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Warranty and Disclaimer

Warranty

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

If the board is defective, we will, at our option, repair or replace the product. We offer a full refund on the purchase price if returned in original condition in less than 30 days.

Return the product with a description of the problem. We will return your item or its replacement using the same shipping method used to ship the product originally.

Disclaimer of Liability

Northlight Systems is not responsible for any special, incidental, or consequential damages resulting for 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.

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8 Channel, Digital Dimmer board

Features

- Allows DMX512 digital protocol or Standard serial port to control 8 solid state relay dimmers
- Outputs 255 discrete levels
- Mini DIP switch address all 512 channels.

SPECS

Input Signal: Northlight Dim08 board accepts DMX512 - 1990 as specified by USITT. The Dim08 board can receive data at the full rate. The dimmer is responsive to all 512 channels.

Dim08 can be configured to accept 9600 baud serial data using Scott Edwards Mini SSC protocol.

Output: Output is 8 channels solid state relay based AC phase control.

Address switch: Mini DIP switches.

Power requirements: 6 to 12 volts AC @ 150 mA. Max. for controller board.

LED Indicators:
Red power LED.

Green DMX512 indicator. Flashing indicates no DMX or bad DMX.
A steady bright LED indicates good DMX.
A steady but dim LED indicates bad DMX or backwards connections.

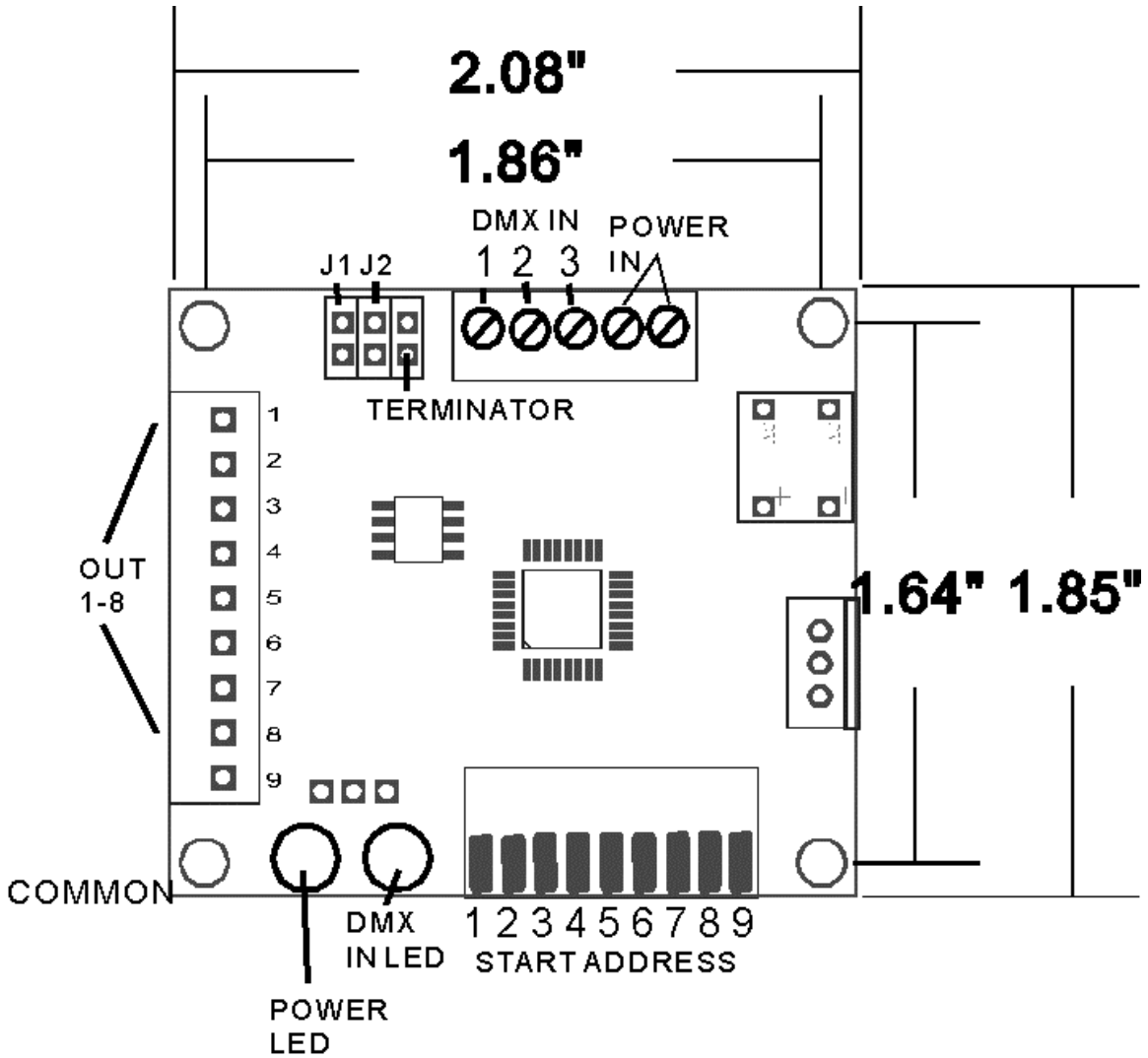
Board connections: All connections are made via screw terminals.

