ClearOne®

Application Guide

WS800 Wireless Microphone System

Antenna Application Guide

ClearOne Extension Antennas Application Guide

ClearOne's digital technology supports much larger microphone systems than is possible with analog technology. It should be noted that marginal antenna designs may work well with smaller systems, but they can cause hits and dropout as the channel counts go up. On the other hand, a well designed antenna system delivers excellent performance with both big and small systems.

ClearOne engineers rely on following these design criteria:

Design Goal: Keep the power level of all the microphones between -40 and -60 dBm all of the time to prevent hits and dropouts.

Design Rules:

+ **Rule 1: Intermodulation Distortion**[1] The distance to the most distant transmitter should not be more than double the distance to the closest transmitter.

+ **Rule 2: Diversity**[2] The antennas should be separated so that the ends of the transmitter antenna (the null) cannot be aimed at both antennas at the same time.

+ **Rule 3: Line of Sight** All transmitters should remain in the line of sight of both antennas. Line of sight means all transmitters are not blocked by metal, concrete, and similar radio opaque objects, and there is minimal signal absorption through people's bodies.

+ **Rule 4: Cable Loss** The total antenna cable loss should be less than 15 dB.

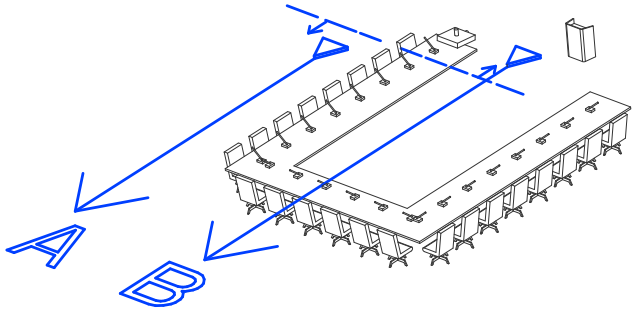
+ **Rule 5: Range Loss** Doubling the distance between a transmitter and an antenna cuts the signal strength by a factor of 4 (inverse square law). Keep the antennas as close to the performance space as practical without violating Rule 1.

+ **Rule 6: Transmitter Power**[5] Adjust the transmitter power to meet the -40 to -60 dBm rating.

The following case studies show how these rules may be applied in several common configurations:

Case I:
Flexible Configurations Conference Room

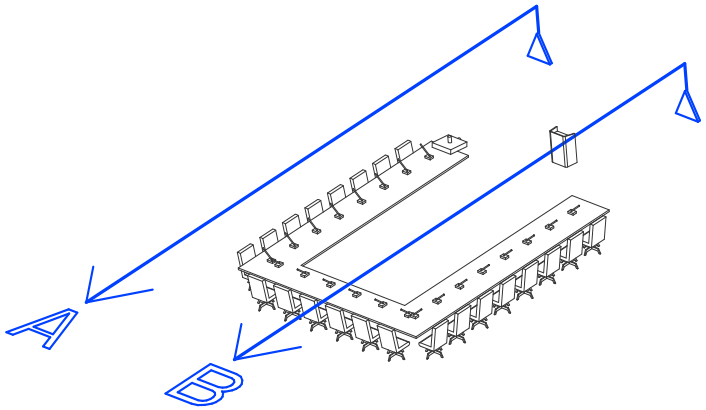
A.



1st Choice

Factor	Antennas In Drop Ceiling
IMD	All of the transmitters are about the same distance to the closest antenna. The IMD product is small compared to the transmitter signal. It meets the design rule.
Diversity	The antennas are separated so at least one antenna is always out of the null. This meets the design rule.
Line of Sight	All transmitters are in the line of sight of both antennas. This meets the design rule.
Cable Loss	This configuration requires a shorter antenna run to the rack. It meets the design rule.
Range Loss	All transmitters are close to at least one antenna and have about the same gain. It meets the design rule.
Transmitter Power	The setup is ideal, so set the power to 1mW for extended battery life and minimal interference with systems in near-by rooms.
Rating	Expect excellent performance in all room configurations.

B.

