Introduction

This AppNote should give you a basic understanding of what DMX is and how it is used with a Pharos control system.

What is DMX?

DMX512 is a serial protocol that has been used by the entertainment industry since the early 1990s to control lighting fixtures. DMX stands for Digital MultipleX, which essentially means that it is a digital signal (High and Low voltages) which carries a stream of data down a single cable. The standard is maintained by PLASA as ANSI E1.11 - 2008, USITT DMX512-A.

DMX Signal

The DMX signal is based on EIA-485 (RS-485) which is a unidirectional serial protocol, meaning that data is streamed from a transmitter to one or more receivers. The transmitter takes a universe of data (512 channels) and streams them down the DMX connection in channel order (1,2,3...510,511,512 etc.).

To ensure that each receiver gets the correct channels, the receiver is set with a Start Address (the first channel that it should look for in the data stream) and a personality (which maps the control parameters to channels), so that it knows how many channels to look at.

DMX Wiring

DMX Connectors

The standard connectors used for DMX for Entertainment are XLR5 and RJ45. Additionally, the Architectural industry may use other non-standard connectors as appropriate to the equipment.

XLR3 is specifically prohibited by the DMX standard, but is still often used by lighting manufacturers due to its lower cost.

XLR-5 pinout:
1. Signal Common
2. Data 1- (Primary Data Link)
3. Data 1+ (Primary Data Link)
4. Data 2- (Optional Secondary Data Link)
5. Data 2+ (Optional Secondary Data Link)

XLR-3 pinout:
DMX+ and DMX- are often swapped. The most commonly encountered pinout is given below.
1. Ground
2. Data 1- (Primary Data Link)
3. Data 1+ (Primary Data Link)

3-Pin Phoenix connector pinout (for Pharos):
1. Ground
2. Data -
3. Data +

RJ-45 pinout (Standard)
1. Data 1+
2. Data 1-
3. Data 2+
4. Unused
5. Unused
6. Data 2-
7. Signal Common (0 V) for Data 1
8. Signal Common (0 V) for Data 2

RJ-45 pinout (Color Kinetics)
1. Data 1-
2. Data 1+
3. Shield
4. Unused
5. Unused
6. Shield
7. Unused
8. Unused

When using XLR connectors, the socket connector is always the output, and the plug connector is always the input. XLR cables should always be plug -> socket cables.

When using RJ45 connectors, both Input and Output use plug connectors, meaning that RJ45 cables should always be plug -> plug.

The connectors used on Pharos devices are 3-Pin Phoenix connectors with screw terminals, which can be wired up to any other connector required by the rest of your system.

DMX Cable

DMX cable is specified in terms of impedance. Cables for DMX will have a nominal characteristic impedance of 120ohms. Belden 9729 cable is often recommended for this purpose.
Additionally, network cables (Cat5, 5e or 6) cables are acceptable for use with DMX signals.

DMX Topology

A DMX system consists of a single transmitter and between 1 and 32 receivers. These receivers are typically lighting fixtures, dimmer packs. The receivers are daisy-chained together such that the output of each device is connected to the input of the next device. The signal should never be Y-Split as this reduced the reliability of the communications. If the signal needs to be split up to distribute the signal, or if there are more than 32 receivers, then a DMX Splitter can be used, such as a Pharos Repeat.

The maximum distance permissible for a DMX signal is 300m. If you need longer distances, DMX Splitters are required, such as a Pharos Repeat.

DMX lines should always be terminated with a DMX terminator. This adds a 120 ohm resistor between the data pins, and prevents reflections of the data back down the line.

It is also recommended to use an Optically Isolated DMX Splitter, as this reduces the risk of stray voltages damaging devices on the DMX line.

Extensions to DMX

RDM

RDM (Remote Device Management) is an extension to DMX that sits between the signal packets and allows messages between the transmitter and receivers (and back again). This allows transmitters to change settings on the receiver/s, such as start address. Receivers can also send data back such as lamp hours or current temperature, provided the receivers, transmitter and intermediate devices are capable of this communication. The standard is referred to as ANSI E1.20.

Note: Pharos controllers support RDM commissioning (address and personality setting from Designer).

eDMX/xDMX

There are a number of protocols that have been developed to pass DMX over ethernet networks. These pass the DMX universe into a network packet, these include sACN (Industry Standard ANSI E1.31), Art-Net (Public Domain, created by Artistic Licence), Pathport (proprietary Pathway) and KiNet (proprietary Philips Color Kinetics).

DMX in a Pharos System

With Pharos Designer, once you have added fixtures to the project, you then patch them. This links the fixtures in the project to the DMX Universe and Channel that its levels should be output to. This patched address should be the same as the Start Address on the receiver so that the correct data is sent and received.

All DMX connections on Pharos devices use the 3-pin Phoenix connector, and the pinout is displayed on the connection. You can verify the DMX levels that the controller is outputting by navigating to the Controller's Web Interface and selecting the Output view.

DMX Troubleshooting

If you have issues with your DMX fixtures you can check the following:
• Is the DMX terminated? Missing termination can result in flickering of some or all of the fixtures on the DMX line.
• Is the cabling in good condition? Broken cores, poor soldering or incorrect wiring will result in the signal not reaching some receivers.
• Is the cabling of the correct standard? Low quality or incorrect impedance cables can result in signal degradation
Note: DMX Testers (such as the ones available from Artistic Licence and Goddard Design) can be used to verify the quality of the connections and output levels to connected receivers to test them.

pharoscontrols.com

Glossary

16 bit	A number which when converted to binary can be expressed with 16 1's and 0's (0-65535)
8 bit	A number which when converted to binary can be expressed with 8 1's and 0's (0-255)
Channel	A single 8 bit value used to control a parameter of the light (Intensity, Red level, Pan etc.)
Footprint	The total number of channels required for the receiver
Mode	One of a number of configurations linking incoming channels to parameters of the receiver
Patching	The act of assigning a fixture within the lighting controller (e.g. Pharos LPC) to an output channel
Personality	see Mode
Start Address	The first channel that the fixture has been set to receive
Terminator	Usually a DMX connector with a 120 ohm resistor connected between the Data + and Data – pins
Universe	A collection of 512 DMX Channels

Further Information

Further information on control standards (DMX, RDM sACN) is available from the ESTA Technical Standards Program:
tsp.esta.org
There are many online resources with information regarding DMX wiring etc.
If you need any further information, please contact Pharos Support.

pharoscontrols.com