Physical Dimensions

2.08" L X 1.85" W +/- .10"

The **DMX input** pin numbers correspond to the XLR pin numbers.

The **Common** connector is signal ground – not earth ground.



Using the Dim08

Power Input

6 to 12 volts AC @ 150 mA. MAX current, for the board. On average the current consumption is around 60 mA.

Ground

The signal ground connector is the common signal ground – not earth ground.

DMX512 In

The DMX input pin numbers correspond to the XLR pin numbers.

Pin 1 is signal ground , not earth ground

Pin 2 is DMX512 +

Pin 3 is DMX512 -

PC Serial port

To connect a PC serial port use pin 1 for signal ground, use pin 2 for Data.

Address Switch

The individual switches are numbered 1 – 10, left to right.

On the switches, Up position is off, Down is on.

Terminator

When the jumper pins are shorted, the DMX input is terminated with a 120 Ohm resistor across DMX Input pins 2 and 3.

It is best to add a toggle switch to the front panel instead of the jumper. The switch should be labeled “In” and “Out” according to the current DMX512 standards.

Setting the address for DMX512 or PC serial port

Set the starting address to the first in a group of 8.
The address is entered on the DIP switches in standard binary code starting with 0. See the chart of all 512 address switch positions at the back of this manual. A valid address can use switches 1 – 9.
For DMX512 the address can be up 511.
For PC serial mode the address can be up to 253.

Using the configuration jumpers

There are 2 configuration jumpers on the Dim08.

J1 – Determines the output in the event of DMX signal loss. This function is not affected by the A2 setting.

Open(no jumper) – When the DMX signal is lost the Dim08 will hold and continue to output the last valid data.

Closed(jumper in place) – When the DMX signal is lost, the servo's will go to the center position.

J2 – Determines the control signal protocol. These jumpers are only checked once when the power is first applied. Changing the jumper setting will not take effect until the power has been cycled off and on.

Open(no jumper) – the Dim08 is configured to receive DMX512.

Closed(jumper in place) – The Dim08 is configured to receive Mini SSC protocol from a PC serial port @ 9600 baud.

