

## Table of Contents

<b>Warranty and Disclaimer</b>		2
<b>Introduction</b>		3
<b>DMX512 Output</b>		4
<b>Physical Dimensions</b>		
Board Layout		5
<b>Usage</b>		
Connectors		6
Address switch		7
Setting the configuration jumpers		9
Expansion board		10
Ground referenced transmitter		11
Setting up the DMX loop through		12
<b>Troubleshooting</b>		
Ground, termination, LED		15
<b>Some notes on DMX512</b>		
Splitters, terminators		17
Wire type, cable length, connectors		18
<b>Mini DIP address settings</b>	1-256	20
	257-512	21

---

## ***Warranty and Disclaimer***

### **Warranty**

Northlight Systems warrants this product against defects in materials and workmanship for a period of 1 year.

### **Returns Policy**

If there is a defect, we will repair or replace the product at our discretion.

We offer a full refund on the purchase price if returned in original, unused and “like new”, condition in less than 30 days.

Return the product with a description of the problem. Free repairs are for defective parts or workmanship only.

Repairs due to improper hookup, over voltage, short circuits, physical damage etc., will be charged to the customer.

### **Disclaimer of Liability**

Northlight Systems is not responsible for any special, incidental, or consequential damages resulting from any breach of warranty, or any legal theory, including lost profits, downtime, goodwill, damage to or replacement of equipment or property, and any costs associated with the use of Northlight Systems products described herein.

Northlight Systems has a policy of continually improving our products as new technology becomes available. Northlight Systems reserves the right to make changes and improvements to the specifications of this equipment at any time without notice.

Northlight Systems has made every attempt to ensure that the information in this document is accurate and complete. Northlight Systems assumes no liability for any damages that result from the use of this manual or the equipment it documents. Northlight Systems reserves the right to make changes to this document at any time without notice.

### **Contact**

Northlight Systems  
1247 E. Valerie Drive  
Tempe, AZ 85281

Voice 480 429-0577

## **16 Channel DMX512 Encoder with DMX Merge**

The ENCM48 board accepts analog 0 -10 VDC input and a DMX512 data stream from another source. The analog voltage is combined with the DMX512 input to create a single DMX512 output.

The analog voltage is converted to 255 discrete levels.

Use to upgrade 0-10 volt analog lighting consoles, or add your own switches and pots to create custom controls for lighting, home or building automation.

### **SPECS:**

**Analog input:** 0 -10 VDC. This board expects a conditioned signal. If the encoder board is to be used in a noisy environment, external signal conditioners should be used.

**DMX512 input:** Accepts DMX512 digital stage lighting protocol up to 512 channels. Only DMX packets with a zero start code will be accepted. Non-zero start code packets will be ignored.

If non-zero start codes and DMX512 utilizing talk back capability is needed for other DMX receivers down stream from the Encoder, then a separate DMX through connector should be used for those devices.

**Address switch:** Address selection is via a 9 position mini DIP switch or push button BCD switch.

### **Power requirements:**

8 to 12 volts DC @ 80 mA.

**Board connections:** Power and DMX output connections to the board are made via screw terminal blocks. Acceptable wire size is 18 – 24 AWG. See drawing for connector locations.

**Input channel assignment:** The Main board is input channels 1 – 16. The expansion board is channels 17 – 48.

**DMX output signal details:**

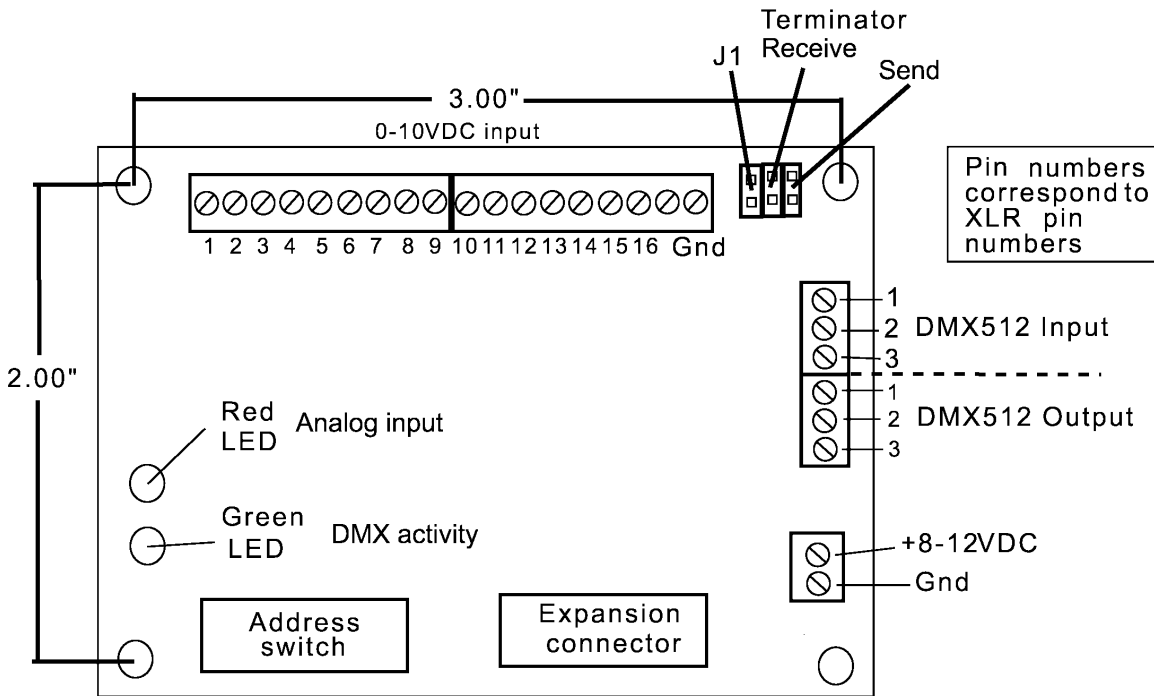
**Output is compliant DMX512A protocol.**

250 Kbaud                    4us/ bit  
 Start code:                    0  
 Break Length:                200 us  
 Mark after Break            100 us  
 Inter frame time            40 us  
 Output channels            16 + start address or up to 512 using DMX512 input

Note that the timings are not as fast as the protocol allows. This should accommodate all compliant receivers.