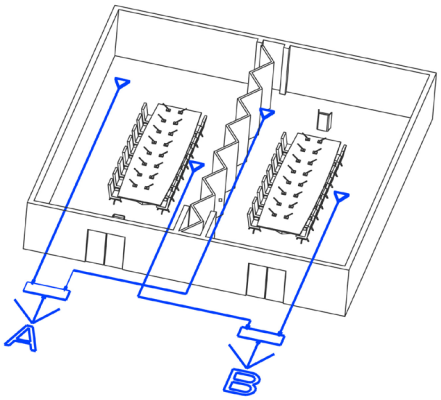


Not Recommended

Factor	Antennas On Back (or Front) Wall
IMD	The IMD from the transmitters close to the antennas can interfere with transmitters away from the antennas. Expect drop-out and hits with large numbers of transmitters.
Diversity	The antennas are separated so at least one antenna is always out of the null. This meets the design rule.
Line of Sight	All transmitters are in the line of sight of both antennas, provided the antennas are high on the wall and not blocked by bodies. This meets the design rule.
Cable Loss	Long cable runs require expensive RG8 low-loss cable but it will meet the design rule.
Range Loss	Transmitters away from the antennas have approximate 3 dB less gain than the close transmitters, but it meets the design rule.
Transmitter Power	Use 10 mW output power to assure pick-up of the far transmitters.
Rating	This design is prone to dropouts and hits with large numbers or transmitters.

Case II:
Split Flexible Configurations Conference Room

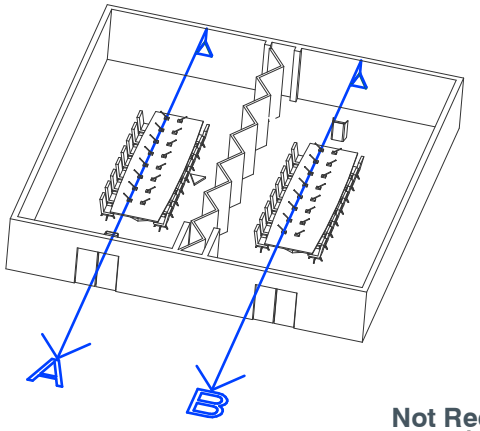
A.



1st Choice

Factor	4 Antennas In Drop Ceiling
IMD	All of the transmitters are about the same distance to the closest antenna. The IMD product is small compared to the transmitter signal. It meets the design rule.
Diversity	The antennas are separated so at least one antenna is always out of the null. This meets the design rule.
Line of Sight	All transmitters are in the line of sight of both antennas. It meets the design rule.
Cable Loss	Antenna combiners add 3 dB loss. Make sure the total loss in each run is less than 15 dB to meet the design rule.
Range Loss	All transmitters are close to at least one antenna and have about the same gain. This meets the design rule.
Transmitter Power	The setup is ideal, so set the power to 1mW for extended battery life and minimal interference with systems in near-by rooms.
Rating	Expect excellent performance open or closed.

B.

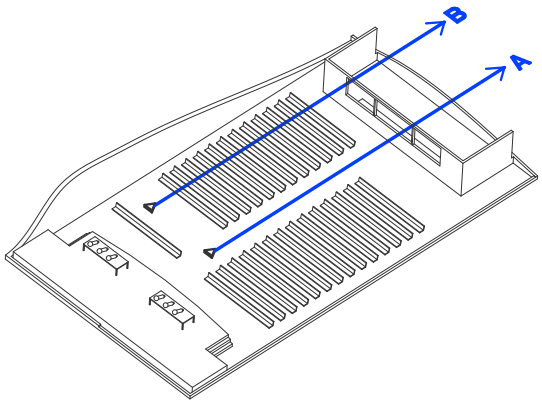


Not Recommended

Factor	2 Antennas On Back (or Front) Wall
IMD	The IMD from the transmitters close to the antennas can interfere with transmitters away from the antennas. Expect dropout and hits.
Diversity	Dividers often have metal cores which are radio opaque. Diversity is defeated when there is only one antenna in a room. Expect dropout and hits when the room is divided.
Line of Sight	No transmitter is in the line of sight of both antennas when the room is divided. It does not meet the design criterion.
Cable Loss	Long cable runs require expensive RG8 low-loss cable. Make sure the loss on each side is less than 15 dB.
Range Loss	Use low-loss cable for long runs. Make sure the loss on each side is less than 15 dB.
Transmitter Power	Use 10 mW output power to assure pick-up of the far transmitters.
Rating	This system is prone to dropouts and hits open or closed.