Setting up the DMX connectors

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

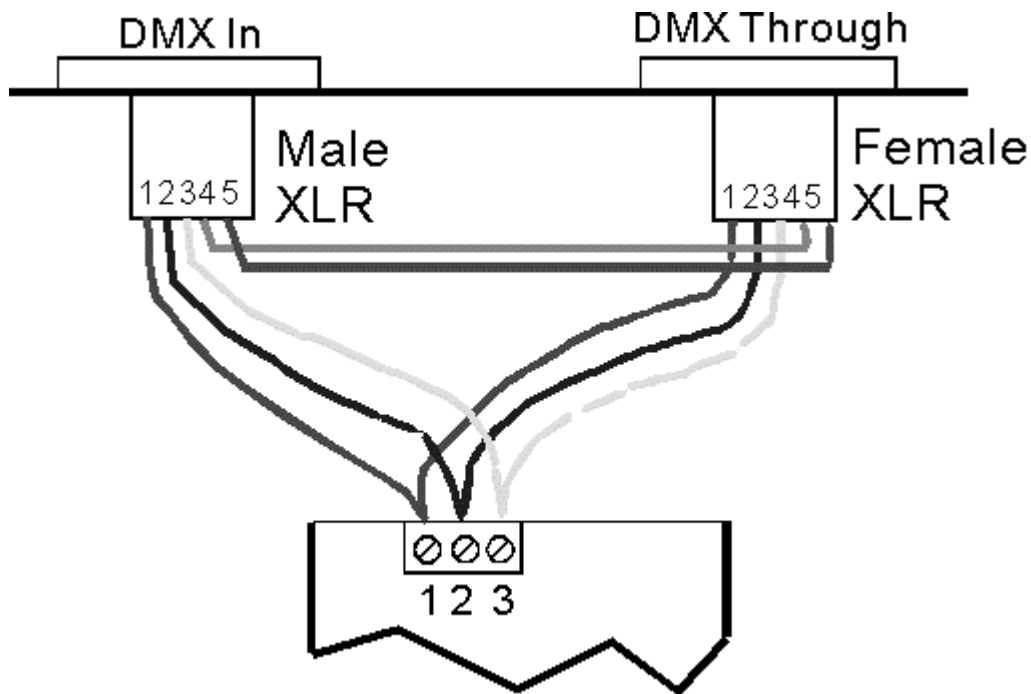
The specific description is below:

Secondary data link - passive loop through ports

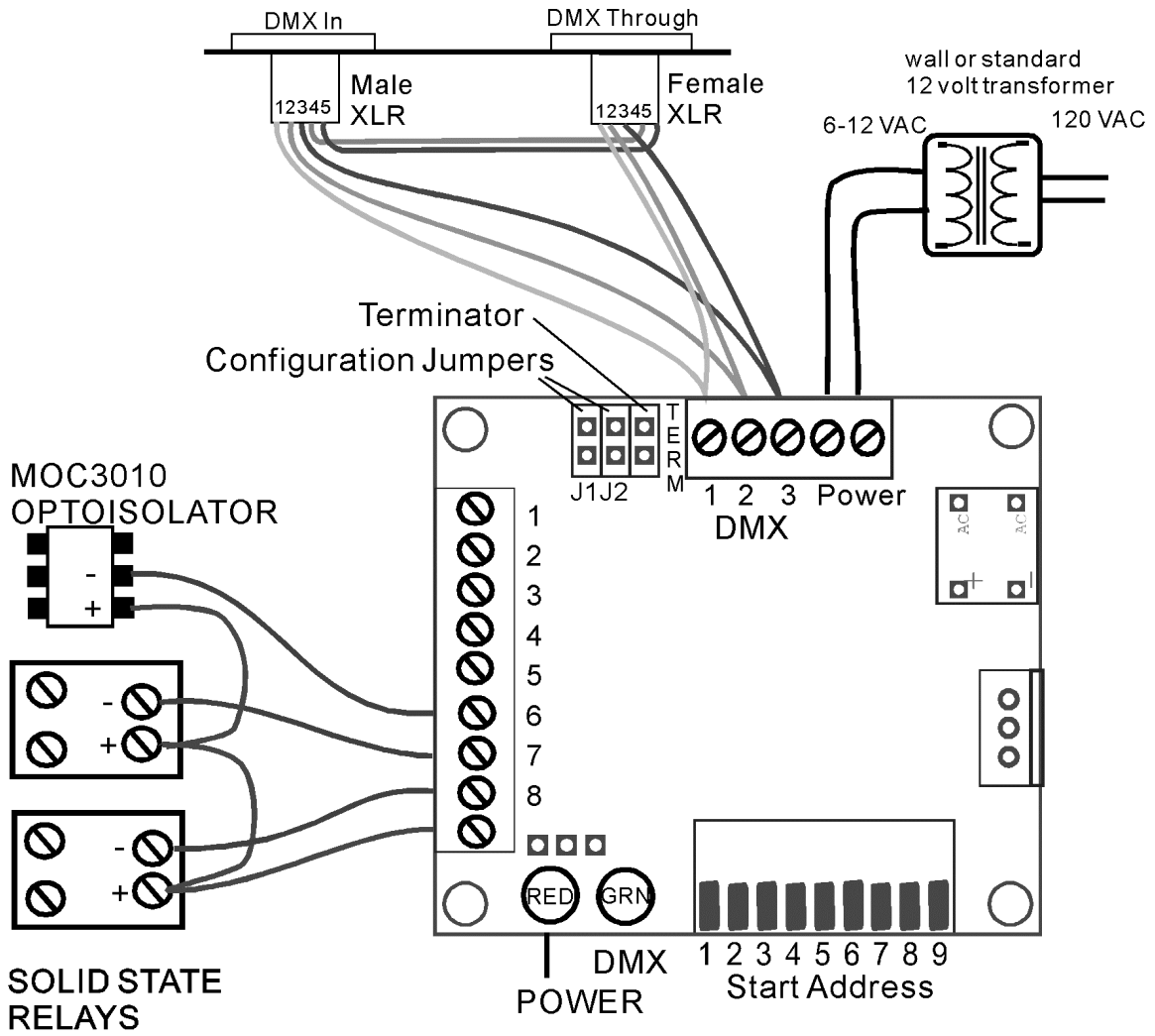
Devices containing two DMX512 ports, one for receive and one for transmit, that do not actively process or buffer data, shall provide a direct passive link for all pins between the two ports....

