# DMX Run Installation Assistance Guide

Pathway Connectivity Solutions - Acuity Brands Lighting
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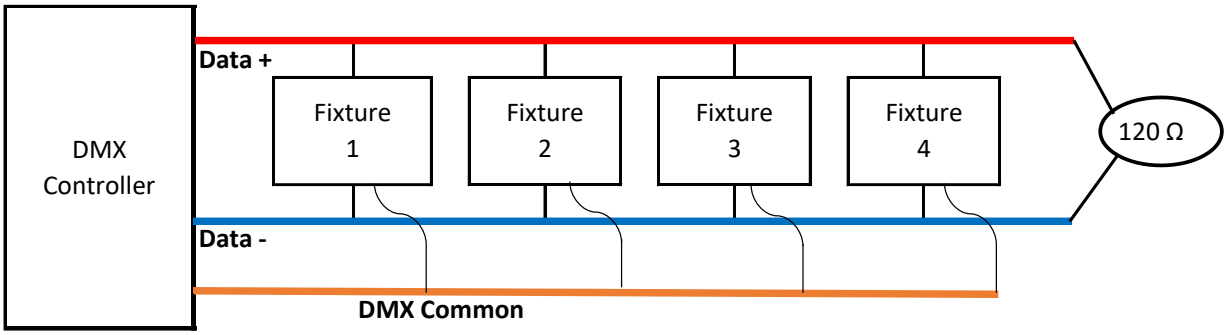
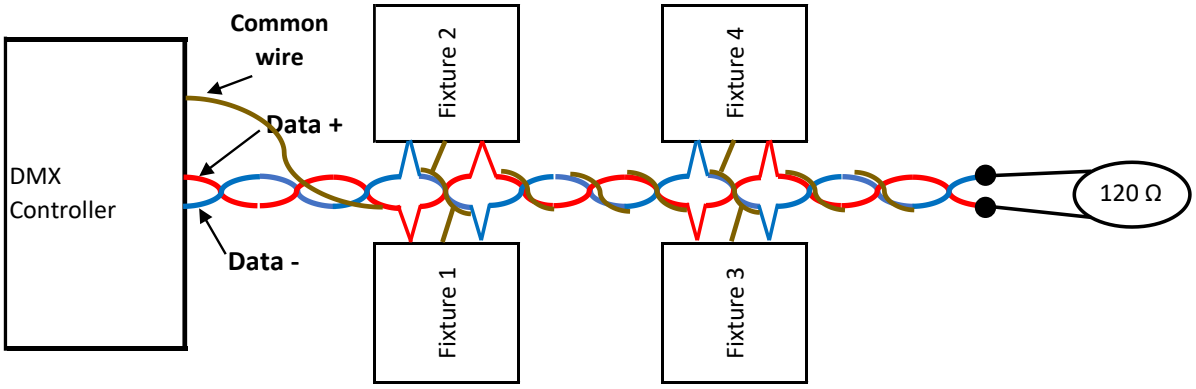
## Clean DMX wiring is critical to the operation of DMX controlled fixtures and is required to successfully trouble shoot any fixture/driver issues.

The following illustration is a conceptual view of a DMX run. The two data lines are parallel wires with a 120 ohm terminator at the end of the run. The terminator absorbs the data signals to prevent the data from bouncing back and causing fixture operational problems. The Common line is a zero reference for the two Data lines; it is not an earth-ground.




In practice the wires need to be DMX standard approved *twisted* pair cable wire. The twists help mitigate RF interference. Refer to ANSI standards E1.27-1 and E1.27-2.



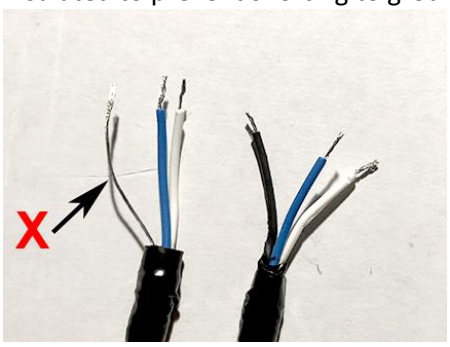

- The run must be Daisy-chained; no branching or T-Taps.
- The max DMX unit load per run is 30 Devices. (the standard is 32, however the controller and terminator each count as loads so the run can have a maximum of 30 additional device or unit loads)
- For complaint DMX512/RDM operation, the maximum cable length must not exceed 1000 feet from controller to devices, including optically isolated splitters.
- Wire used must be approved for use with RS-485 or EIA/TIA568 Category 5 or higher (UTP or STP).
- If using Shielded Twisted Pair (STP), do not connect the shield to data common.

