

# MIMO External Antenna Kit

from 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 hundreds of customers improve signal to their LTE 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 Antenna Kit

### About Waveform

Your MIMO Antenna Kit is sold and supported by Waveform and our team of Signal Specialists.

We've helped over 20,000 customers boost 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.



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

# What's in the Box

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## Antennas

Depending on which kit you purchased, you'll either have a single MIMO Panel Antenna or two Log Periodic Antennas.

We typically recommend using the MIMO Log Periodic Antennas if you have line-of-sight to your nearest cell towers. If you're surrounded by trees, buildings, or hills, the MIMO Panel Antenna will likely perform slightly better.



1x MIMO Panel Antenna **or** 2x Log Periodic Antennas

## Cables and Adapters

Depending on which adapter you selected, you'll have either 2x TS9-Male or 2x SMA-Male Pigtail Adapters.

Most consumer hotspots use TS9 connectors, while most LTE Routers SMA connectors. TS9 is a friction connector, while SMA is a threaded connector.



2x 30 ft  
RS400 Cables



2x N-Male to N-Male  
Barrel Adapters



2x TS9 or SMA to N-Type  
Pigtail Adapters



J-Mount Antenna  
Mount



Optional: 2x Lighting  
Protector Kits

# Install Manuals, Who Needs 'Em?

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Improving your signal can be a finicky affair. Fortunately, setting up the MIMO Antenna Kit is relatively simple and shouldn't take you more than a few hours.

Once you get it set up and running properly, you should see a significant improvement in signal and performance on your LTE router, right away.

We've written this guide based on our own experiences and those of dozens of customers who we've helped. 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.

## Stuck? Have Questions? Contact Us!

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

We're happy to discuss any issues you're having or walk you through any of the steps in this manual. Helping people improve their signal is what gets us out of bed in the mornings.

Even if everything goes smoothly, reach out and let us know how your system is performing. We particularly appreciate feedback: let us know if there's any way we could have made the install process or this manual better.

**Call us at (800) 761 3041, We're generally available from 9am-5pm PT, Monday to Friday. Alternatively, visit [waveform.com/help](http://waveform.com/help)**

# 00 Before You Start

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

## What Do We Mean by "Usable"?

When you take your LTE router or hotspot outdoors, you should have a reliable data connection even without connecting your new external MIMO antenna(s). 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, the MIMO Antenna Kit likely won't help.


You can certainly still give the MIMO Antenna Kit a shot, but you may not see a huge improvement.

## Compatibility

First, a quick reminder. Our 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.

Supports all 4G LTE bands between 600 and 2700 MHz, including:

 **AT&T** B2, B4, B5, B12, B17, B29, B30, B66

 **verizon** B2, B4, B5, B13, B66

 **T-Mobile** B2, B4, B5, B12, B25 B26, B41, B66, B71

Supports all 5G bands between 600 and 2700 MHz, including:

 **AT&T** n5

 **T-Mobile** n41, n71

## 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 don't see any improvement at all. Our CEO often says that despite all the science, wireless signals often work in "strange and magical" ways. That makes it hard for us to make guarantees. But one of the best ways to find out is to try it!

If you've gone through this manual and aimed the antenna(s), but you're still not seeing as much improvement as you'd expect, reach out to us for some help optimizing your system. 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 Antenna Kit:

- 1 Read this manual.** Ideally from start to finish so that you understand the whole process before you begin.
- 2 Assemble your antenna(s) to your mount.** Start by assembling your J-Mount and attaching your MIMO Panel Antenna or cross-polarized Log Periodic Antennas.
- 3 Find the best antenna location and direction.** 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 LTE router and run speed tests - if everything's looking good, it's time to finalize your 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 Antenna(s)

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The pictures below show how your antenna(s) should be secured to your J-Mount.

Note how the two Log Periodic Antennas on the right are angled at 45 degrees in opposite directions. This is called “cross-polarization” and is crucial to MIMO. Mount these exactly as in the image and then treat them as a single antenna.

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

If you’d like more detailed instructions on how to assemble the 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 Antenna(s)

Finding the right antenna position for your MIMO Antenna Kit is the most important part of the install. In this section, we explain the best and simplest method for positioning and aiming. Section 7 covers some more advanced tweaks that we don't recommend for most users.

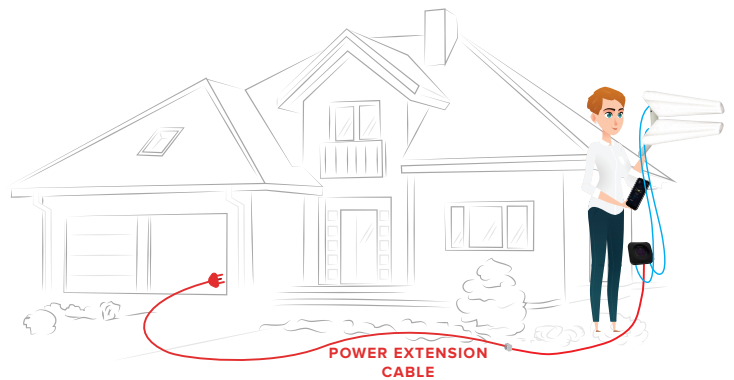
## The Goal

Your aim is to find the best location and direction for the antenna(s). The location should maximize data rates to your LTE 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 Kit in "Test Mode"

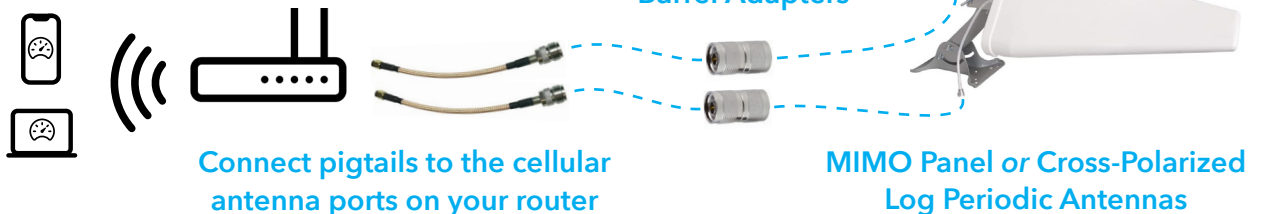
Is your hotspot or router battery-powered?  
Or do you have a power extension cord?

