Appendix E: Using DMX512 Devices with ACL

What is DMX512?

DMX512 is a data transmission standard originally developed in 1986 for controlling dimmers and other devices. It covers electrical characteristics, data format, data protocol, connector type, and cable type. It was revised and enhanced in 1990 and the current standard is called DMX512/1990. Another revision is currently underway that is known as DMX512-A that should soon be approved.

As its name implies, DMX512 is designed to allow control of up to 512 devices from one controller. These devices are usually light dimmers, but can also be smoke machines, strobes, lasers, confetti launchers, or many other types of devices. Each device being controlled has one or more addresses ranging between 1 and 512. On the surface 512 devices seems like a lot if each were only one light. But modern intelligent fixtures often use multiple addresses for one fixture. For example, some moving stage lighting may use 8 or more addresses for position, color, gobo, or focus. Some controllers have recognized this limitation and allow multiple groups of 512 devices, calling each a universe.

Each of the 512 devices receives a value between 0 and 255. In the case of a light dimmer, each number represents a dim level between 0 (off) and 255 (fully on). An intelligent fixture may interpret one address as an X position, another as a Y position, another as a color, and so forth. A smoke machine might interpret numbers below 127 as off, and above 127 as on. Each manufacture defines how its fixture maps into its address space.

DMX512 is a simple protocol that sends each of the 512 device values in a row, repeating continuously. When a device sees its bytes go by, it grabs those values and changes its light levels to match. It ignores all the other addresses except its own. If nothing is changing (i.e. no lamp levels change) the same data will be sent out over and over again.

The bytes are sent at 250,000 bits per second using the RS-485 transmission standard over two wires. As with microphone cables, a grounded cable shield is used to prevent interference from other signals. The maximum recommended cable length is 4000’, but long cable runs greatly increase the chance of problems due to noise and reflections. Terminating the end of the line is also very important to minimize signal reflections that can garble data.

DMX512 depends on the constant repetition of data to overcome many of its shortcomings. If bytes get garbled they will be repeated a short time later. 250kbs is a pretty rapid rate for digital data traveling over distances, and care must be taken on the type of wire used, and proper termination. Poor wiring or line reflections can cause huge headaches trying to track down mysterious or intermittent problems.

DMX512 is connected using a daisy-chain methodology where the source connects to the input of the first device, the output of the first device connects to the input of the next device, and so on. The standard allows for up to 32 devices on a single DMX link. Although each device has an input and output connector, these are merely wired together - no re-transmission or amplification is performed by each device. In order to support more than 32 devices you must employ repeaters or splitters to amplify and retransmit the signal.

Not all 512 channels need to be output per packet, and in fact, it is very uncommon to find all 512 used. For example, most simple lighting consoles only output 16 channels or less. The fewer channels are used, the higher the "refresh" rate. It is possible to get DMX512 refreshes at around 1000 times per second if only 24 channels are being transmitted. If all 512 channels are being transmitted, the refresh rate is around 44 times per second.

What is ACL and how is it different?

The ACL protocol is Animated Lighting's data transmission format for controlling distributed, intelligent lights and devices.

The major differences between Animated Lighting's ACL protocol and DMX512 are the use of distributed processing and high-level command sequences. Whereas DMX512 has one centralized controller sending out low-level commands to every attached dumb fixture, the ACL protocol is composed of high-level commands sent to other controllers that perform complex operations at the controller. Each of the remote controllers has its own powerful microprocessor that handles all of the low-level processing locally.

For example, in DMX512, to dim 100 light fixtures from fully on (255) to fully off (0), the control console would have to keep track of and send every dim code between 255 and 0 to each lighting fixture. That's 25,600 commands. By contrast, Monster Brain can issue one high-level command to all controllers to fade the lights over a one second period and the controllers handle all of the work locally. During that time Monster Brain can continue processing or controlling other controllers.

This technique of distributing the computing power over the entire network allows for complex effects on a large number of fixtures with very simple commands.

There are several benefits of using Animated Lighting's ACL protocol over DMX512.

The computing power is distributed over the entire network allowing more powerful effects on a larger numbers of lights or devices.

The use of high-level commands in ACL allows complex sequences to be performed with a single command. This allows much finer synchronization with music or external events since the command needed to trigger a large scene is very small (versus sending thousands of commands in DMX512).

ACL is a two-way protocol, allowing interaction and feedback between the master controller (Monster Brain) and the remote controllers. Monster Brain can read the operating status of all the connected controllers as well as query devices that return data (reading inputs or voltages remotely).

ACL was designed to handle a diverse number of devices other than lights including devices that return data (e.g. reading inputs and status), devices that require data (e.g. bitmap, picture, or sound data), and devices that need to operate in synchronization.

Using ACL with DMX512 fixtures

There are a large number of DMX lighting fixtures available today. Integrating these fixtures into Animated Lighting's network is very simple. And using ACL to control these fixtures greatly increases their versatility and capabilities.

Animated Lighting's DMX controller allows control of DMX fixtures using its powerful ACL command language. Each DMX controller contains a microprocessor and powerful firmware that treat fixtures connected to that board as one DMX Universe. You can have multiple DMX controllers (up to 255) each acting as its own DMX Universe. You can also mix the DMX controllers with other Animated Lighting controllers to control a diverse number of devices.

Each DMX Universe controlled by a DMX controller takes on the characteristics of Animated Lighting's other intelligent controllers. This includes the local control of built-in effects such as ramping, fading, sparkling, shimmering, pop-fades, etc. It also allows the DMX fixtures to become members of Groups and Scenes – powerful concepts that give ACL extreme flexibility in how it controls lighting and devices.