**Physical Dimensions:**

Overall 3.25" X 2.25"



Please note Gnd = signalground/common NOT earthground.

## **Using the Encoder**

### **Power Input**

8 to 12 volts DC.  
Average idle current for the 16 channel encoder is 80 milliAmps.  
The total current is based on the DMX512 load. Generally when the DMX output is terminated the current will increase by up to 15 milliAmps.  
Generally a current of 150 milliAmps should cover all the bases.

### **Ground**

The ground connector is the common signal ground.

### **Analog Inputs**

Input is an analog voltage spanning 0 - 10 VDC @10mA.  
This should be a smooth DC voltage with no noise or ripple. Any imperfections in the input voltage will be reflected in the DMX512 output.

**Red analog in LED:** When the voltage on any of the input channels is over .DMX level 3, the red LED will turn on. If the LED flashes or does not lite up there is a problem with the input voltage. Check the signal ground. Make sure the input is not even a little over 10 volts.

**Green DMX512 signal LED:** Steady on indicates valid input DMX512 signal, flashing or dim indicates no signal or invalid signal.

### **DMX512 In**

The DMX input pin numbers correspond to the XLR pin numbers.  
The ground pin(1) is signal ground – not earth ground.  
Pins 4 and 5 are not used.

<b>PIN</b>	<b>WIRE</b>	<b>SIGNAL</b>
1	shield	ground/return
2	signal	data compliment ( - )
3	signal	data true ( + )
4	signal	not used
5	signal conductor	not used

### **Address Switch**

The address switch is used to determine the starting channel of the analog input, in the DMX512 output data stream.

For example if the start address is 1 then the analog input data will be output from channels 1 - 16.

A start address of 8 will output analog data on channels 8 – 24 in the DMX transmit data stream.

The address switch has no effect on the incoming DMX512 data. The incoming DMX512 will be output in its original form except where it overlaps the analog input voltage.

When the incoming DMX and analog inputs overlap the final output will be determined by the configuration jumper settings..

To avoid overlapping the incoming DMX and the analog input one would usually address the analog voltage to be output after the incoming DMX.

Two switch options are offered, the Mini DIP switch and the Push button switch. When using the mini DIP switch, the address is entered in the standard binary code starting with 0. See the chart of all 512 switch positions at the back of this manual.

The individual switches are numbered 1 – 9 , left to right, on the switch. On the switches, Up position is off, Down is on.

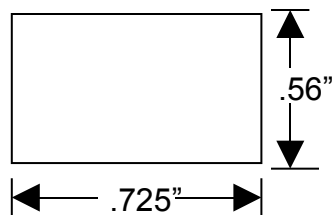
The Push button address switch is a snap fit for a panel up to .13” thick.

The switch connects to board via 14 pin ribbon cable. The ribbon cable is installed with the ribbon going away from the board.

When using the Push button switch, set the starting address to the first in a group of 16. Start with address 1, up to 511.

#### Switch mounting

Mounting for Push button switch



The BCD switch ribbon cable is connected as shown below

**Using the Configuration Jumper**

**J1** – Determines the DMX output in the event of DMX receive signal loss.

**Open**(no jumper) – When the DMX receive is lost the Encoder will hold and continue to output the last valid data.

**Closed**(jumper in place) – When the DMX receive is lost, the last valid input data will be cleared after 1 second of no valid DMX. Subsequent DMX output will be zero's.

**Expansion board**

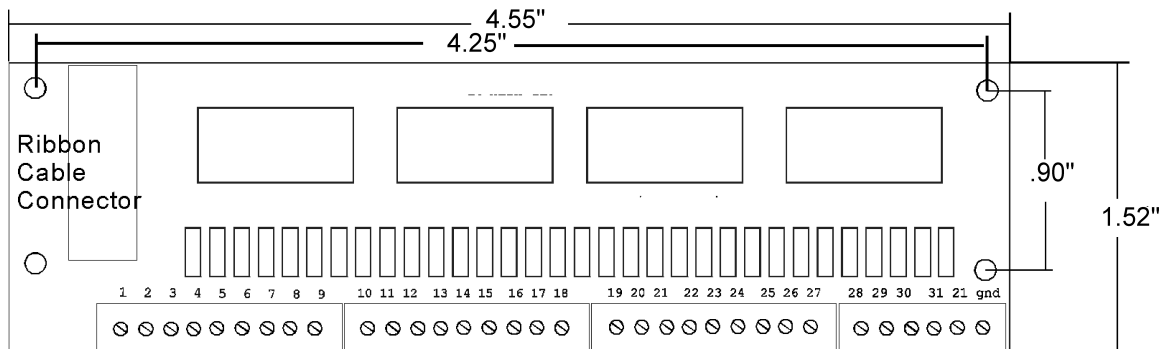
The 32 channel expansion board has the same input requirements as the main Encoder board.

The expansion board is automatically detected by the main Encoder board when it is connected via the IDC ribbon cable.

