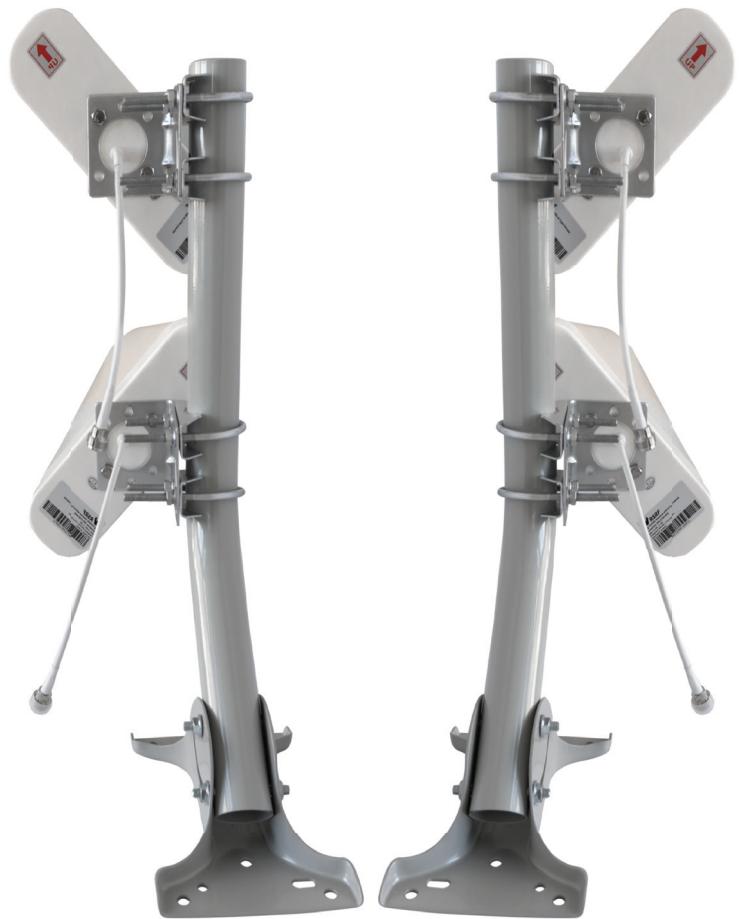
The pictures below show how your antennas should be secured to your mount.

**If you have the kit with four Log Periodic Antennas:** Note how the two Log Periodic Antennas on each mount are angled at 45 degrees in opposite directions. This is called “cross-polarization” and is crucial to MIMO.

To achieve 4x4 MIMO, mount the two pairs of cross-polarized antennas as shown below. Keep the antennas as far apart as your cables allow, and treat all four as a single antenna: always keep them aimed in the same direction.

For the next step in section 3 it'll be helpful to have your antennas attached to your mount, so take some time to get these set up before moving on.

If you'd like more detailed instructions on how to assemble our J-Mount and mount the L-bracket(s), you can find that online at [waveform.com/polemount-instructions](http://waveform.com/polemount-instructions)



# 03 Positioning and Aiming the Antennas

Finding the right antenna position for your MIMO antennas is critical. We'll explain the best and simplest method for positioning and aiming. Section 7 covers some more advanced tips.

## The Goal

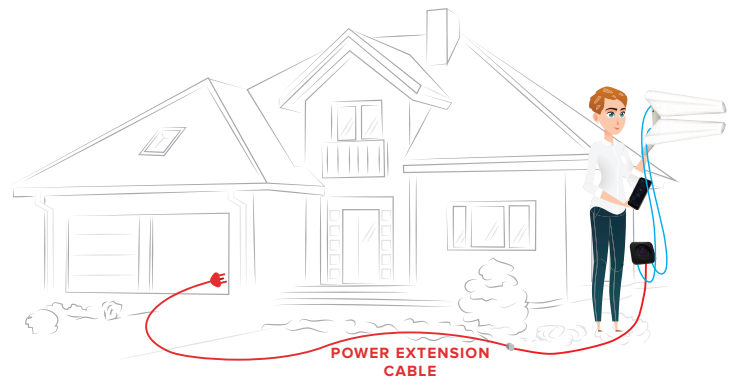
Your aim is to find the best location and direction for the antennas. The location should **maximize data rates** to your LTE/5G router or hotspot. It can take a little patience, but spending some time here can have a huge impact - it's worth a bit of extra effort.