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

The drawing below shows a typical installation.



Typical hook up



Hardware

Transformer

As you can see from the hook up drawing the dimmer board requires an AC transformer input for the board power. The reason for this is that the board uses the transformer power to synch up to the AC line. If DC power is input to the board it will seem to work, the LED's will light up, but it will not dim.

The transformer must be connected to the same hot leg of the AC power line as the SSR's.

This dimmer is a single phase dimmer. That is to say that all the SSR's must be connected to the same hot leg of the AC power line.

Heatsinks

Solid State Relays require heatsinks if they are controlling more than a few watts of lighting. The heatsink can be individual or a larger heatsink can be attached to all the SSR's. The metal base on the SSR is isolated so it can be attached directly to the heatsink.

In some situations where a metal enclosure is used the enclosure can be used as a heatsink.

Fan cooling is required if the SSR is used near its maximum rating.

In general any SSR that has a load of over 100 watts will require a properly sized heatsink.

For higher loads a finned cast or machined aluminum heatsink will be needed.

RF noise

Choke coils are sometimes required to minimise RF noise generated by the SSR switching of the AC load.

Random turn on SSR

Many SSR's have zero crossing detector circuits built in. The zero crossing detector will cause the SSR to turn on only at the zero crossing point of the AC line. This is used to reduce switching noise. However these are not suitable for dimmers.

Dimmers require Random Turn On SSR's.

A sampling of part #'s below are suitable for dimmers.

Crydom: Any Crydom with a -10 suffix, for example:

D2425-10 D2440-10 D2440D-10

P&B Any P&B with a R suffix

SSR-240D25R SSRT-240D25R

Using the PC serial port

To communicate with the Dim08, you can use just about any computer that has a serial port on it.

Some computers, like the Apple come with serial ports which are directly compatible with the RS-422 / RS-485 signal levels the Dim08 wants to see. These signal levels are close enough to be used with the RS-232 signal levels found on most PC's.

The Dim08 board can accept 9600 baud data from a computer serial port. The protocol used is compatible with a number of servo controllers including Scott Edwards mini SSC servo controller. There are several commercial animatronics software packages available for a servo controllers using this protocol.

A freeware Visual Basic example is available on the Northlight web site. Includes source and compiled code.

If you are using a computer as a terminal you will need to run a modem or terminal emulation program. These will send everything you type on the keyboard out the serial port on your computer.

Every copy of Windows comes with HyperTerm or Terminal.EXE, which are just such programs.

Selecting PC serial mode

The SIP jumper pins must be shorted for PC serial mode.

