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Using High Gain Directional Antennas

City Theatrical's SHoW DMX Transmitters and Receivers are provided with 5dBi omni-directional antennas as standard equipment when shipped from the factory. This is a good general purpose choice when nothing else is known about the application the equipment will be used for; the antennas provide adequate power and the omni-directional pattern adapts well to a wide variety of environments. But specialized antennas can enhance the performance of a wireless system in a variety of ways if the environmental conditions are known, or if particular problems need to be overcome. CTI offers a range of approved specialized antennas that can enhance system performance in a range of applications.

Antenna Approval

2.4GHz antennas are available on the general market and are often sold without caveat or restriction, however many federal authorities require antennas used with transmitting radios to be approved for the specific radio system they are used with. The CTI 5632, 5633, 5634 and 5636 Antennas have all been tested and approved for use in both the US and Canada with CTI's 5600 SHoW DMX Transmitter, 5610 SHoW DMX Receiver, and many of the CTI wireless products that utilize built-in SHoW DMX technology[1]. Beware of unapproved after-market antennas that may push your system out of compliance and may be illegal.

Power ratings

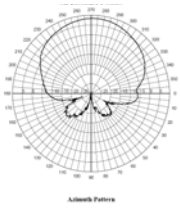
CTI's antennas are rated in decibels or "dBi". The dBi rating describes the gain of the antenna (how powerful it is), with higher numbers indicating greater power. 8dBi is more powerful than 5dBi.

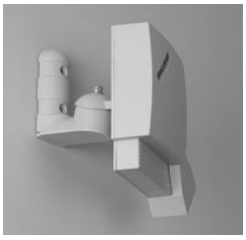
Types of Antennas

Omni-Directional antennas radiate in all directions and produce a pattern of radio waves that looks almost like a donut around the antenna axis. These antennas basically broadcast in all directions, so their available energy is spread out over a wide area. The CTI 5630 7" Omni-Directional Antenna provided with all SHoW DMX models is a typical small omni-directional antenna.

For best results, always orient these antennas in the same direction (normally vertically, the CTI 5630 is a vertically polarized antenna) on the transmitter and receiver, and locate the units as high as possible above the ground, as well as away from other surfaces (walls, ceilings, etc.).

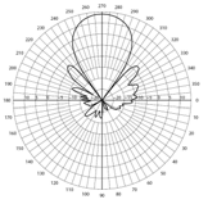
Panel antennas are basically flat box shaped units, and radiate primarily from their front "panel" surface. These antennas produce a relatively wide beam of radio waves that can be aimed or directed toward targets and away from things that might cause problems. The CTI 5632 8dBi Panel Antenna (pictured) has a 60º beam angle, meaning that most of the antenna's energy is shaped into a 60º wide beam (see the beam pattern near right), and much like a light fixture with a 60º beam angle,





[1] Contact CTI for a complete list of approved equipment

this antenna can be focused at a desired target or group of targets.



Yagi antennas focus most of their energy forward, producing a highly directional, narrow beam. The CTI Yagi antennas are enclosed in a plastic cylinder and radiate from the flat end of the cylinder. A mounting bracket is provided at the other end. To focus the Yagi antenna, simply point it along the axis of the cylinder, away from the mounting bracket. These antennas are useful for very long range broadcast to fixed targets. The CTI 5636 14dBi Yagi Antenna (pictured right) is a very powerful, highly directional antenna, and is capable of significant range when installed correctly.

Using directional antennas
In general, using a directional antenna instead of an omni-direction antenna is a trade; you are trading the 360º coverage of the omni for the added power and reduced interference of the directional antenna. If you are broadcasting to spread out and/or moving targets within an acceptable range, omni-directional antennas are usually best. If your target is stationary or limited in motion, or if you have multiple targets in a defined area, then a directional antenna can improve your range and fidelity.

All antennas must be installed correctly to get the best results.

- Mount the antennas above the ground and away from hard reflective surfaces (directional antennas may be positioned to point away from a mounting surface). In CTI range tests, elevating the Transmitter and Receiver by as little as 8' above the ground dramatically improved range.
- Note the polarity markings on the antennas and orient them so that transmitter and receiver antennas are polarized the same way. Start with the vertical polarity marks pointed up.
- Try to put the antennas above/away from radio barriers. Water, metal and some kinds of glass are typical radio barriers (people, plants and animals are mostly water).
- Use the correct type of cable and keep your cables as short as possible.

Different antennas can be combined: You can use a directional antenna on your transmitter while keeping omnis on your receivers, or use directional antennas on both receivers and transmitters.

Increasing range: One of the most popular uses for directional antennas is to increase range. Adding a directional antenna to the transmitter can increase effective range significantly, even if the power of the directional antenna is no greater than the omni-directional unit it replaces. Some of the longest distance transmissions have been achieved with yagi antennas connected to both receiver and transmitter, and with the antennas correctly like-polarized and pointed at each other. Note that the tight beam angle of these antennas requires careful aiming to get the antennas aligned.

Reducing interference: Using directional antennas can effectively reduce the amount of reflection or *multi-path* signals created by your broadcast, and can also help your system "cut through" interference created by other systems operating in the area. Combining a directional antenna with lower broadcast power can be a very effective combination. In CTI

outdoor testing, high fidelity broadcasts were achieved over 4/10 of a mile at 5mW broadcast power with the addition of a 5632 8dBi panel antenna to the transmitter (leaving an omni on the receiver), and data fidelity was actually better in this test than with omnis at both ends and 50mW broadcast power.

Using directional antennas at lower power settings can also reduce the amount of interference that *your system creates for other systems* operating in the same part of the spectrum, while still giving you the punch and fidelity you need.

Splitters: Sometimes you may want to broadcast to two different areas which are divided by a barrier or are separated in some way. You can achieve this by using a pair of identical directional antennas and a splitter. For example, one of CTI's clients wanted to control equipment located on two perpendicular intersecting streets in NYC, 6th Ave. and 42nd St. The solution was to position the transmitter at the corner of a building on the corner of 42nd St. and 6th Ave., connect the transmitter's antenna output to a CTI 5637 Antenna Splitter, and connect identical panel antennas to the two outputs of the splitter. The panels were separated from each other by a few feet of cable and each panel was positioned on one of the intersecting walls of the building (one on the 42nd St. wall and one on the 6th Ave. wall) and pointed down one of the two intersecting streets at the desired targets. The result was two separate directional broadcast beams of the same signal, each sent in a different direction. When using this solution, there are a few things to remember:

- The antennas must be identical
- The splitter will divide the transmitter power between the antennas, so each will be only half the output that the same antenna would have alone
- Position the antennas so that the beams don't overlap; overlapping can cause signal corruption and poor reception
- Height is your friend

Cables: Radio performance can be impaired if poorly made or excessively long cables are used for antenna connection. It is important that the correct coaxial cable material is used and that the cable is properly assembled. CTI's antenna adapters and extension cables are carefully matched to our radio transceivers and antennas to assure the best possible operation. Cable performance can be significantly impaired if the cable is sharply bent or kinked, or if it is compressed in some way. When installing antenna cables, be careful not to bend cables excessively or kink them. If strain reliefs such as cable ties are used, be careful not to over-tighten them.

Electrical Safety: Radio antennas can attract lightning during an electrical storm. When operating the SHoW DMX system, be aware of the weather conditions, particularly when using the system outdoors.