Case III:
Small Auditorium or Church

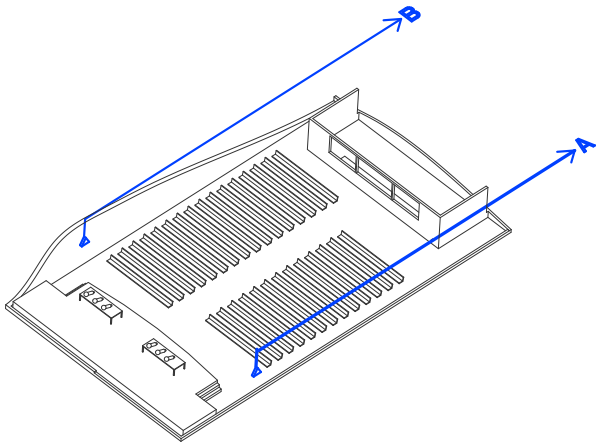
A.



1st Choice

Factor	2 Antennas In Drop Ceiling
IMD	All of the transmitters are about the same distance to the closest antenna. The IMD product is small compared to the transmitter signal. This meets the design rule.
Diversity	The antennas are separated so at least one antenna is always out of the null. This meets the design rule.
Line of Sight	All transmitters are in the line of sight of both antennas. This meets the design rule.
Cable Loss	Use low loss cable to assure total loss in each run is less than 15 dB to meet the design rule.
Range Loss	All transmitters are close to at least one antenna and have about the same gain to meet the design rule.
Transmitter Power	The setup is ideal, so set the power to 1mW for extended battery life and minimal interference with systems in near-by rooms.
Rating	Expect excellent performance with small and large channel counts.

B.

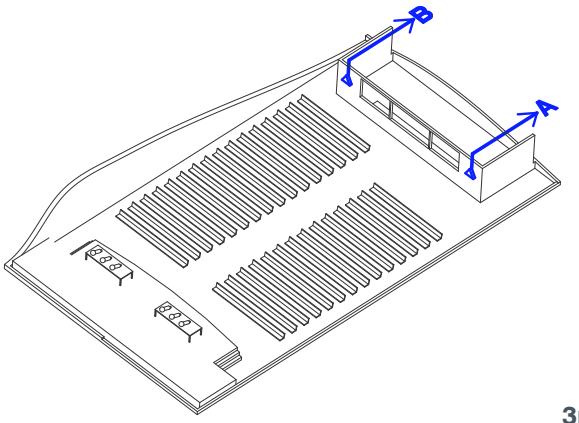


2nd Choice

Factor	2 Antennas On Opposing Wall
IMD	All of the transmitters are about the same distance to the closest antenna. The IMD product is small compared to the transmitter signal. Meets the design rule.
Diversity	The antennas are separated so at least one antenna is always out of the null, provided the antennas are mounted in front of the performance space. This meets the design rule.
Line of Sight	All transmitters are in the line of sight of both antennas, provided the antennas are high on the wall and not blocked by bodies.
Cable Loss	Use low-loss cable to assure total loss in each run is less than 15 dB.
Range Loss	All transmitters are close to the antennas. It meets the design rule.
Transmitter Power	Use 10 mW (or 25 mW) output power to assure pick-up through Presenter's bodies and stage obstacles.
Rating	Expect excellent performance with small and large channel counts.

