

DMX Module
USER'S GUIDE
For Specifiers, Installers and Programmers

November 3, 2005

NOTE: This guide is presented as a tool to assist a specifier, installer, or programmer in understanding and using the functions of the DMX option in Fiberstars™ illuminators. While this pamphlet contains advice and suggestions, it should **not** be considered your primary source of information for DMX use and practice. The USITT DMX512 (1990) Standard defines the protocol and should be your primary source of information.

In cases of conflicting information, USITT DMX512 (1990) Standard takes precedence over this document. The standard is available from:

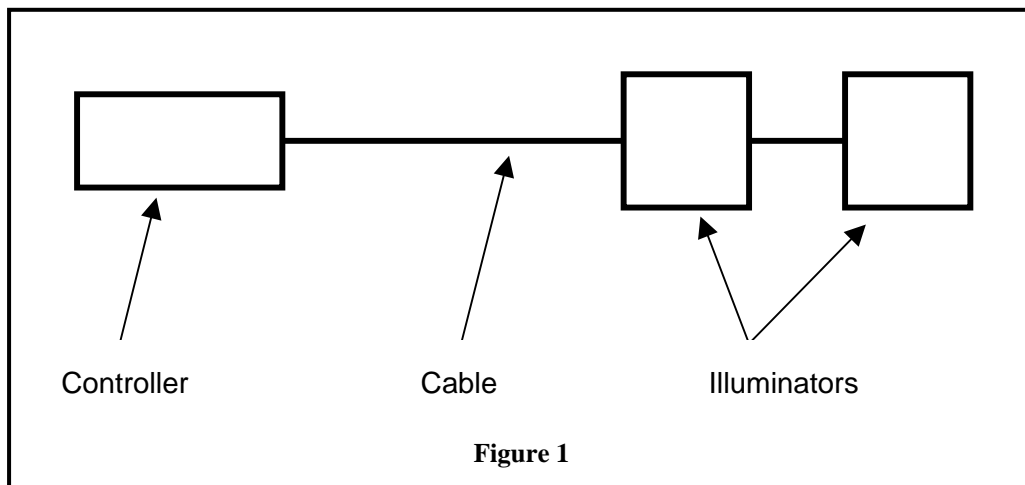
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Introduction

DMX is a digital protocol, or language, used throughout the world to control entertainment lighting equipment and other devices. Though there are a number of various protocols, DMX512 is by far the most widely used.

DMX512 allows a controlling device to assign values to various parameters in dimmers, lighting fixtures, and other devices. Not all lighting fixtures are capable of responding directly to DMX control, but those that are may dim, change color, aim in a new direction, zoom in or out, etc., all from the remote controller. A manufacturer will inform you of what—if any—functions can be controlled via DMX.

Diagram of Simple DMX System



Fiberstars™ DMX Option

Appearance

The addition of the DMX option to a Fiberstars™ illuminator occurs almost entirely inside the unit. The only modification visible from the outside is that there is an extra knockout in the illuminator enclosure with XLR connectors or protruding wires.

There is a module inside the illuminator in place of the color wheel plate. This module contains two stepper motors, a color wheel, a dowser flag, other light filters, DIPswitches, wires, and computer-controlled circuitry to keep it all working properly.

Availability

The DMX option is available as a standard option in the 404, 405N, 601, and 602 illuminators. For other illuminators, please consult your rep for information and availability.

Functionality

Color Wheel Position—DMX Channel Assigned

This function allows the user to assign a specific color-wheel location. Upon a change in value, the color wheel will rapidly rotate to that new location. Locations are continuously addressable from 0% (beginning of the first color) to 100% (end of the last color) in 1% steps via the DMX controller. Each color uses approximately 13 percentage points. It is possible to set the color wheel between two colors, if desired.

NOTE: setting the Color Wheel Rotational Behavior value (see below) to any level above 10% disables this function.

Dowser Position—DMX Channel Assigned + 1

This function allows the user to assign a specific dowser flag location. Upon a change in value, the dowser flag will rotate to that new location. Locations are continuously addressable from 0% (no light emitted—flag completely blocks port) to 100% (all light emitted—no blocking occurs).

