Carpe DMX- Seize the Data

by Tony Hansen

One of the biggest sources of confusion in the world of lighting seems to be the control protocol that is used by many, but not all, of today's lighting controllers to talk to the various lights, dimmers, etc. So the following is my attempt to disseminate and defuse DMX.

Formally, we are discussing DMX 512 (1990), there are new protocols currently in development but they are not out there yet- so let's not muddy up the water any more than we need to.

DMX History

DMX is a culmination of several other control protocols, defined beginning in 1986, with slight revisions in 1990. The controlling organization is a group of designers, manufacturers, distributors, etc. called ESTA. (The Entertainment Services and Technology Association) Their website can be viewed at http://www.esta.org/. Another Excellent source is USITT at WWW.USITT.ORG, take a look at the book entitled book *Recommended practice for DMX 512* by Adam Bennette. The point of DMX was to eliminate many of the wires associated with traditional dimmer control systems. Older analog systems used to run wires for every dimmer in the system. In large theatres this could mean bundles of thousands of wires. DMX is a digital way of sending up to 512 individual channels of data down a lightweight 5 wire cable. In addition to combining channels into a smaller cable, DMX also offers a pretty clever way of eliminating data errors.

DMX 101

The original draft of DMX was based on the Colortran D192 protocol which is somewhat similar to the older AMX protocol (not to be confused with a company of the same name that makes fine control products today). DMX is actually transmitted via the industry interface known as RS-485, this is very similar to the RS-232 port on most computers. Confused yet?

The actual stream of data always starts with a little bit of training information for all of the devices down the line, and then moves on to the actual data in sequential order. No matter how many lights you have in your system, the data always starts with channel 1 and goes up from there. Depending on your controller, it may stop at the highest used channel and start over, or it may simply go through all 512 channels before repeating. This means that it is probably better to start with the lowest DMX channels and work up.

Electrically, DMX only uses 3 wires in its 5 wire system (the other 2 wires are for future use and have not been defined yet). The #1 pin is the shield (do NOT connect to the body of the connector). The #2 pin is the Signal – and #3 is Signal +. If you need to use devices in your system that have both 3 pin DMX and 5 pin DMX, an adapter can be purchased or simply made by wiring pins 1 thru 3 to the matching pins on the other connector. Some manufacturers over the years have used pins 4 & 5 for their own benefit, but they are not formally defined for use. If you have any other type of connectors other than 3 or 5 pin XLR, you likely are not using DMX, and you should contact your supplier for assistance.

DMX is a low voltage switching signal that flip/flops a +5 volt and a –5 volt current between pins 2 & 3. It is sort of like Morse code. The receiving device only needs to detect a change between the wires as small as $1/5^{th}$ of a volt to see the code. Additionally the #1 pin is acting as a shield *reference*, not a drain. This means that any electrical noise picked up by the cable will be equally induced on all wires and the state change will be unaffected.

No Talking Back

It is important to understand that DMX is a one way protocol. In other words, the console only speaks and does not hear a response. What this means is that the lights and dimmers don't have a way of

talking back to the console, they can only listen. The devices have to count up from 1 each time and keep track of their information. Each device will have an address. This number is usually unique to each fixture, but it doesn't need to be. If you have multiple items using the same address, they will all do the same thing. It is just like tuning multiple TV's to the same channel. The problem comes in when addresses are allowed to overlap. Some devices (like intelligent lights) use more than one address and need the appropriate space allotted to them. If for example, you have an intelligent light that needs 10 channels and you address it at #1, the next light cannot be before channel #11. If you were to address the second at say #8, the last 3 channels of the first light would overlap with the first 3 of the second light. The console does not receive any feedback so it would go along as normal but the lights would be getting conflicting information.

This can all get very confusing very fast, but the newer consoles try and help by not allowing addressing conflicts. You can get channel information from the light manufacturers for the fixtures and "Libraries" are available from most of the console manufacturers. Since the consoles are the best at figuring out the addressing, I usually patch them first and use that information to address my lights. When wiring the lights they can all daisy chain together, they do not need to be in any order since their address tells them what to do.

DMX is DMX is DMX

There is only one type of DMX currently in use. As long as a manufacturer is using DMX, it is all the same. There is no difference between the brands, nor is there moving light DMX or smoke machine DMX or dimmer DMX. It's all the same. As long as your console has a DMX out and your light has a DMX in, they will work together!

The biggest confusion comes with moving lights. When DMX was being developed, they weren't really an issue yet. As the moving lights developed they just sort of piggybacked onto DMX. A moving light that uses 10 channels of data is no different than a 10 channel dimmer pack to the console. Each channel is a sliding value from 0 to 255, the moving light breaks down channels into individual functions of the lights. Thus, the first channel may be the intensity, the second pan, the third tilt, fourth color and so on. The trick is to get the console to map these functions out into a reasonable order. If you simply had 10 sliders for every light (some lights use 32 channels or more), it would get really confusing really fast. The newer consoles offer an easier interface which is the source of a future article.

The next thing to consider with DMX is that in normal use it only goes to 512 channels, although most larger boards advertise up to 2048 channels and more. This means that the console has multiple "universes" of DMX coming out. Each universe will start over again at 1 and go up to 512, when you patch, you just need to be mindful of where you are sending the data out, and you will need to run additional wires for each universe. A terminator is to be placed at the end of each branch of DMX. The idea is that it will eat up any additional signal and eliminate "reflections" that could bounce back down the line. I will admit that I have run a system without terminators and it worked just fine. I will however use them whenever possible, and I have had them clear up data problems.

A terminator will look like a plug with no wire, or it is sometimes built into the device either automatically or as a physical switch. If you are having data issues past a certain point, make sure that a terminator switch is not on. A terminator can be made by simply soldering a 120 Ohm/.25 watt resistor between pins 2 & 3 of a male connector.

Data, not Voice

DMX is a form of data and not voice, so a proper install will utilize an instrumentation grade, twisted pair data cable. Remember that we want to induce noise onto our lines- unlike audio cable which will drain the noise. In an emergency, you can use microphone cable for DMX and it will likely work just

fine. However, DMX is designed to run over data cable and some work is even being done to use CAT 5 network cable. Obviously it would not be a good idea to use a DMX cable for audio since it is not properly shielded.

Hopefully this cleared up a little confusion on this subject, next month we will look into GUI's. Have a great New Year- Peace and Happy Lighting!

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