Case III: (continued)
Small Auditorium or Church

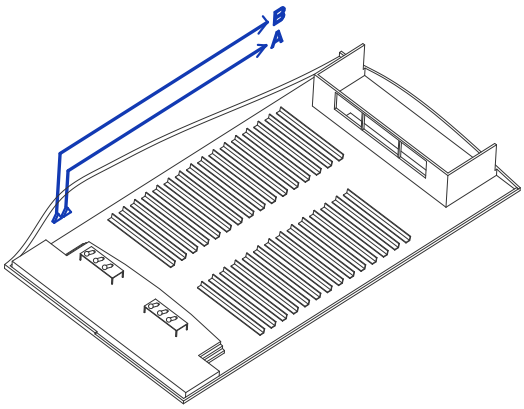
C.



3rd Choice

Factor	2 Antennas On Back Wall
IMD	All of the transmitters are about the same distance to the closest antenna. The IMD product is small compared to the transmitter signal. This meets the design rule.
Diversity	The antennas are separated so at least one antenna is always out of the null. This meets the design rule.
Line of Sight	Place the antennas over the audience to keep the line of sight for both antennas. This meets the design rule.
Cable Loss	Short antenna lengths reduce loss and cost. Use low loss cable to assure total loss in each run is less than 15 dB.
Range Loss	All transmitters are far from the antennas, but within range. It meets the design rule.
Transmitter Power	Use 25 mW to overcome range loss.
Rating	Expect excellent performance with small and large channel counts.

D.



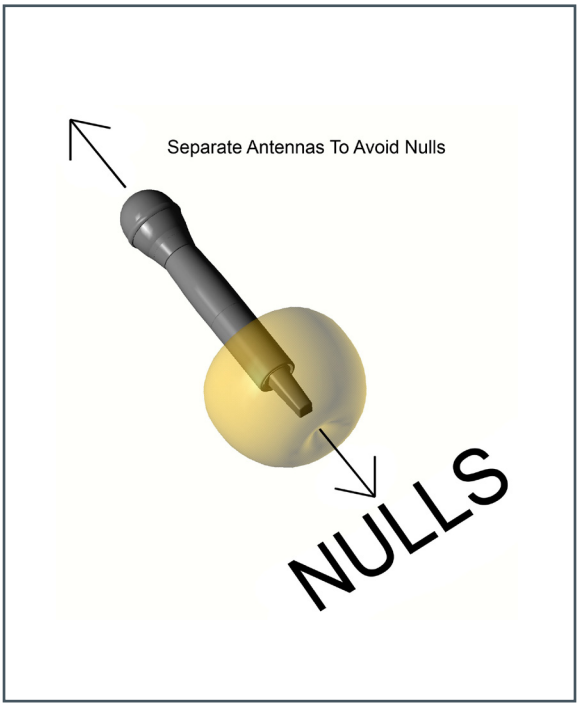
Not Recommended

Factor	2 Antennas On Side Wall (or Rack Mounted w/ Dipoles)
IMD	The IMD from the transmitters close to the antennas can interfere with transmitters away from the antennas. Expect dropout and hits.
Diversity	Diversity is defeated when the antennas are too close together. Expect dropouts when the transmitter antenna null points at the antennas.
Line of Sight	All transmitters are in the line of sight of both antennas but blocked by bodies.
Cable Loss	Use low-loss cable to assure total loss in each run is less than 15 dB.
Range Loss	The far transmitters have less gain than close transmitters.
Transmitter Power	Use 10 - 25 mW output power to assure pick-up of the far transmitters.
Rating	This system is prone to dropouts and hits with large numbers of transmitters.

Appendix

(1) Intermodulation Distortion Interference (IMD)
Two or more transmitters operating in close proximity produce low-level, side-band frequencies called IMD. These sideband frequencies can interfere with other microphones that normally operate on the same side-band frequencies, but only when the IMD signal strength is comparable to the transmitter's signal strength. This can happen when the interfering transmitters are in close proximity to the antennas while the interfered transmitter is far away.

Case III - D above is a typical example. Microphones four feet away from the antennas on stage left will have a signal (and corresponding IMD) that is 64 times greater than the signal from a transmitter that is 32 feet away on stage right by the inverse-square law. In this case, the IMD signal will cause dropouts and hits.