Both port capacity and porting practices affect, perhaps significantly, the minimum percentage at which light will pass into the fiber and the maximum percentage at which no light is blocked for the fiber. For example, a 300-fiber system may begin emitting light at 3% whereas a 25-fiber system may not emit any light until 25% or higher.

Color Wheel Rotational Behavior—DMX Channel Assigned + 2

This function allows the user to switch control of the color wheel between a directly assigned value (as described above) and continuous forward rotation. With this value set via the DMX controller at or between 0% and 10%, the color wheel obeys the value of the Color Wheel Position parameter (see above). If this value is set at or above 11%, the color wheel rotates continuously. A setting of 11% yields slow rotation (3/4 r.p.m); a setting of 100% yields rapid rotation (15 r.p.m). The wheel rotates forward only.

How To Order

The DMX option is ordered by including the suffix of –DX or –DXLR to the part number of illuminator models 404, 405N, 601, and 602. There are a few special conditions to consider, as described below.

XLR?

The –DXLR part designation is used when 5-pin XLR connectors are required. These connectors are the standard, used throughout the entertainment industry for the rapid connection and disconnection of DMX controlled units. XLR connectors are cannon-style male/female pairs. If ordered, the *DMX In* is the male connector and *DMX Out* is the female connector. XLR connectors for DMX control (–DXLR option) are typically used in temporary installations only. Permanent installations usually opt for hardwire connections (–DX option).

Bow Tie vs. Claw

There are two shapes of dowser flags used in Fiberstars™ illuminators. Their shape distinguishes them—one is similar to a bow tie, the other is like a radial claw. Either will work for a system, however one is usually preferred over another. For side-emitting systems, the bow-tie shape is preferred. For end-emitting systems where individual fibers are seen (LightlyExpressed™ products and star points, for example), the claw dowser is preferred. If a claw dowser is preferred, add /CLAW to the part number (–DX/CLAW, for example).

NOTE: when using a dowser, you may not get absolute darkness in the fiber due to miniscule light bleed.

Colors

DMX systems use color wheels with eight segments. All eight segments must be used, and multiple, adjacent segments can have the same color. For example, if you only want two colors, you alternate the colors in three different ways: A-B-A-B-A-B-A-B, or A-A-B-B-A-A-B-B, or A-A-A-A-B-B-B-B. If you want white light, be sure to include a *clear* filter segment. Consult your Fiberstars™ binder for available colors.

What IS Required but IS NOT Included

Your Fiberstars™ illuminators are one part of a system (see Figure 1 above). The following sections describe other components required in order to operate your DMX controlled illuminators.

1. DMX Controller

The DMX controller is the *brain* of the system. It commands the other components to take action, such as change color or down closed. Often controllers have memory systems to store various profiles that it then plays back on command. Some controllers have touch screen user interfaces, some have no interfaces. There are many, many different kinds of DMX controllers, each with advantages. Note that any controlling device that conforms to DMX512 protocol and outputs three adjacent DMX channels can control Fiberstars™ DMX illuminators. Also, note that DMX enabled illuminators require a DMX controller to operate—there is no built-in program.

2. Data Cable

Description

The controller information, in the form of digital serial signal, is transmitted from the controller to the first illuminator, and then to each subsequent illuminator, by means of electrical wires bundled together into one cable. The exact requirements of the cable are described in detail in the DMX Standard issued by USITT. Please consult that document for full details.

Generally, the cable should be:

- Designed for RS485/EIA485
- One or more twisted pairs
- Foil and braided shield
- 22 gauge or bigger
- Low capacitance
- Nominal impedance of 120 ohms

Cables used in many installations (but not necessarily suitable for your application!):

- 9729
- 8102
- 9829
- 9842
- and others

4 Wires, 2 Are Used

The DMX standard calls for four wires and a foil/braided shield to transmit the signal from the controller. Each conductor has a specific use and purpose. In a few systems, all five conductors will actively convey signal. Fiberstars™ systems (as with most systems) only use the three primary conductors (wires 1 and 2, and the shield). If you are unsure about how many conductors to use, consult your control system designer or electrical engineer, or simply use all five conductors.