The Serv8 board is shipped in DMX mode, with the SIP header open. When the jumper is changed it will not take effect until after the power to the board has been cycled off and on.

Mini SSC protocol

To send a new position command, 3 bytes are needed.

The first is a “sync” byte with a value of 255.

The second byte is the servo address. It is a number from 0 to 254.

The third byte is the actual position data, between 0 and 254.

This sequence is followed for each servo position.

For example, as shipped the Dim08 board address is 1. The 8 channels are addressed 1-8. Simple enough, For channels 9 – 15 the Dim08 board address would be set to 9. Channel 3(on the board) would be 11 to the controller, the board address plus the channel # - 1.

For example, for a level of 50%, three bytes must be sent.

| Sync | Add | Level |
|------|-----|-------|
| 255 | 3 | 128 |

Connections:

Only 2 wires are needed from the PC serial port.

PC ground is connected to DMX input 1.

The RS232 signal is connected to DMX input 2.

On a standard DB-9 connector use these pins:

Pin 3 = Serial data

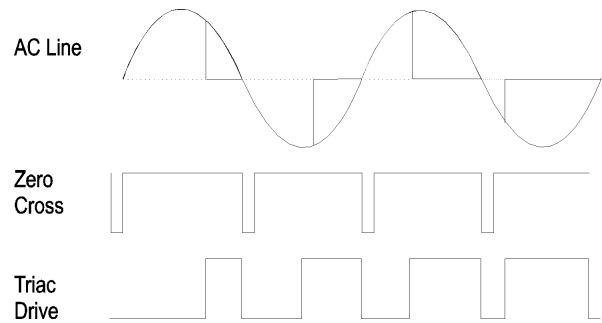
Pin 5 = Signal ground

A note about the basic operation TRIAC and SCR based lighting dimmers.

In order to vary the brightness of a lamp the TRIAC is turned on for only a portion of the AC cycle. By controlling when the TRIAC is fired during each AC half cycle the average power to the lamp can be varied, and thus the brightness.

For a microprocessor this is a simple task.

First determine when the AC zero crossing point is reached. This is the beginning of the half cycle. At this point it is a matter of delaying the firing of the TRIAC until the proper time. If the delay time is long the TRIAC will be on for a small portion of the cycle and the lamp will be dim. As the delay becomes shorter, the on time will be longer and lamp will be brighter. This process is repeated every half cycle.



Choke coils

TRIAC's are easy to use but have some disadvantages as well.

One problem is the once the TRIAC is turned on it will stay on until the voltage across the main terminals falls below a certain level called the "hold on" voltage.

On AC the TRIAC will turn off at the end of every half cycle of the AC line.

Therefore the TRIAC has to be triggered on every half cycle.

The problem is when the TRIAC need to be on for part of the half cycle. If it could be turned on at the zero crossing point then the voltage would slowly rise and fall with the AC line. However since the TRIAC won't go off until the end of the half cycle dimming would be impossible. Therefore the TRIAC is turned on after the zero crossing point which cause a large amount of current to suddenly shoot through the TRIAC which causes a momentary spike of high voltage AC noise. This can cause sound systems to "buzz" and cause radio frequency(RF) interference.

To solve this problem choke coils are commonly used to slow the surge through the TRIAC. This is called slew rate limiting. The slew time or "rise time" of the choke determines how much noise is suppressed.

Typical rise times are 100 microseconds for a low cost dimmer. Better "touring" quality dimmers will use chokes with a rise time of 350 – 500 microseconds.

The better "Theater or studio quality dimmers will have rise times from 600 - 800 microseconds. At the highest end are dimmers with 1200 microseconds rise time. These are used in TV studios or areas where noise suppression is of highest importance.

Trouble shooting

Basically the board is plug and play. When all connections are properly made, an variable pulse, proportional to the input signal will be present at the output pins.

