PHILIPS

Introduction to DMX

BU Controls
2008
Objective

• Explain simplified functioning of a DMX control system

• Provide basic technical clarification
What is DMX

The origin of the abbreviation of DMX is unknown. However it is often explained as Digital Multiplexed signal.

It is a protocol, in which a DMX controller communicates to DMX luminaires.

In other words,

DMX is the language in which DMX controller talks to DMX luminaires.
Examples of DMX products

Luminaires

Switchpacks

DMX controllers
History of DMX

DMX originated in the world of theatre was developed by USITT in 1986. DMX is used mainly for “controlling lighting equipment and accessories” in entertainment applications (theatre, staging, concerts etc).

Nowadays DMX is used more and more in architectural scene setting applications as well.

PHILIPS
The DMX signal explained

A DMX controller sends DMX values.

This is a 8-bit value (value between 0-255) corresponding to a 0-100% intensity

<table>
<thead>
<tr>
<th>DMX Value</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>64</td>
<td>25%</td>
</tr>
<tr>
<td>128</td>
<td>50%</td>
</tr>
<tr>
<td>192</td>
<td>75%</td>
</tr>
<tr>
<td>255</td>
<td>100%</td>
</tr>
</tbody>
</table>
The DMX signal explained

Strings of 512 values are sent 40 times per second.
The location of a DMX value is referred to as “address”
The DMX signal explained

By addressing the DMX device, it knows which DMX value to use

Address 006

Address 005

Address 004

Address 003

Address 002

Address 001

000 255 255 192 064 128

50% 25% 75% 75% 0% 100%

Address 001

Address 002

Address 003

Address 003

Address 006

Address 005
The DMX signal explained

By addressing the DMX device, it knows which DMX value to use
The DMX signal explained

By addressing the DMX device, it knows which DMX value to use

Address 006
Address 005
Address 004
Address 003
Address 002
Address 001

000 255 000 255 000 255

100% 0% 100% 100% 0% 100%
The DMX signal in scene setting

Most DMX devices use more than one DMX-address. In example, the LED LINE2 uses 3 DMX addresses.

1\textsuperscript{st} DMX value determines the intensity of RED,
2\textsuperscript{nd} DMX value determines the intensity of GREEN
3\textsuperscript{rd} DMX value determines the intensity of BLUE

The DMX-start address is the first DMX value used, (DMX-start address+1) the second value, etc.

Start address: 1 4 22 215
DMX addr. Red intensity: 1 4 22 215
DMX addr. Green intensity: 2 5 23 216
DMX addr. Blue intensity: 3 6 24 217

One DMX line can control 512/3=170 individual RGB units
The DMX signal in scene setting

Address 006
192

Address 005
255

Address 004
000

Address 003
000

Address 002
064

Address 001
255

Start address: 1

Start address: 1

Start address: 4

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The DMX signal in scene setting

With changing the DMX values, different colours are created

Start address: 1

Start address: 4
The DMX signal in scene setting

With changing the DMX values, different colours are created.
The DMX signal in scene setting

Note: luminaires with the same address will always react the same!
Addressing luminaires

How a start address should be changed depends on the luminaire.
The DMX cable explained

A good DMX control cable is a RS485 “shielded twisted pair”
This exist of 3 connections; 2 signals and a ground (GND).

Shielded CAT.5 (or higher) cable can also be used.

The data (+) and data (-) signal create the actual DMX signal
Ground must be connected for reference, and to prevent interference.
The DMX connector explained

Preferred DMX connectors are RJ45 and Neutrik XLR 5 pin

<table>
<thead>
<tr>
<th>PIN 1</th>
<th>DATA +</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIN 2</td>
<td>DATA -</td>
</tr>
<tr>
<td>PIN 3</td>
<td></td>
</tr>
<tr>
<td>PIN 4</td>
<td></td>
</tr>
<tr>
<td>PIN 5</td>
<td></td>
</tr>
<tr>
<td>PIN 6</td>
<td></td>
</tr>
<tr>
<td>PIN 7</td>
<td>GND</td>
</tr>
<tr>
<td>PIN 8</td>
<td>GND</td>
</tr>
</tbody>
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</tr>
<tr>
<td>PIN 4</td>
<td></td>
</tr>
<tr>
<td>PIN 5</td>
<td></td>
</tr>
</tbody>
</table>