## Set up Your MIMO Antenna in "Test Mode"

Is your hotspot or router battery-powered?  
Or do you have a power extension cord?

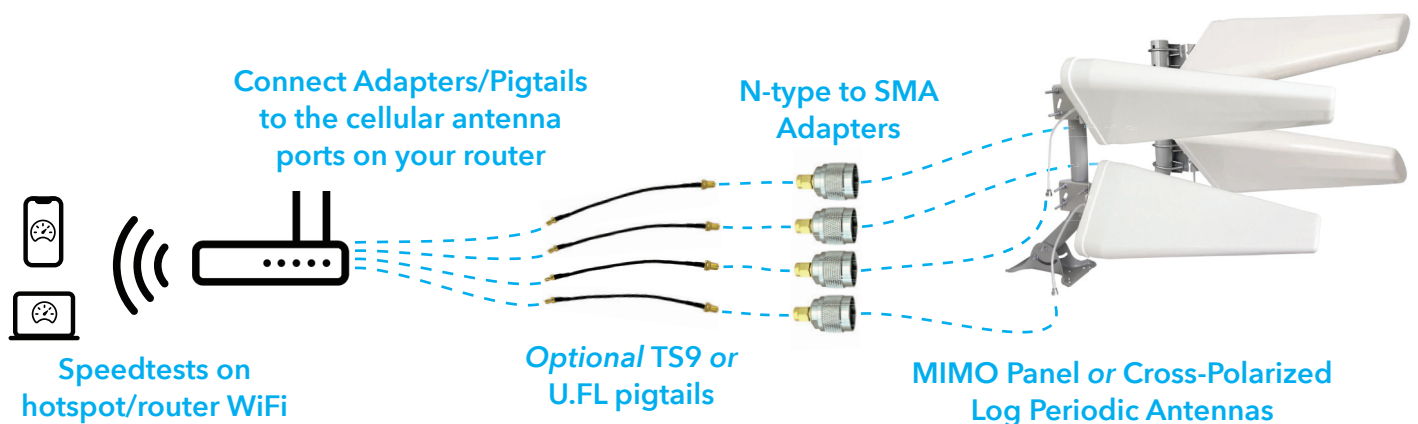
If so, set up your MIMO antennas in "test mode" by **connecting them** directly to your router.

Now, take your hotspot and antenna outside with you, and you'll have everything you need to start testing different locations and directions.



Moving and aiming all four antennas at the same time is a bit awkward. If you know which antenna port is the primary port on your router, you can use just one antenna for this step. If you don't, use all four antennas and have a second person help you.

Here's how to set up your hotspot and two of your antennas in test mode if you're using all four antennas:



**Don't have a way of taking your router outdoors with you?** No problem. Just keep your router or hotspot indoors near a power socket, and use a longer coax cable in place of the barrel adapters so you can take just the antennas outside.

If you aren't able to bring your router or hotspot outside with you, then your connection speed may be limited by the router's WiFi range rather than its cellular connection. We recommend asking a second person to stay near the hotspot or router with a phone: ask them to run speed tests as you try different positions with the antennas.

## Running Speed Tests

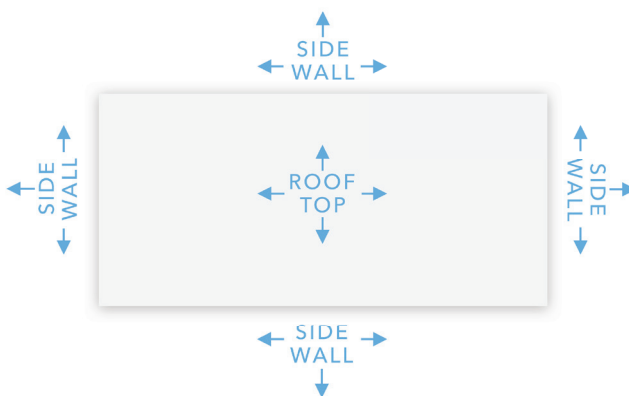
Since the goal is improved data rates, it makes sense to **use a speed test app to measure your data rates** through your cellular router or hotspot's WiFi.