XLR Connectors Recommended for Portable Systems

In a permanently installed system, the data-cable terminations are usually hardwired. In temporary installations, such as a live-performance theater show, XLR connectors may be preferable in order to connect and disconnect the data cables more rapidly. Check with your engineer, system designer, or electrical inspector to verify if connectors are preferable and permitted in your application.

3. Terminator(s)

To complete a DMX system, the signal must be properly terminated. This is accomplished by installing a 120-Ohm, ¼-watt resistor between Pins 2 and 3 (DATA + and DATA – wires), **after** the last DMX device on the chain. This resistor serves as a drain, soaking up excess signal and preventing signal *echoes* on the line.

In –DXLR systems, it is convenient to build a *termination plug*, which is a male 5-pin XLR connector with the 120-Ohm, ¼-watt resistor between Pins 2 and 3. This plug is inserted into the *DMX Out* port of the last illuminator only.

If your system includes branch circuits (which must be optically isolated—see Optical Isolation and Splitting on page 10) every branch must be independently terminated.

Installation

1. Mount all units per manufacturer's instructions

2. Connect Data Cable

Pin-outs

Not all cable color schemes are the same. **Be certain to maintain pin-to-pin continuity throughout every line.** Regardless of color scheme, pin one must always connect to pin one, pin two must always connect to pin two, etc. This is **extremely** important. See the following color scheme typical for Fiberstars™ DMX option:

Pin	Purpose	Fiberstars™ Wire Color	DMX Cable
1	Ground	Black	Shield
2	Data –	Green	Conductor 1
3	Data +	Red	Conductor 2
4	(Not used in Fiberstars™ systems)		
5	(Not used in Fiberstars™ systems)		

Table 1

Most Problems Occur Here

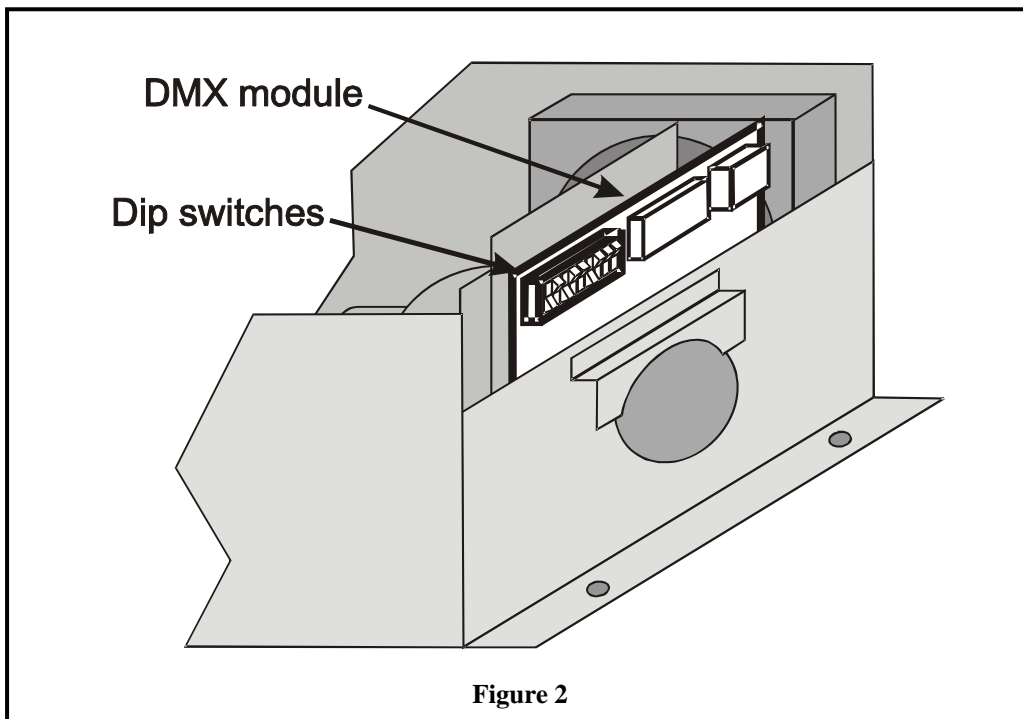
Virtually every installation error in DMX systems has occurred in the wiring. It is **critical** to maintain proper continuity across each pin. If anything fails to operate properly, check your continuity!