The science of IMD control is to arrange the antennas so that all of the transmitters are about the same distance away from an extension antenna. A good rule of thumb is to divide the distance between the transmitters located closest to an antenna and farthest from an antenna. The result should be a number between 1 and 2. It may seem counter-intuitive to move the antennas away from the performance area to reduce dropouts, but Case III C will have less IMD interference than Case III D.

In addition, ClearOne's digital wireless transmission method uses numerical techniques that make them far less prone to IMD interference than is possible with analog systems. That is one reason ClearOne's arrays can be much larger than is possible with analog systems.

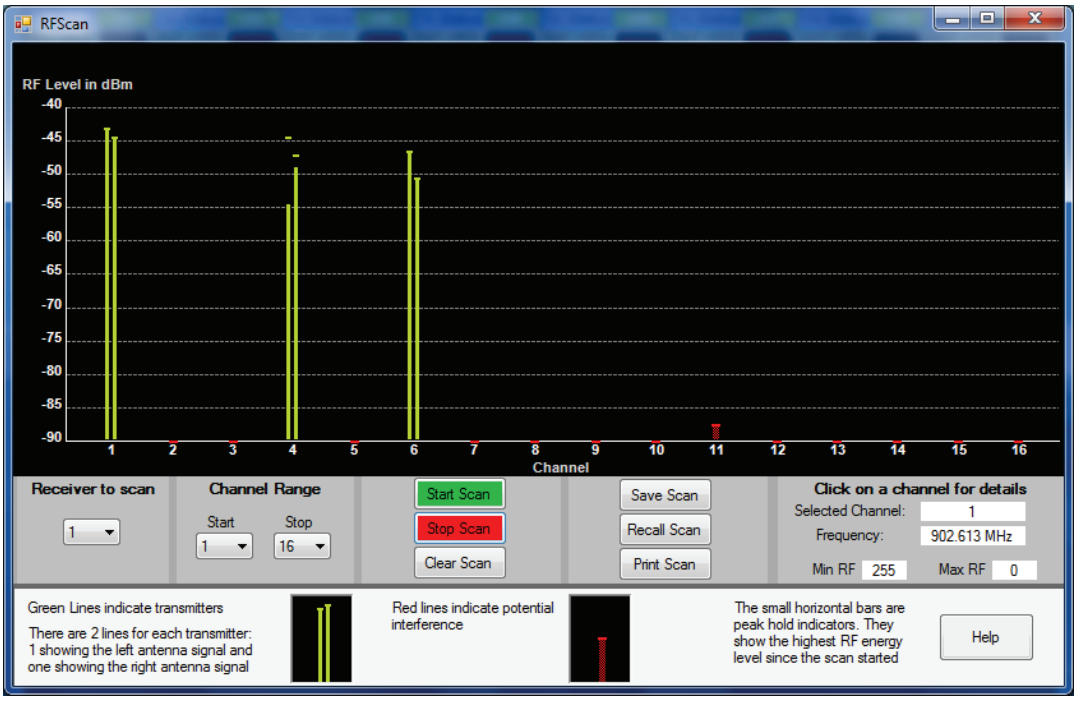
(2) Diversity
Transmitter antennas radiate power in a toroid-shaped (donut) pattern. Very little energy radiates out the ends of the transmitters. Separate the antennas sufficiently so at least one receives a strong signal.

(3) Dipole Antennas:
ClearOne systems are shipped with dipole (rabbit ear) antennas, but they are only recommended with small systems and only when they are in the line of sight. They provide only a minimal diversity.
ClearOne recommends extension antennas whenever possible.

(4) Free Antenna Design:
ClearOne offers complete antenna hardware kits custom made for your project. The kits include extension antennas, tested antenna cables with proper terminations, and antenna combiners if required. The goal of extension antenna kits is to take all of the guesswork out of one of the most challenging and critical aspects of a wireless microphone installation so your job is completed on time and within budget.