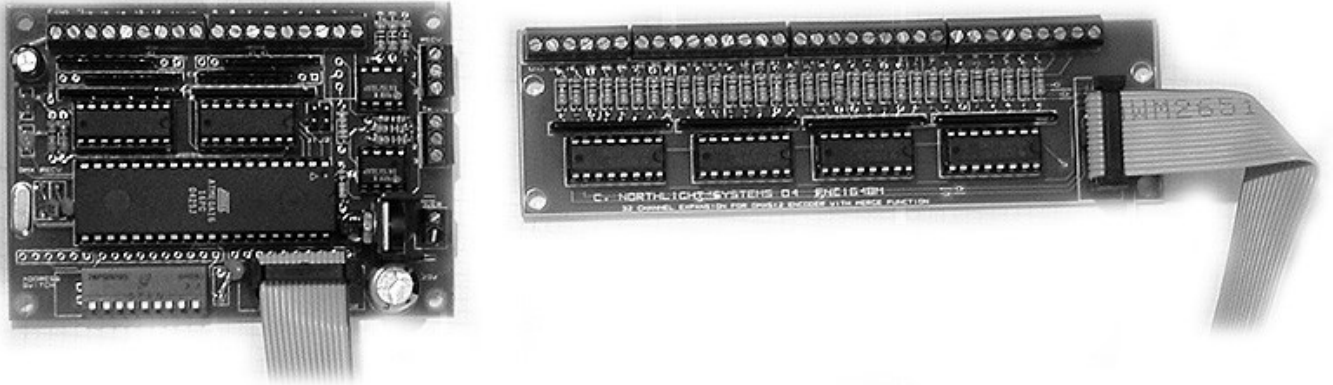
With the expansion board oriented as shown below, the input channels are 17 – 48, left to right.

Input 17 ----- 48 Gnd

**Connection**



The ribbon cable is connected as shown below.



### Earth ground connection

The DMX512 standard has changed over time from the original version. Originally, connecting pin 1 to earth ground was not specified.

The latest DMX version recommends use of earth ground referenced transmitting devices and isolated receiving devices.

Older devices that do not use a ground referenced transmitter are “legal”.

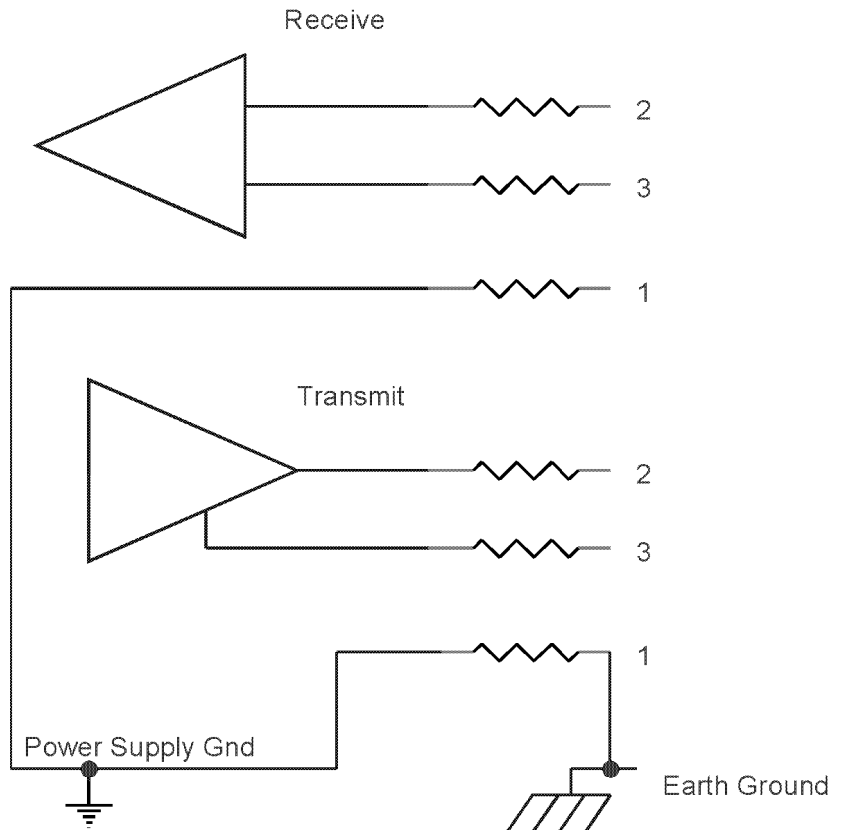
The normal configuration for the Encoder is to not use the earth ground.

The encoder is wired with the 0 volt power supply (circuit common), connected to both the receiver and transmitter.

The ground, pin 1, will be at the same potential for the receiver and transmitter.

The DC power supply should not have the 0 volt power supply connected to earth ground.

The equivalent circuit of the transmitter and receiver is shown in the figure below. The resistor values are 10 Ohms.



Setting up the DMX loop through connectors

The current DMX512 standards require one to provide passive loop through connectors.