3. Assign Addresses

Fiberstars™ illuminators, like most DMX receivers, respond to a given set of DMX commands. The illuminators operate on a *base address* convention. This means that the user sets one address, or DMX channel, as the first channel, and that channel along with the next two are reserved for that illuminator. If the base address of an illuminator is 10, then the illuminator responds to channels 10, 11, and 12. If the base address is set to 11, then that illuminator responds to channels 11, 12, and 13.

Location of DIPswitches

The base address is set via a series of DIPswitches located on the DMX module inside the illuminator. To access the switches, disconnect power to the illuminator, open the cover, and find the DMX module near the port end of the unit. The DIPswitches are in the upper left corner of the front of the DMX module.



Binary Number System

DIP switches are a computer device and as such use a binary number system (0-1). This is different and potentially confusing since we are more accustomed to a decimal number system (0-9). To set the illuminator to a certain base address, you must add the values of the numerous switches. Use the following table to understand the value of each switch.

Switch	1	2	3	4	5	6	7	8	9
Value	+1	+2	+4	+8	+16	+32	+64	+128	+256

Table 2

To set the number 37, for example, turn on switch 6, 3, and 1 ($32 + 4 + 1 = 37$). See below and the next page for more info and a drawing of this configuration.

Switch Direction

The value of the switch is added when the switch is depressed on the top. Remember: Up=On=True=1, 2, 4, 8, 16, 32, etc. Fiberstars™ illuminators use *base-one* numbering, meaning that if all switches are down the channel set is zero, which is void. At least one switch must be in the up position.

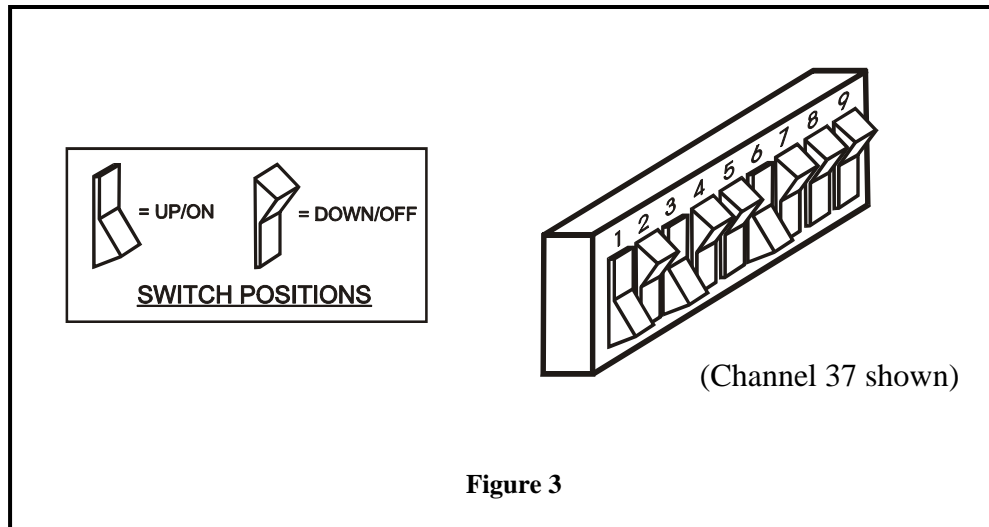


Figure 3

Use Unique Channels Per Illuminator

DMX512 recommends that each device use a unique block of addresses. It is not recommended to share addresses, though there are many successful installations where addresses were shared. To be safe, plan to provide three unique DMX addresses for each illuminator you plan to control. For example, if you are controlling five illuminators, you should provide a minimum of 15 channels.

4. Power Up Reset and Calibration

Every illuminator with the DMX option goes through a start-up routine every time power is applied to the unit. This routine happens automatically and lasts less than one minute. During this routine, the illuminator calibrates the color wheel and dowsers for proper operation. After making any changes to the DMX module, you must allow the illuminator to complete this start-up routine in order for the changes to take effect.