PC Serial Port

If you have hooked up the Dim08 to your computer and it doesn't seem to respond to the keyboard, the first thing to check is that you are attached to the right serial port. The easiest way to do this is to disconnect the Dim08 and short between the Tx data out and Rx data in pins on the serial port connector on the back of your computer. On all IBMs and compatibles this means sticking a piece of wire, paper clip, or similar tool between pins 2 and 3 on the 'Com.' connector. While running a modem program, anything you type should be shown on the screen while this paper clip is in place, while nothing will appear when you remove it. If your computer passes this test, then you are using the right serial port and the problem is most likely the baud rate setting or in your wiring to the SERV8. If you get characters on the screen even with the paper clip removed from the serial port, it means you probably need to set the 'echo' mode to 'none' or 'full duplex' and try this test again.

Signal Ground/common: On the board, there is NO connection between chassis/earth ground and Signal/common ground. Do not install one.

On the DMX data cable, there is NO connection between the shield/XLR shell earth ground and the signal/common ground. Do not connect these together.

Termination: It is up to the user to determine the termination requirements. If the Decoder board is the last one on the DMX link the built in 120 terminating resistor can be used.

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

Red Power LED: Double check the input power by using a multimeter on the screw terminals of the input power connector. If the red LED is out the power supply may be defective.

Green Signal LED: If the green LED is blinking, there is no valid signal present.

If the LED is on, but dim, and the receiver is not responsive, try to reverse the DMX signal wires. A valid signal will produce a steady bright LED.

Double check the input ground connections. Use a terminator

No output:

DMX512 Check the signal wires as noted above.

Be sure the address is set to a valid address. The Serv8 start address should not be higher than the highest address received. On the mini DIP switch, up position is off. Down is on.

PC mode Make sure the jumper is set for PC mode, cycle the power to be sure it is reset.

Erratic output: This problem can be hard to track down.

First check the input signal integrity. There should be signal present on both Data lines for DMX512. Reverse the connections.

In PC mode make sure there is no terminating resistor.

Misc: Good solid connections are a must. The mini 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. It is recommended that a separate transformer be used to power the Serv8 board. Occasionally unexpected problems can occur if power is "borrowed" from another source. Small wall wart transformers work well for this application.

Using 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 Dim08 is compliant with the full requirements of the Data Protocol. There is a certain amount of flexibility in the signal timing, Northlight's Dim08 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 Dim08 is compliant with RS-485. Each Dim08 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 outputs 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 LEDs 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.

The Dim08 board has a terminator that is selected with a switch or jumper.

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 wire type. You can use a range of wire gauges, most frequently use 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

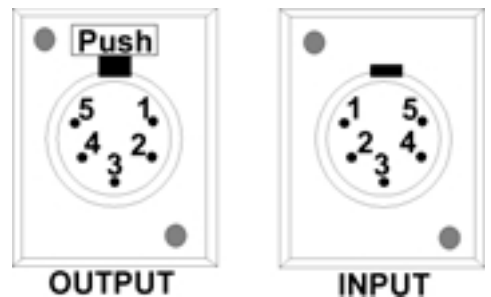
At 250K bits per second the max cable length is about 1000 ft for DMX512 in good conditions.

Connectors

DMX512 protocol specifies that 5 pin XLR connectors be 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.