The specific description is below:

**Secondary data link - passive loop through ports**

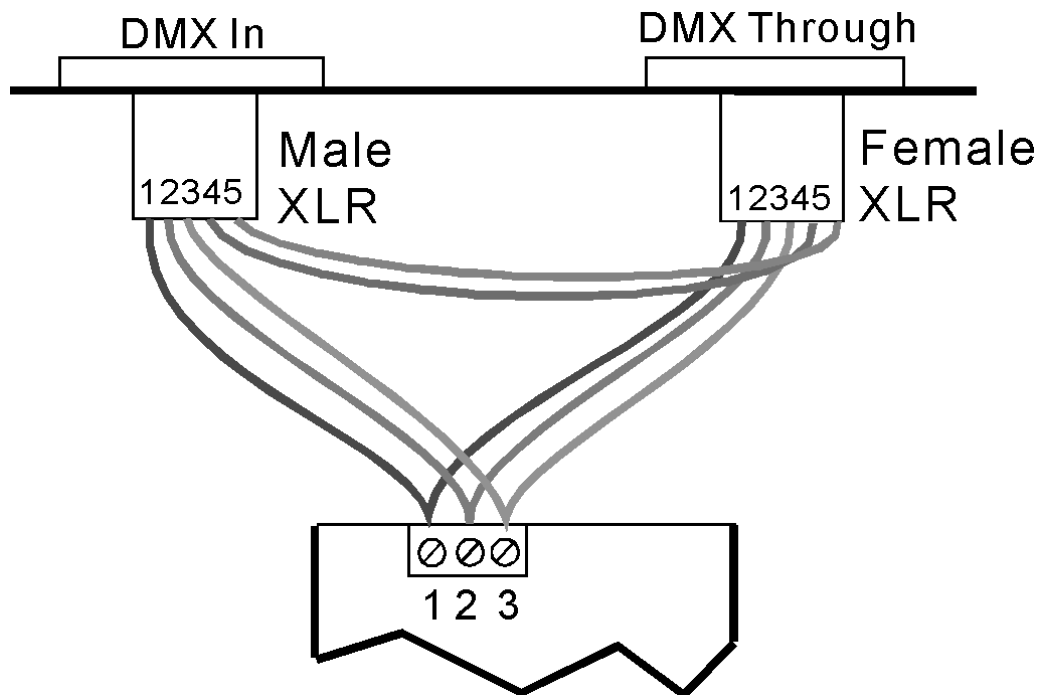
Devices containing two DMX512 ports, one for receive and one for transmit, ....., shall provide a direct passive link for all pins between the two ports.

Equipment designers are encouraged to provide passive loop through on Pins 4 and 5 whenever possible, even if not required.

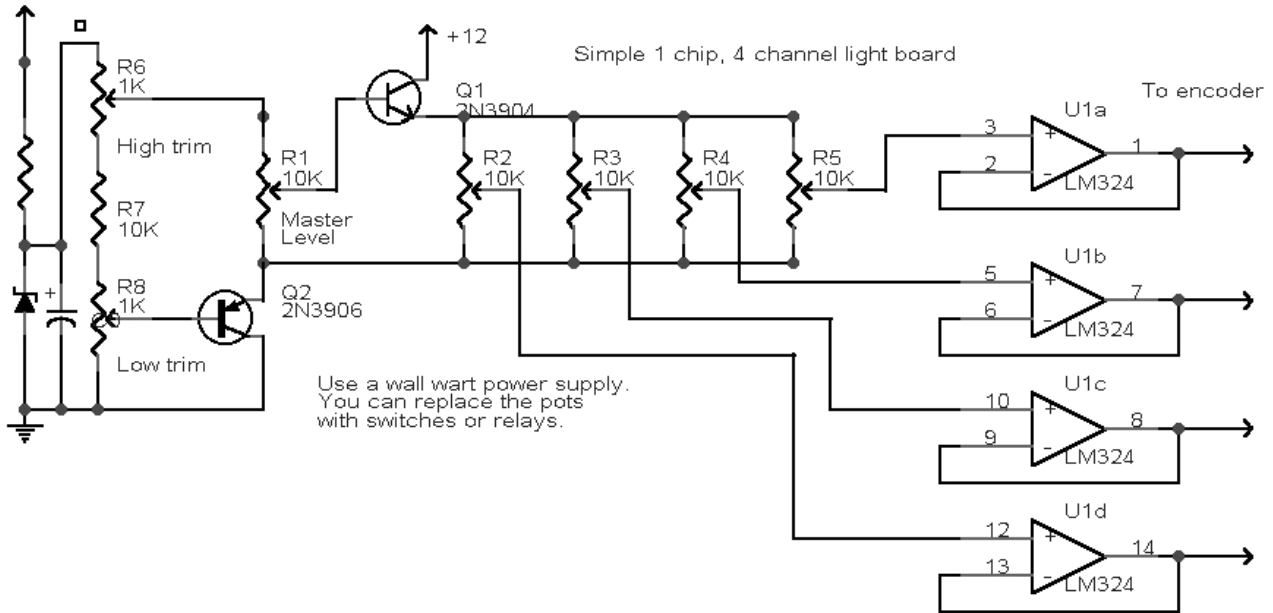
The Encoder will not accept DMX512 with non-zero start codes and will not accept DMX512 that uses pins 4 and 5.

If devices that use non-zero start codes or pins 4 and 5 are needed then a loop through connector is required.

The drawing below shows a typical installation for a DMX512 input and loop through connection.



Typical input circuit



## Trouble shooting

Basically the board is plug and play. There are no user adjustments. When all connections are properly made, a DMX signal, proportional to the input voltage will be present at the output pins.

**Signal Ground:** The input circuit signal ground, should be connected first.

### Termination:

If the Encoder board is the last one on the DMX link a jumper for the terminating resistor can be installed on the PC board.

It is possible to “over terminate”. In other words make sure there is only 1 terminator on the end of the DMX line. Some devices have internal terminators, double check the settings.