Can appear to be out-of sync—restart program cycle

Depending on the design and programming of your system, if one illuminator is reset and the others are not, or the illuminators are not reset simultaneously, color wheels may appear to be uncoordinated. This is caused by a program sequence using continuous rotation at a set rate. When one illuminator is removed from that synchronization and the others continue to move forward, synchronization is lost. To reset, command your controller to stop and then restart the sequence.

Control System Design Suggestions

Number of DMX Channels

We recommend three unique channels per illuminator. This complies with the DMX512 protocol and offers the greatest flexibility in programming; however, many installations have successfully used the same three channels for all illuminators in the system.

Number Of DMX Devices

The protocol recommends that no more than 32 devices (illuminators) be connected to any one branch; however, many installations have successfully connected more than 32 illuminators. If multiple braches are used, you must use an optical splitter (see below).

Data Cable Length

The total recommended length depends on the cable used. For an exact answer, contact your control system designer or electrical engineer. In most applications, a total length of 1,000 feet or less is acceptable. This includes the cable from the controller to the first illuminator, from the first illuminator to the second, from the second to the third, and so on. Remember, data cables cannot be *y-spliced* without optical isolation (see below).

If additional length is desired, or to have branches, you must use an optical splitter (see below).

Optical Isolation and Splitting

What Are They?

- Opto-Isolator—a device that prevents a corrupt signal from reflecting back into the control wire. This device is often incorporated into the other devices below, and can be used to isolate any single circuit.
- Opto-Splitter—a device that successfully distributes the DMX signal into multiple isolated paths. Use this device at every branch in a DMX circuit. Terminate every branch.
- Opto-Repeater/Amplifier—a device that boosts the strength of the DMX signal. Use this if your branch cable length exceeds 1,000 feet.

Why Use Them?

- DMX control cable must be daisy-chained (unless optical splitters installed)
- Total length not to exceed 1,000 feet (per leg if optical splitter/amplifiers installed)
- There may be no more than 32 devices (illuminators) per leg. If you have more than 32 illuminators, split the control into multiple branches with an optical splitter.
- Greatly simplifies larger installations by isolating faults
- Protects the controller and other legs from disruptions in one leg

Remember: Terminate every Leg!

(NOTE: In hardwired installations, both the cable from the DMX controller and the cable to the next illuminator are landed on the leads of one illuminator. This does—by definition—create a very short branch circuit, and this is the **only** instance in which a branch circuit is allowed. Do not add cable to the leads coming from the illuminator, or introduce any other branch circuitry.)

Troubleshooting

If any illuminator exhibits strange control behavior, there are two steps for correcting a problem:

Cycle Power to Reset Illuminators

- Power Down All Components
- Wait 3 Minutes
- Restore Power to controller
- Wait 1 Minute
- Restore Power to illuminators
- Wait 1 Minute
- Initiate Program/Test

Verify the Wiring

- Nearly all problems are found in improper wiring!
- Verify continuity on all pins 1, 2, and 3
- Verify that each branch circuit (if any) is protected by an opto-splitter and is properly terminated

Summary

Attribute Functions

- DMX Channel Selected—Color Wheel Position
- DMX Channel Selected + 1—Dowser Flag Position
- DMX Channel Selected + 2—Color Wheel Rotation Behavior

Ordering Options

- -DXLR—for temporary installations
- /CLAW—for all end-emitting systems
- Colors—select eight colors (including *Clear* if desired) in proper sequence at time of order

Required Equipment By Others

- DMX Controller—must comply with USITT DMX-512 and provide three adjacent channels for illuminator use
- Cable—9729, 8102, 9829, 9842, (and others) may be appropriate.
- Terminators—120-Ohm, ¼-watt resistor between Pins 2 and 3 (DATA + and DATA – wires) on every branch

Installation

- Mount all devices per manufacturer's recommendations
- Connect data cable via daisy-chain—maintain continuity!
- Assign addresses via DIPswitches
- Reset illuminators/cycle power
- Initiate programming

System Design Suggestions

- Use 3 channels per illuminator
- Use no more than 32 illuminators per leg
- Limit cable to less than 1,000 feet per leg
- Optically split and isolate every leg
- Terminate every leg