If you're testing with your phone, download "Speedtest by Ookla" by visiting this URL: [waveform.com/speedtest](http://waveform.com/speedtest). If you're using a laptop, visit [speedtest.net](http://speedtest.net) in a browser. Go ahead and run a few speed tests indoors from a device connected to your router or hotspot's WiFi.

**Now go outside. With each location and direction you try, run 1-2 speed tests, and make a note of the results in the table on the opposite page.**

## How to Position & Aim

Finding the right antenna location and direction takes some patience, but it's absolutely worth it. Spending time to get it right will have a big impact on your system's performance. Here are all the locations and directions where we recommend testing your MIMO antennas:



Don't just go to the highest point of the roof! While signal is generally stronger the higher you go, there's also often more interference. We've found it's often better to mount the antennas on the side of the building where the structure can shield the antennas from interference.

**Once you've found the best antenna location and direction, move on to section 5 below to get ready for your final installation.**





# 05 Assembling Your System

Once you've identified the best location for your antennas, it's time to set up a provisional install. Keep your antennas outside in the location you've selected, but run the cables and test your router/hotspot indoors.

**Don't drill any holes in your walls yet!** Start with a temporary install to make sure everything is working well, as described in the next section of the manual.

## Getting the Complete Kit Set Up

Refer to the diagram to the right as needed, for assembling the complete kit.

- 1** Secure your MIMO Panel Antenna or Log Periodic Antennas to your mount if you haven't already. If your kit includes four Log Periodic Antennas, be sure to cross-polarize them. See section 2 above for more information.
- 2** Mount the antenna(s) outdoors in the location and direction where you found the fastest data rates using the method described in section 3.
- 3** Connect your Quad RS240 coax cables to the MIMO Panel/Log Periodic Antennas. Or, if you purchased lightning surge protectors, connect the MIMO Antenna(s) to the included 5' jumper cables, Lightning Surge Protectors, and Quad RS240 coax cable. Instructions on grounding are in the next section of the manual.
- 4** Connect the SMA ends of the Quad RS240 cable to the antenna ports on your router and hand-tighten them. If your device uses TS9 or U.FL connectors, then use the included pigtail adapters to connect to the coax cables.

**Install tip:** Some devices have both WiFi and cellular 4G/5G external antenna ports. Make sure you connect the MIMO antenna to your device's cellular antenna ports and not the WiFi port. Your device's user manual or our device-specific guides may help here.

## 4x4 MIMO Panel Antenna or cross-polarized Log Periodic Antennas

Depending on which kit you purchased. Shown with the included J-Mount(s).



### 4x Optional Lightning Surge Protector Kits

Included with some kit configurations only. Includes 5 ft jumper cable and 5 ft red grounding cable.

Should ideally be installed outdoors, just before cable enters the building.

Connect Lightning Surge Protectors to the building's ground with 10 AWG or higher grounding cable.

### Quad RS240 N-Male to SMA-Male Cable

Included with the optional kit only.

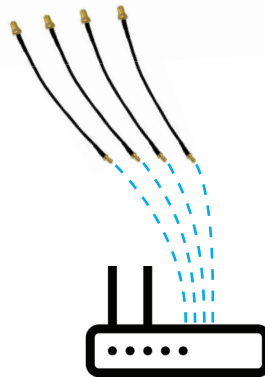


### Optional TS9 or U.FI Pigtail Adapter x4

Included with the optional kit only.

If your router uses SMA connectors for the cellular antenna ports, you can skip these and connect the Quad Cable directly to the router.

If your router uses TS9 or U.FL connectors, you'll install the relevant adapter here.



### Your LTE/5G router

Connect the cables or pigtails to the cellular antenna ports.

Check your manual or search online if you're not sure which are the cellular ports.











# WAVEFORM

## Need help? We're ready and waiting.

MIMO Antennas aren't always easy to install. In fact, getting everything up and running can sometimes be a pain. But the end result is worth it.

One of the benefits of buying from Waveform is our **lifetime technical support** on every system we sell. We've installed hundreds of these devices ourselves, and can walk you through troubleshooting and fine-tuning your installation for best results.

**Simply give us a call at (800) 761-3041, or pop us an email at [help@waveform.com](mailto:help@waveform.com). We're generally available from 9 am to 5 pm PT, Monday to Friday.**

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52 Maxwell,  
Irvine, CA 92618



+1 (800) 761-3041



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[help@waveform.com](mailto:help@waveform.com)