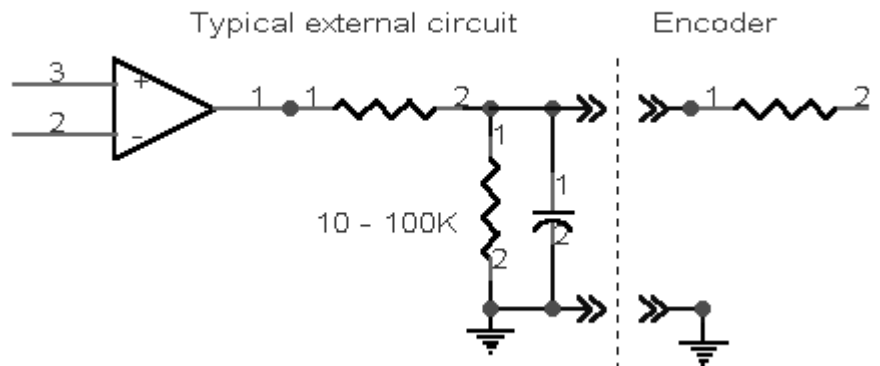
If there is no DMX and the green LED is not blinking, then a the terminator jumper should be used.

Terminators on the transmitter end are not usually required.

**Erratic output:** This problem can be hard to track down. First check the input signal quality and voltage. If the input voltage goes over 10 VDC, the output may be erratic.

Another potential problem here is the user circuit interface.

It is important that the ground from the external ground be connected first. The input maximum voltage is 10 VDC. Higher voltages may damage chips.



**Misc:** Good solid connections are a must. The micro screw terminals provide good connections. However the screws can be stripped by over tightening.

DMX512 signal wires should be twisted together all the way to the connector.

## Some notes about DMX512

DMX 512 is a digital communications protocol that specifies a set of requirements for transmitting and receiving digital signals between lighting controllers and dimmers. There are 2 main components to this spec. The Data

Protocol is the meaning of the bits and bytes that are transmitted. Northlight's Encoder is compliant with the full requirements of the Data Protocol. There is a certain amount of flexibility in the signal timing, Northlight's Encoder is capable of receiving data at the full data rate specified.

The other component of DMX512 is the Electrical Specifications. The hardware electrical specs are listed in EIA-485, commonly referred to as the RS-485 specs. The RS-485 standard, specifies only the electrical characteristics of the driver and the receiver to be used at the line interface. Northlight's Encoder is compliant with RS-485. Each Encoder represents less than 1 node load to the system.

RS485 is a data transmission system using balanced differential signals. That is 2 signal wires and signal ground. 3 wires are required.

### **Splitters/Repeaters**

Isolation between the console and dimmers is sometimes required to prevent signal degradation and protect devices from damaging voltages on the control cable. Optically isolated splitters help avoid these problems.

Each DMX512 output can drive up to 32 devices. If there are more devices on the line, a "repeater" or "booster" is required. Some cheap devices are not fully compliant and actually represent a load equivalent to 2 or more devices.

Long or improper cables, electrically noisy environment (generators, motors) and improper use of passive "Y" splitters all contribute to DMX signal degradation. A repeater/booster may help to solve these problems.

### **Why ask WYE?**

Wye(Y) splitters are NOT recommended for DMX512 systems. Wye splitters are simply a male inline XLR connector; parallel wired to 2 female inline XLR's. While convenient, Wye splitters cause unwanted signal reflections and possible ground loops, leading to signal degradation.

The best layout for DMX systems is a Daisy chain configuration, where the signal cable jumps from one device to the next, with no branching. Each chain can have up to 32 devices on it. When using an isolated splitter, each output can be a separate DMX daisy chain.

### **Termination**

A common problem with DMX systems is improper termination.

A simple terminator consists of a 120 Ohm resistor connected across pins 2-3 of the DMX signal. More complex terminators utilize voltage spike protection and BI-color LED's to indicate signal integrity.

Terminators are an impedance matching circuit required to damp signals that "reflect" from the end of an improperly terminated cable, causing signal degradation under certain conditions.

On devices that have a DMX thru, a male XLR connector with terminating resistor connected across pins 2-3 and installed on the DMX thru connector will suffice. Some devices with isolated outputs will not use a terminator on the DMX out. These usually have an internal terminator that is selected with a switch.

**Wire Type**

There is a difference between microphone cable and “Data” cable. Sure you can get away with mic. cable for short runs in many situations. However on longer runs or marginal situations mic. cable will let you down. You may have random errors or the system won’t work at all. It comes down to insurance. If you want to insure the most reliable DMX signal distribution you need the most appropriate wire for the job. DMX512 requires wire suitable for RS-485, there is no way to get around that.

Twisted-pair cable is the most common. You can use a range of wire gauges, but the most common is 22 – 24 AWG. The characteristic impedance of the cable should be 100 to 120 Ohms.

Some other requirements are, at least 1 twisted pair plus ground and shield. It should have low capacitance and overall braid and foil shield.

**Data Rate VS Cable Length**

At 250K bits per second the max. cable length is about 1000 feet for DMX512 in good conditions.

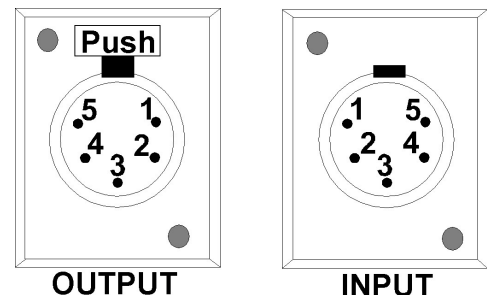
**Connectors**

DMX512 protocol specifies that 5 pin XLR connectors are used. Female on the transmitter and male on the receiver.

When a 3 pin XLR is used it is wired the same as the first 3 pins on the 5 pin XLR.

<b>PIN</b>	<b>WIRE</b>	<b>SIGNAL</b>
1	shield	ground/return
2	signal	data compliment ( - )
3	signal	data true ( + )
4	signal	spare data compliment ( - )
5	signal conductor	spare data true ( + )

Conductors 2/3 and 4/5 should be twisted together.