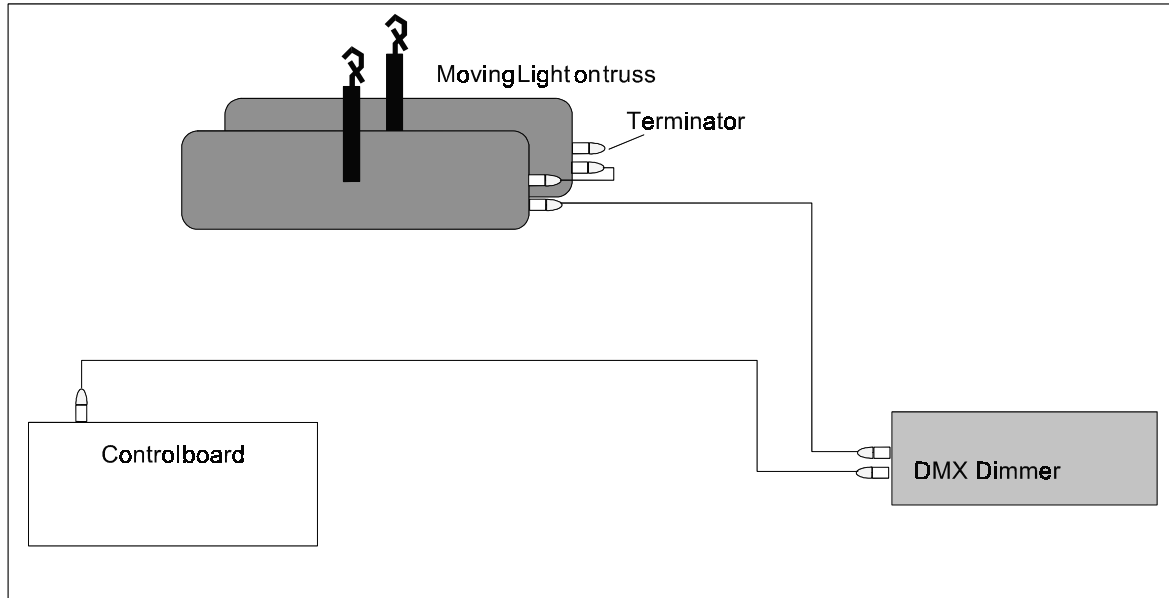
| PIN | WIRE | SIGNAL |
|------------|------------------|-----------------------------|
| 1 | shield | ground/return |
| 2 | signal | data compliment (-) |
| 3 | signal | data true (+) |
| 4 | signal | spare data compliment (-) |
| 5 | signal conductor | spare data true (+) |



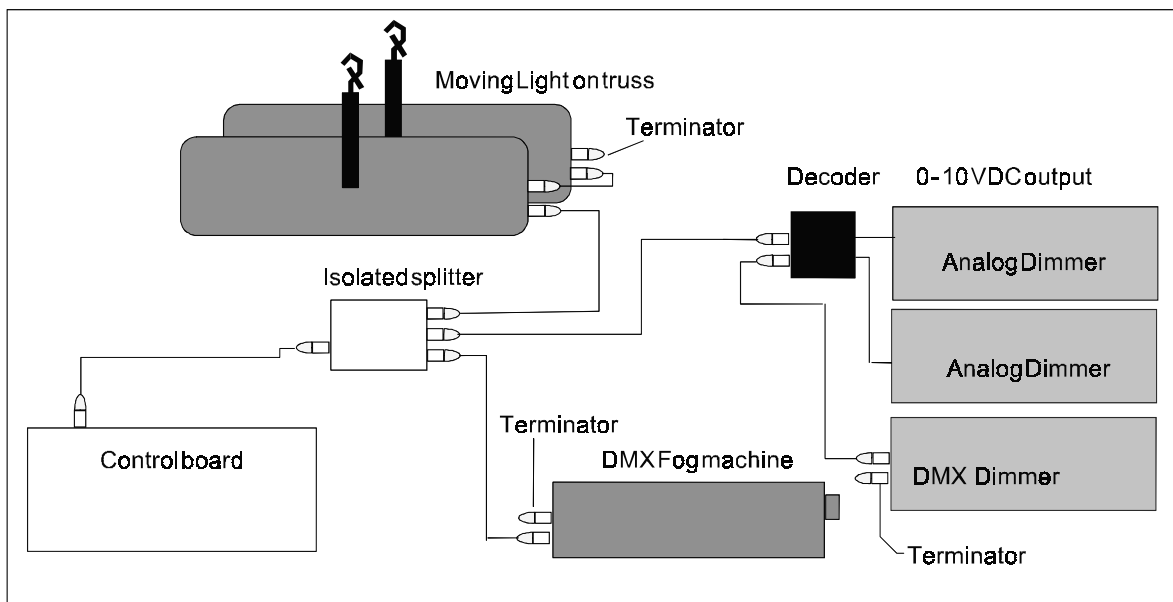
Conductors 2/3 and 4/5 should be twisted together.

Typical DMX signal routing

Simple setup



A more complicated setup. The Isolated splitter greatly simplifies cable routing and keeps individual runs short.



| 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 |

NORTHLIGHT SYSTEMS

| 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 | = 1,2,3,4,5,6,7,8 |