This application note discusses what is needed to extend the length of the RF cable for the Twin Link, as well as how to add an external, waterproof antenna.

Considerations

The Twin Link comes with a 3dBi indoor antenna. If the device is installed in an outdoor-rated plastic enclosure, there is usually no need to use an outdoor antenna, as the standard antenna is protected from the elements by the enclosure.

However, if the device is housed in a metal enclosure, the metal will attenuate the RF signal, reducing transmit distance. This loss may be negligible, depending on your application. For example, if the distance between the Twin Link's input and output is only 100ft, the loss of transmit distance caused by the metal cabinets will probably be insignificant.

The caveat here, is that the loss of transmit distance will be affected by the **thickness** of the metal enclosure and **type of metal**, and the **earthing** of the cabinets.

If you need to need to mount your antenna on top of the metal cabinet, you can use a Wi-Fi antenna extension cable.

Indoor Applications

The Define Wi-Fi Antenna Extension cable provides a 12" bulkhead extension for the standard antenna, and is suitable for **indoor applications.**

catalog.defineinstruments.com/aec-wifi

To install, simply drill a hole in the metal enclosure, and screw in the bulkhead end. The other end screws into the device itself. Then, you can screw the standard antenna directly into the bulkhead.

Note that this setup is intended for indoor use only.

Fig 1

Fig 2

Outdoor Applications

If the Metal Enclosure is exposed to the weather, you'll need to provide an outdoor rated antenna.

Most outdoor antennas use an N-type connector, while the device has an RP-SMA connector. We recommend buying an adaptor cable, like the one shown in Fig 3.

This cable provides an **N-Type** to **RP-SMA** adapter that screws onto the Twin Link. For a waterproof setup, you'll need a **bulkhead N-Type female 2.4 GHz antenna**.

The antenna shown in Fig 4 is suitable for the job, and has a gain of 3dB, which is similar to the antenna supplied.

Simply drill a hole into the top of the enclosure, and screw in the antenna, using the provided seal to ensure it is waterproof. The N-Type adaptor above screws into the corresponding antenna connector.

Fig 3

Fig 4

Distance Applications

The next consideration, is when the antenna needs to be mounted at a distance from the Twin Link. For example, the input Twin Link might be in a basement, while the output is across a field, or vice versa.

This can provide some challenges, due to the extension RF cable attenuating the signal. The best way to tackle this issue is to use a N-Type cable to extend the distance.

This time it would be better to use an adapter like the one shown in Fig 5, which provides an **N-Type bulkhead female** at one end, and a **RP-SMA connector** which can screw straight into the Twin Link.

This enables you to use an **N-Type male** extension cable, such as the one shown in Fig 6, to connect the bulkhead of the enclosure to the antenna shown in Fig 4.

However, this is where a bit of math comes into play, because N-Type extender cables are not all equal. They are available in varying thicknesses, and the thicker the cable, the lower the attenuation of the RF signal.

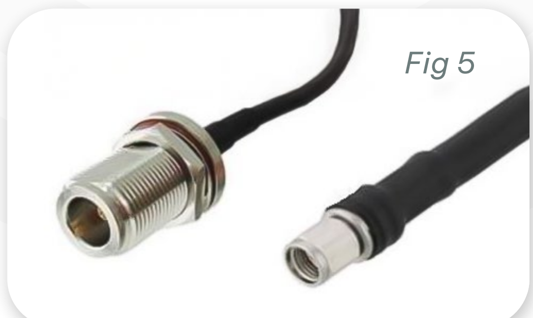

Fig 5

Fig 6

Some common cables that can connect to N-Type connectors include:

Cable Type	Loss/100ft
RG58 attenuation at 2.4 Ghz	32.2dB per 100ft
RG142 attenuation at 2.4 Ghz	21dB per 100ft
LMR240 attenuation at 2.4 Ghz	12.9dB per 100ft
LMR400 attenuation at 2.4 Ghz	6.8dB per 100ft

For example, if we wanted to extend the antenna by 15ft (5m) you can calculate how much attenuation you will get from different cables. The math is **0.15 x loss per 100ft**.

Cable Type	Loss/100ft	Loss/15ft (x0.15)
RG58	32.2dB	4.83dB
RG142	21dB	3.15dB
LMR240	12.9dB	1.935dB
LMR400	6.8dB	0.96dB

Every 6dB of loss halves your transmission distance. So, a 12dB loss would reduce your original transmission distance to a quarter. Based on your application's transmission distance, you can select the appropriate cable thickness.

One option to mitigate cable loss is to use a higher-gain antenna. While antenna theory is beyond the scope of this paper, it's important to note that antenna gain can be considered the opposite of cable loss.

For example, the antenna shown in Fig 7 is an omnidirectional antenna with 8dB of gain. We can subtract the cable loss to determine the overall gain or loss of the antenna and cable combination.

Continuing using our example distance of 15ft, if you used this antenna with an RG 58 cable, your system would have 8 - 4.83 = 3.17 dB positive gain. However you would also need to subtract 3dB, which is the antenna gain that the range tests were performed with. This leaves a positive gain of 0.17dB, which means effectively you have not lost any transmission distance at all.

Fig 7

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