## Northlight Systems

Ch# Dip Switch On	Ch# Dip Switch On	Ch# Dip Switch On	Ch# Dip Switch On
1 = 0	65= 7	129 = 8	193 = 7,8
2 = 1	66= 1,7	130 = 1,8	194 = 1,7,8,
3 = 2	67= 2,7	131 = 2,8	195 = 2,7,8,
4 = 1,2	68= 1,2,7	132 = 1,2,8	196 = 1,2,7,8
5 = 3	69= 3,7	133 = 3,8	197 = 3,7,8
6 = 1,3	70= 1,3,7	134 = 1,3,8	198 = 1,3,7,8
7 = 2,3	71= 2,3,7	135 = 2,3,8	199 = 2,3,7,8
8 = 1,2,3	72= 1,2,3,7	136 = 1,2,3,8	200 = 1,2,3,7,8
9 = 4	73= 4,7	137 = 4,8	201 = 4,7,8,
10 = 1, 4	74= 1,4,7	138 = 1,4,8	202 = 1,4,7,8
11 = 2,4	75= 2,4,7	139 = 2,4,8	203 = 2,4,7,8
12 = 1,2,4	76= 1,2,4,7	140 = 1,2,4,8	204 = 1,2,4,7,S
13 = 3,4	77= 3,4,7	141 = 3,4,8	205 = 3,4,7,8
14 = 1,3,4	78= 1,3,4,7	142 = 1,3,4,8	206 = 1,3,4,7,8
15 = 2,3,4	79= 2,3,4,7	143 = 2,3,4,8	207 = 2,3,4,7,8
16 = 1,2,3,4	80= 1,3,4,7	144 = 1,2,3,4,8	208 = 1,2,3,4,7,8
17 = 5	81= 5,7	145 = 5,8	209 = 5,7,8
18 = 1,5	82= 1,5,7	146 = 1,5,8	210 = 1,5,7,8
19 = 2, 5	83= 2,5,7	147 = 2,5,8	211= 2, 5,7,8
20 = 1,2,5	84= 1,2,5,7	148 = 1,2,5,8	212 = 1,2,5,7,8
21 = 3,5	85= 3,5,7	149 = 3,5,8	213 = 3,5,7,8
22 = 1,3,5	86= 1,3,5,7	150 = 1,3,5,8	214 = 1,3,5,7,8
23 = 2,3,5	87= 2,3,5,7	151 = 2,3,5,8	215 = 2,3,5,7,8
24 = 1,2,3,5	88= 1,2,3,5,7	152 = 1,2,3,5,8	216 = 1,2,3,5,7,8
25 = 4,5	89= 4,5,7	153 = 4,5,8	217 = 4, 5,7, 8
26 = 1,4,5	90= 1,4,5,7	154 = 1,4,5,8	218 = 1,4,5,7,S
27 = 2,4,5	91= 2,4,5,7	155 =2,4,5,8	219 = 2,4,5,7,8
28 = 1,2,4,5	92= 1,2,4,5,7	156 = 1,2,4,5,8	220 = 1,2,4,5,7,8
29 = 3,4,5	93= 3,4,5,7	157 = 3,4,5,8	221 = 3,4,5,7,8
30 = 1,3,4,5	94= 1, 3,4,5,7	158 = 1,3,4,5,8	222 = 1,3,4,5,7,8
31 = 2,3,4,5	95= 2,3,4,5,7	159 = 2,3,4,5,8	223 = 2,3,4,5,7,8
32 = 1,2,3,4,5	96= 1,2,3,4,5,7	160 = 1,2,3,4,5,8	224 = 1,2,3,4,5,7,8
33 = 6	97= 1,6,7	161 = 6,8	225 = 6,7,8
34 = 1,6	98 = 1,6,7	162 = 1,6,8	226 = 1,6,7,8
35 = 2,6	99 = 2,6,7	163 =2,6,8	227 = 2,6,7,8
36 = 1,2,6	100 = 1,2,6,7	164 =1,2,6,8	228 = 1,2,6,7,8
37 = 3,6	101 = 3,6,7	165 =3,6,8	229 = 3,6,7,8
38 = 1,3,6	102 = 1,3,6,7	166 = 1,3,6,8	230 = 1,3,6,7,8
39 = 2,3,6	103 = 2,3,6,7	167 = 2,3,6,8	231 = 2,3,6,7,8
40 = 1,2,3,6	104 = 1,2,3,6,7	168 = 1,2,3,6,8	232 = 1,2,3,6,7,8
41 = 4,6	105 = 4,6,7	169 = 4,6,8	233 = 4,6,7,8
42 = 1,4,6	106 = 1,4,6,7	170 = 1,4,6,8	234 = 1,4,6,7,8
43 = 2,4,6,	107 = 2,4,6,7	171 = 2,4,6,S	235 = 2,4,6,7,S
44 = 1,2,4,6	108 = 1,2,4,6,7	172 = 1,2,4,6,8	236 = 1,2,4,6,7,8
45 = 3,4,6	109 = 3,4,6,7	173 = 3,4,6,8	237 = 3,4,6,7,8
46 = 1,3,4,6	110 = 1,3,4,6,7	174 = 1,3,4,6,8	238 = 1,3,4,6,7,8
47 = 2,3,4,6	111 = 2,3,4,6,7	175 = 2,3,4,6,8	239 = 2,3,4,6,7,8
48 = 1,2,3,4,6	112 = 1,2,3,4,6,7	176 = 1,2,3,4,6,8	240 = 1,2,3,4,6,7,8
49 = 5,6	113 = 5,6,7	177 = 5,6,8	241 = 5,6,7,8
50 = 1,5,6	114 = 1,5,6,7	17S = 1,5,6,8	242 = 1,5,6,7,8
51 = 2,5,6	115 = 2,5,6,7	179 = 2,5,6,8	243 = 2,5,6,7,8
52 = 1,2,5,6	116 = 1,2,5,6,7	180 = 1,2,5,6,8	244 = 1,2,5,6,7,8
53 = 3,5,6	117 = 3,5,6,7	181 = 3,5,6,8	245 = 3,5,6,7,8
54 = 1,3,5,6	118 = 1,3,5,6,7	182 = 1,3,5,6,8	246 = 1,3,5,6,7,8
55 = 2,3,5,6	119 = 2,3,5,6,7	183 = 2,3,5,6,8	247 = 2,3,5,6,7,8
56 = 1,2,3,5,6	120 = 1,2,3,5,6,7	184 = 1,2,3,5,6,8	248 = 1,2,3,5,6,7,8
57 = 4,5,6	121 = 4,5,6,7	185 = 4,5,6,8	249 = 4,5,6,7,8
58 = 1,4,5,6	122 = 1,4,5,6,7	186 = 1,4,5,6,8	250 = 1,4,5,6,7,8
59 = 2,4,5,6	123 = 2,4,5,6,7	187 = 2,4,5,6,8	251 = 2,4,5,6,7,8
60 = 1,2,4,5,6	124 = 1,2,4,5,6,7	188 = 1,2,4,5,6,8	252 = 1,2,4,5,6,7,8
61 = 3,4,5,6	125 = 3,4,5,6,7	189 = 3,4,5,6,8	253 = 3,4,5,6,7,8
62 = 1,3,4,5,6	126 = 1,3,4,5,6,7	190 = 1,3,4,5,6,8	254 = 1,3,4,5,6,7,8
63 = 2,3,4,5,6	127 = 2,3,4,5,6,7	191 = 2,3,4,5,6,8	255 = 2,3,4,5,6,7,8
64 = 1,2,3,4,5,6	128 = 1,2,3,4,5,6,7	192 = 1,2,3,4,5,6,8	256 = 1,2,3,4,5,6,7,8