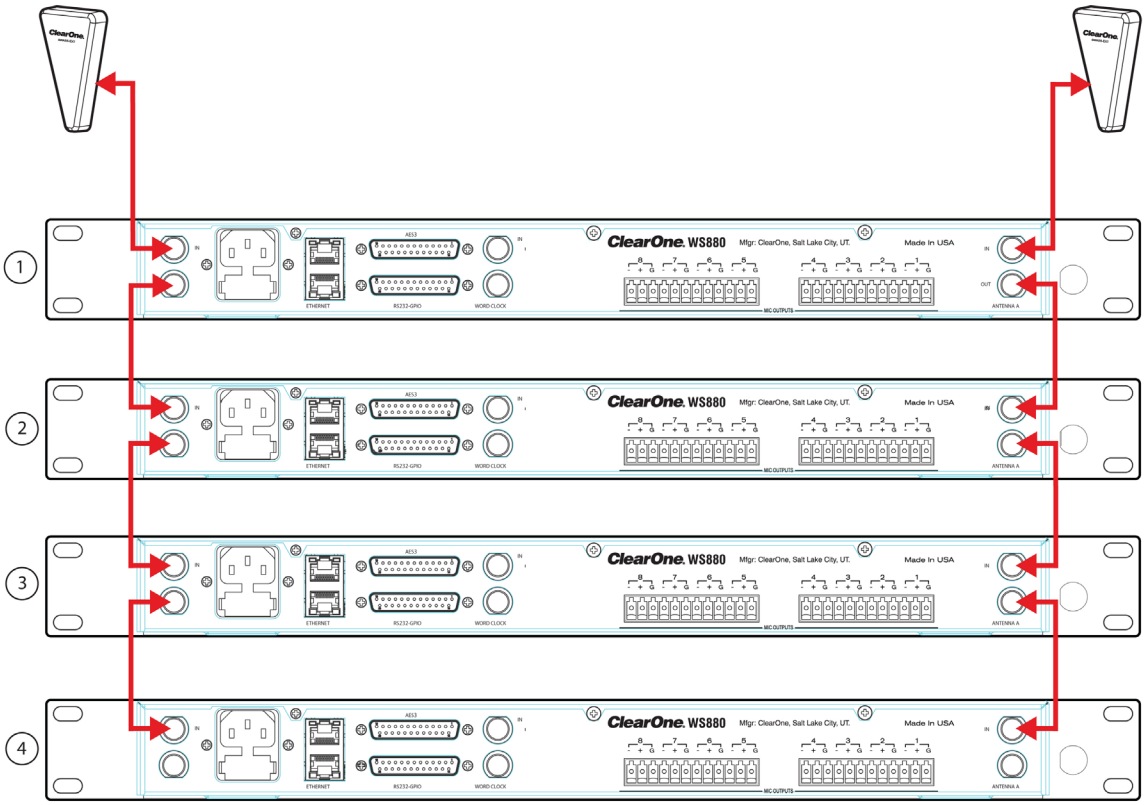
(5) RF Scan: Antenna Power Measument

Run the ClearOne Remote software RF Scanner to verify the antennas and cables are working correctly. Each transmitter is represented by two green lines, one for each antenna. The received power from at least one antenna should always be between -40 and -60 dBm.



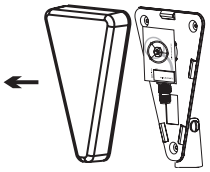
(6) Built-in antenna distribution

Daisy-chain up to 32 channels and connect to a pair of extension antennas

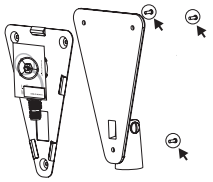


Antenna Mounting Instructions

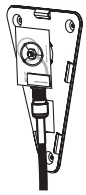
1 Gently pull the plastic exterior case from the rest of the antenna assembly. It is a press fit.