If so, set up your MIMO Antenna Kit in "test mode" as shown below, using the included J-Mount or an alternative mount. Take your hotspot and antennas outside with you, and you'll have everything you need to start testing different locations and directions.



Here's how to set up your hotspot and antennas in test mode:

### Speedtests on hotspot/router WiFi



**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 the 30 ft coax cables included in the kit to take the antenna(s) outside. Everything will be the same as the diagram above, except you'll use the 30 ft coax cables instead of the barrel adapters.

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. So 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 antenna(s).

## 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 LTE router or hotspot's WiFi.

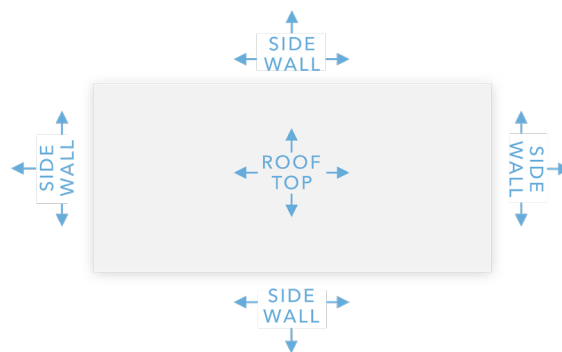
If you're testing with your phone, download our favorite speed test app ("Speedtest by Ookla") by visiting this URL: [waveform.com/speedtest](http://waveform.com/speedtest). If you're using a laptop, visit [speedtest.net](http://speedtest.net) in a browser. Go ahead and run a couple of speed tests indoors from a device connected to your router or hotspot's WiFi. You'll notice that your results will fluctuate a little between tests - that's normal.

**Now go outside, with each location and direction you try, run 1-2 speed tests, phone, and 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 Antenna:



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 antenna(s) 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 Kit

Once you've identified the best location for your antenna(s), it's time to set up a provisional install. Keep your antenna(s) 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 Parts Set Up

Refer to the diagram to the right as needed.

- 1** Secure your MIMO Panel Antenna or Log Periodic Antennas to the J-Mount if you haven't already. If your kit includes the 2x Log Periodic Antennas, be sure to cross-polarize them at  $\pm 45^\circ$  from vertical ( $90^\circ$  to each other). 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** Read the notes in section 6 on grounding and lightning surge protection if you haven't already. If your kit included the optional lightning surge protectors, connect the antenna(s) to the 5 ft RS200 Jumpers, lightning surge protectors, and RS400 cables. If you don't have the lightning surge protectors, simply connect the antennas directly to the RS400 cables.
- 4** Connect the two RS400 cables to the two SMA or TS9 Pigtail Adapters and hand-tighten them.
- 5** Connect the two Pigtail Adapters to your LTE router or hotspot.

## MIMO Panel Antenna or cross polarized Log Periodic Antennas

Type depends on the kit you purchased. Shown with the J-Mount.



**5 ft RS200 Jumper x2 (optional)**

Provided with the optional Lighting Surge Protectors.

**Lightning Surge Protectors x2 (optional)**

Includes 5 ft grounding cable. See next page for installation details.



**30 ft RS400 Cable x2**

**SMA or TS9 to N-Female Pigtail Adapter x2**

Type depends on the kit you purchased



**Your LTE Router or Hotspot**

Connect the pigtails to the LTE antenna ports, not the WiFi antenna ports.



# 07 **Advanced Optimization**

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By this point, you should have a really solid understanding of how to aim your MIMO antenna(s) and get great performance. In fact, **we're convinced that for 95% of people the instructions provided in this manual so far are more than enough.**

If, however, you'd like to go a little deeper and get technical to optimize your system even further, here are some general guidelines.

- 1** Look up your nearby towers on CellMapper.net. If you can, find the eNodeBIDs that your LTE router or hotspot is actually connecting to using the device's admin interface.
- 2** Aim your antenna(s) at each nearby tower and band lock your hotspot or router to every band that the tower transmits. Run speed tests on each band to find the fastest bands.
- 3** Try enabling multiple bands and using carrier aggregation to find the fastest band combination. Carrier aggregation allows your devices to connect to two or more bands simultaneously but doesn't always result in an improvement, so stick to a single band if that gets you the best results.

**Unfortunately, every LTE router and hotspot is so different that we just can't provide detailed instructions on how to perform these steps on different devices.**

Many devices don't offer band locking or eNodeBIDs or any kind of cell tower identifiers, making these steps impossible. We suggest referring to your user manual or searching Google to see if anyone has documented the specific instructions for your device.

## **We're Here to Help!**

We know, there's a lot of information out there and this can get very technical. Don't be afraid!

**If you're having difficulty, aren't happy with the performance of your system, or you'd just like a hand, we'd love to help!** Call us at (800) 761-3041 or email [help@waveform.com](mailto:help@waveform.com). We're generally available from 9am-5pm PT, Monday to Friday.







# 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.**

We love helping solve tricky install problems.



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