## Encode 1648M

Ch# Dip Switch On	Ch# Dip Switch On	Ch# Dip Switch On	Ch# Dip Switch On
257 = 9	321 = 7,9	385 = 8,9	449 = 7,8,9
258 = 1,9	322 = 1,7,9	386 = 1,8,9	450 = 1,7,8,9
259 = 2,9	323 = 2,7,9	387 = 2,8,9	451 = 2,7,8,9
260 = 1,2,9	324 = 1,2,7,9	388 = 1,2,8,9	452 = 1,2,7,8,9
261 = 3,9	325 = 3,7,9	389 = 3,8,9	453 = 3,7,8,9
262 = 1,3,9	326 = 1,3,7,9	390 = 1,3,8,9	454 = 1,3,7,8,9
263 = 2,3,9	327 = 2,3,7,9	391 = 2,3,8,9	455 = 2,3,7,8,9
264 = 1,2,3,9	328 = 1,2,3,7,9	392 = 1,2,3,8,9	456 = 1,2,3,7,8,9
265 = 4,9	329 = 4,7,9	393 = 4,8,9	457 = 4,7,8,9
266 = 1, 4, 9	330 = 1,4,7,9	394 = 1,4,8,9	458 = 1,4,7,8,9
267 = 2,4,9	331 = 2,4,7,9	395 = 2,4,8,9	459 = 2,4,7,8,9
268 = 1,2,4,9	332 = 1,2,4,7,9	396 = 1,2,4,8,9	460 = 1,2,4,7,8,9
269 = 3,4,9	333 = 3,4,7, 9	397 = 3,4,8,9	461 = 3,4,7,8,9
270 = 1,3,4,9	334 = 1,3,4,7,9	398 = 1,3,4,8,9	462 = 1,3,4,7,8,9
271 = 2,3,4,9	335 = 2,3,4,7,9	399 = 2,3,4,8,9	463 = 2,3,4,7,8,9
272 = 1,2,3,4,9	336 = 1,2,3,4,7,9	400 = 1,2,3,4,8,9	464 = 1,2,3,4,7,8,9
273 = 5,9	337 = 5,7,9	401 = 5,8,9	465 = 5,7,8,9
274 = 1,5,9	338 = 1,5,7,9	402 = 1,5,8,9	466 = 1,5,7,8,9
275 = 2, 5, 9	339 = 2,5,7,9	403 = 2,5,8,9	467 = 2,5,7,8,9
276 = 1,2,5,9	340 = 1,2,5,7,9	404 = 1,2,5,8,9	468 = 1,2,5,7,8,9
277 = 3,5,9	341 = 3,5,7,9	405 = 3,5,8,9	469 = 3,5,7,8,9
278 = 1,3,5,9	342 = 1,3,5,7,9	406 = 1,3,5,8,9	470 = 1,3,5,7,8,9
279 = 2,3,5,9	343 = 2,3,5,7,9	407 = 2,3,5,8,9	471 = 2,3,5,7,8,9
280 = 1,2,3,5,9	344 = 1,2,3,5,7,9	408 = 1,2,3,5,8,9	472 = 1,2,3,5,7,8,9
281 = 4,5,9	345 = 4,5,7,9	409 = 4,5,8,9	473 = 4,5,7,8,9
282 = 1,4,5,9	346 = 1,4,5,7,9	410 = 1,4,5,8,9	474 = 1,4,5,7,8,9
283 = 2,4,5,9	347 = 2,4,5,7,9	411 = 2,4,5,8,9	475 = 2,4,5,7,8,9
284 = 1,2,4,5,9	34B = 1,2,4,5,7,9	412 = 1,2,4,5,8,9	476 = 1,2,4,5,7,8,9
285 = 3,4,5,9	349 = 3,4,5,7,9	413 = 3,4,5,8,9	477 = 3,4,5,7,8,9
286 = 1,3,4,5,9	350 = 1,3,4,5,7,9	414 = 1,3,4,5,8,9	478 = 1,3,4,5,7,8,9
287 = 2,3,4,5,9	351 = 2,3,4,5,7,9	415 = 2,3,4,5,8,9	479 = 2,3,4,5,7,8,9
288 = 1,2,3,4,5,9	352 = 1,2,3,4,5,7,9	416 = 1,2,3,4,5,8,9	480 = 1,2,3,4,5,7,8,9
289 = 6,9	353 = 6,7,9	477 = 6,8,9	481 = 6,7,8,9
290 = 1,6,9	354 = 1,6,7,9	418 = 1,6,8,9	482 = 1,6,7,8,9