2 Unscrew and discard the black microphone-stand mount from the antenna assembly.

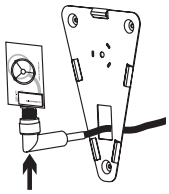


3 Connect the antenna cable to the TNC connector.



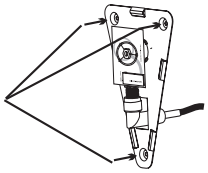
or

4 Use the L-connector to route the cable through the back plate.

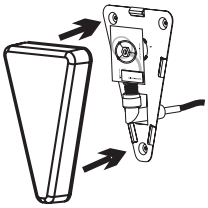


5 Screw the plate to the wall or lay the antenna on a drop ceiling.

NOTE: wall-mounting screws not supplied



6 Press on the plastic case cover.



7

NOTES:

Paint: The plastic case can be painted with non-metalic paint to match the decor.

Outdoor Mounting: ClearOne extension antennas are designed for outdoor use, but they operate normally mounted inside a waterproof plastic box.

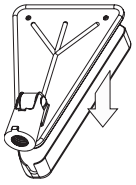
Polar Pattern: ClearOne extension antennas have a 160 degree polar pattern. Ceiling mounted antennas typically cover the entire room.

Mounting Instructions for Mic Stands

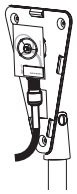
Microphone Stand Mounting

1 Thread the antenna onto the mic stand.

2 Gently pry the exterior case from the rest of the antenna assembly.



3 Attach antenna cable to TNC connector on the antenna assembly. Hand tighten only. Reattach the exterior case.



4 Position antennas according to the rules in the case studies above. Do not daisy-chain extension antennas together in series.

Extension Antenna Cables

Government regulations severely limit the output power of wireless microphones. For a comparison, mobile phones connect to towers miles away, but wireless microphones barely reach 300 feet line-of-sight. A mobile phone is similar to a lighthouse that shines to the horizon, while a wireless microphone is like a penlight that barely casts a shadow on the far side of a dark auditorium. Microphone power limitations make extension antennas systems a critical component of every wireless microphone system, and coax cables are a critical part of every antenna system. There is no room for error.

ClearOne provides antenna kits that includes the extension antennas and the cables. The cables are cut to length, properly terminated, and individually tested at ClearOne operating frequencies. ClearOne also provides extension antennas without cables, but it should be noted that we have found serious errors in the spec sheets published by two of the industry's largest and best know cable suppliers. Had our clients purchased and installed these cables, their microphone systems would have never worked properly, and the antenna cables may have never been identified as the cause.

Plenum Rated Cables have a special coating (usually Teflon) that does not give off toxic gasses and smoke when it burns. Some building codes require plenum-rated cables, but longer plenum cables are considerably more expensive than standard cables. Kits with longer cables are available with plenum or standard cables.

ClearOne systems require 50 Ohm Coax Cable with a total line loss less than 15 dB at 900 MHz.

ClearOne Part Number	Product Description	Length (Ft)	Fire Rating	Diameter (in)	Nom loss at 900 MHz (dB)
910-6005-001	WS-EAK25-M915: Extension Antenna kit with pair of antennas and 25Ft RG58 Plenum cables tuned for Radio Frequency band M915 (902-928 MHz)	25	Plenum	0.158	5
910-6005-002	WS-EAK25-M715: Extension Antenna kit with pair of antennas and 25Ft RG58 Plenum cables tuned for Radio Frequency band M715 (710-740 MHz)	25	Plenum	0.158	5
910-6005-003	WS-EAK25-M610: Extension Antenna kit with pair of antennas and 25Ft RG58 Plenum cables tuned for Radio Frequency band M610 (603-630 MHz)	25	Plenum	0.158	5
910-6005-011	WS-EAK50-M915: Extension Antenna kit with pair of antennas and 50Ft RG58 Plenum cables tuned for Radio Frequency band M915 (902-928 MHz)	50	Plenum	0.158	9
910-6005-012	WS-EAK50-M715: Extension Antenna kit with pair of antennas and 50Ft RG58 Plenum cables tuned for Radio Frequency band M715 (710-740 MHz)	50	Plenum	0.158	9
910-6005-013	WS-EAK50-M610: Extension Antenna kit with pair of antennas and 50Ft RG58 Plenum cables tuned for Radio Frequency band M610 (603-630 MHz)	50	Plenum	0.158	9

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