XLR make stronger connections and are suitable for thicker cables (male for incoming signal, female for outgoing signal)
DMX topology

Topology with DMX is serial (total DMX length <300m)
DMX topology

Topology with DMX is serial (total DMX length <300m)
DMX topology

Notes:
• It is possible to split a DMX line; this can be done using additional hardware: a DMX-Splitter.

• Every DMX luminaire consumes “DMX energy”
  Maximum 30 DMX devices can be connected to one DMX line.
  After this the signal needs to be boosted with a DMX-Booster

The “4 way optosplitter” splits and boost the DMX signal.
DMX topology

Splitted & Boosted Signal ✔
To create a stable DMX signal the end of each DMX line should be “terminated” with a 120Ω resistor. This should be mounted between the Data (+) and Data (-) signal.
### DMX technical characteristics (1)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of units max.</td>
<td>30 (Using boosters: unlimited)</td>
</tr>
<tr>
<td>Number of addresses</td>
<td>512 max</td>
</tr>
<tr>
<td>Signal level</td>
<td>several hundreds of millivolts</td>
</tr>
<tr>
<td>Speed</td>
<td>40 times 512 values / second</td>
</tr>
<tr>
<td></td>
<td>+/- 250 kbaud</td>
</tr>
<tr>
<td>Termination</td>
<td>end of the line, 120 Ohm</td>
</tr>
<tr>
<td>Cable length max.</td>
<td>500m, (Using boosters: unlimited)</td>
</tr>
<tr>
<td>Cable type</td>
<td>Shielded twisted pair 100-120 Ohm</td>
</tr>
<tr>
<td></td>
<td>Cat.5 S/UPT, F/UTP, SF/UTP</td>
</tr>
<tr>
<td></td>
<td>Cat.6 U/FTP, S/FTP, S/STP</td>
</tr>
<tr>
<td></td>
<td>Cat.7 S/FTP, S/STP</td>
</tr>
<tr>
<td>Cable topology</td>
<td>serial (line)</td>
</tr>
<tr>
<td>Termination</td>
<td>120 Ohm</td>
</tr>
<tr>
<td>Safety</td>
<td>DMX is SELV</td>
</tr>
</tbody>
</table>

2008
DMX technical characteristics (2)

- A DMX system contains one controller (transmitter) and receiver(s)
- Information is transferred by modulating the two signal wires in opposite way. Ground is needed as reference
- An receiver has to be given an address. This is a number between 1 and 512. This address cannot be changed via the DMX connection
- DMX is based on RS485 communication. RS485 is two way communication, this is not implemented in DMX (one way only)
- DMX is invented to replace a multiplexed analog system
- In DMX communication there is no address info. The receiver counts the messages
- Random addressing is not possible. Addresses cannot be left out.
- A DMX value can mean anything, depending on receiver. For luminaires with intensity only most often a linear intensity curve is used.
- Standard: “E1.11, USITT DMX512-A”, maintained by ESTA
Summary “Introduction to DMX”

DMX signal: continuous stream of 512 values
Each value (0-255) represents an intensity (0-100%)
DMX address 1, 1st value, (i.e. “128” -> int = 50%)
DMX address 2, 2nd value (i.e. “194” -> int = 75%)
etc.

Luminaire settings:
DMX address (start address)

-terminator
-max. 30 pcs

512 addresses
(i.e. 170x individual RGB)

max 30 DMX devices

Unlimited DMX devices using boosters

Serial topology

Special DMX cable
(shielded twisted pair 120Ω)

Commissioning:
depends on luminaire / controller