291 = 2,6,9	355 = 2,6,7,9	419 = 2,6,8,9	483 = 2,6,7,8,9
292 = 1,2,6,9	356 = 1,2,6,7,9	420 = 1,2,6,8,9	484 = 1,2,6,7,8,9
293 = 3,6,9	357 = 3,6,7,9	421 = 3,6,8,9	485 = 3,6,7,8,9
294 = 1,3,6,9	358 = 1,3,6,7,9	422 = 1,3,6,8,9	486 = 1,3,6,7,8,9
295 = 2,3,6,9	359 = 2,3,6,7,9	423 = 2,3,6,8,9	487 = 2,3,6,7,8,9
296 = 1,2,3,6,9	360 = 1,2,3,6,7,9	424 = 1,2,3,6,8,9	488 = 1,2,3,6,7,8,9
297 = 4,6,9	361 = 4,6,7,9	425 = 4,6,8,9	489 = 4,6,7,8,9
298 = 1,4,6,9	362 = 1,4,6,7,9	426 = 1,4,6,8,9	490 = 1,4,6,7,8,9
299 = 2,4,6,9	363 = 2,4,6,7,9	427 = 2,4,6,8,9	491 = 2,4,6,7,8,9
300 = 1,2,4,6,9	364 = 1,2,4,6,7,9	428 = 1,2,4,6,8,9	492 = 1,2,4,6,7,8,9
301 = 3,4,6,9	365 = 3,4,6,7,9	429 = 3,4,6,8,9	493 = 3,4,6,7,8,9
302 = 1,3,4,6,9	366 = 1,3,4,6,7,9	430 = 1,3,4,6,8,9	494 = 1,3,4,6,7,8,9
303 = 2,3,4,6,9	367 = 2,3,4,6,7,9	431 = 2,3,4,6,8,9	495 = 2,3,4,6,7,8,9
304 = 1,2,3,4,6,9	368 = 1,2,3,4,6,7,9	432 = 1,2,3,4,6,8,9	496 = 1,2,3,4,6,7,8,9
305 = 5,6,9	369 = 5,6,7,9	433 = 5,6,8,9	497 = 5,6,7,8,9
306 = 1,5,6,9	370 = 1,5,6,7,9	434 = 1,5,6,8,9	498 = 1,5,6,7,8,9
307 = 2,5,6,9	371 = 2,5,6,7,9	435 = 2, 5, 6, 8, 9	499 = 2,5,6,7,8,9
308 = 1,2,5,6,9	372 = 1,2,5,6,7,9	436 = 1,2,5,6,8,9	500 = 1,2,5,6,7,8,9
309 = 3,5,6,9	373 = 3,5,6,7,9	437 = 3,5,6,8,9	501 = 3,5,6,7,8,9
310 = 1,3,5,6,9	374 = 1,3,5,6,7,9	438 = 1,3,5,6,8,9	502 = 1,3,5,6,7,8,9
311 = 2,3,5,6,9	375 = 2,3,5,6,7,9	439 = 2,3,5,6,8,9	503 = 2,3,5,6,7,8,9
312 = 1,2,3,5,6,9	376 = 1,2,3,5,6,7,9	440 = 1,2,3,5,6,8,9	504 = 1,2,3,5,6,7,8,9
313 = 4,5,6,9	377 = 4,5,6,7,9	441 = 4,5,6,8,9	505 = 4,5,6,7,8,9
314 = 1,4,5,6,9	37S = 1,4,5,6,7,9	442 = 1,4,5,6,8,9	506 = 1,4,5,6,7,8,9
315 = 2,4,5,6,9	379 = 2,4,5,6,7,9	443 = 2,4,5,6,8,9	507 = 2,4,5,6,7,8,9
316 = 1,2,4,5,6,9	380 = 1,2,4,5,6,7,9	444 = 1,2,4,5,6,8,9	508 = 1,2,4,5,6,7,8,9
317 = 3,4,5,6,9	381 = 3,4,5,6,7,9	445 = 3,4,5,6,8,9	509 = 3,4,5,6,7,8,9
318 = 1,3,4,5,6,9	382 = 1,3,4,5,6,7,9	446 = 1,3,4,5,6,8,9	510 = 1,3,4,5,6,7,8,9
319 = 2,3,4,5,6,9	383 = 2,3,4,5,6,7,9	447 = 2,3,4,5,6,8,9	511 = 2,3,4,5,6,7,8,9
320 = 1,2,3,4,5,6,9	384 = 1,2,3,4,5,6,7,9	448 = 1,2,3,4,5,6,8,9	512 = not used