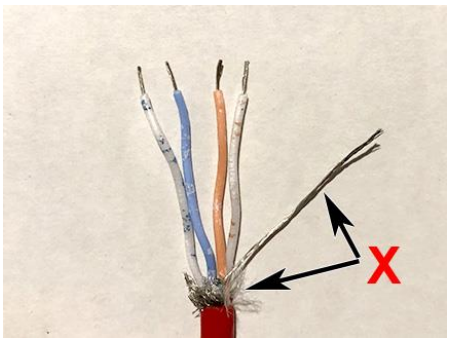
## Clean DMX wiring is critical to the operation of DMX controlled fixtures and is required to successfully trouble shoot any fixture/driver issues.

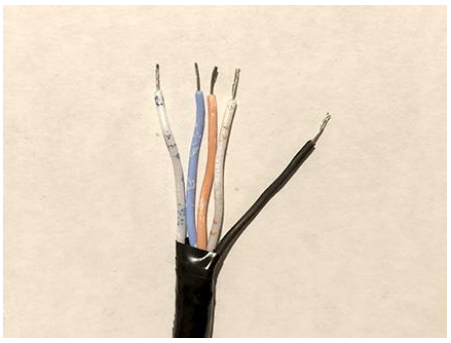
DMX uses a Class 2 low voltage (+/- 5vdc max) network cable with three wires: one twisted pair (Data+ and Data-) plus one other conductor for Common. These wires must be insulated from each other and from earth ground in all locations, including where the data wires connect to the terminator. The terminations should have no exposed conductors.

## Important: All segments on a DMX network need to be the same type of cable.

If using a single pair cable with a shield/drain wire, the drain wire may be used as the DMX Common, but must be insulated to prevent shorting to ground or the other wires.

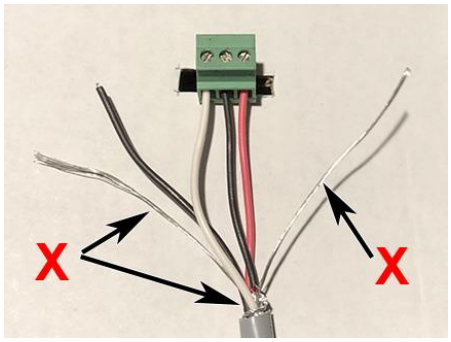


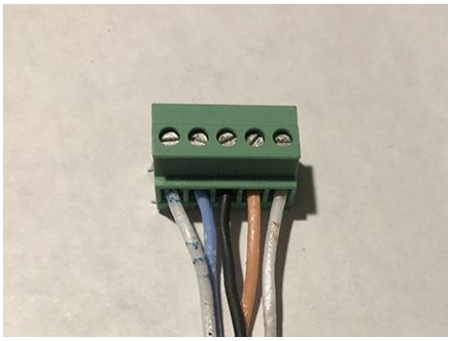
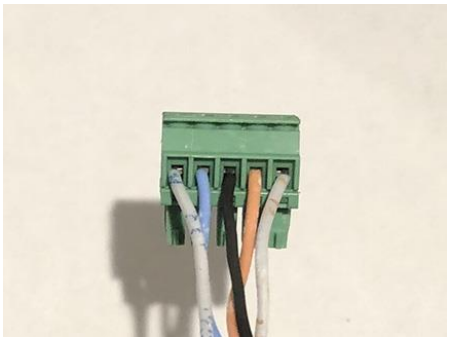
Note: If using a 4 conductor wire with a 3 position connector, one of the spare conductors can be used as the DMX common versus having to insulate the drain wire. In this case the drain wires are not being used, however it is best to remove or tape them to prevent them from contacting an active conductor.

If using a network cable with two twisted pairs, one pair can be used for data, and one conductor from the other pair can used for the Common.



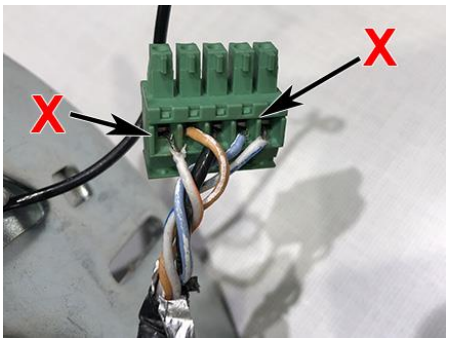
## Clean terminations are a key element.

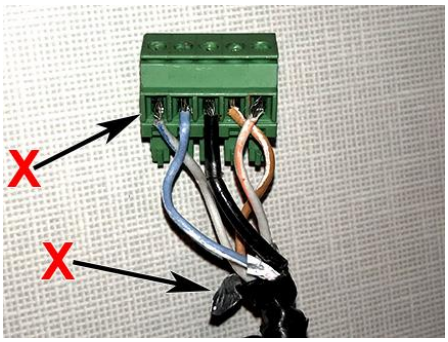
Any exposed conductor can cause communication issues. Wire strip lengths need to be adjusted prevent conductor from being outside the connector. In this case with this green connector the proper strip length is 3/16”.

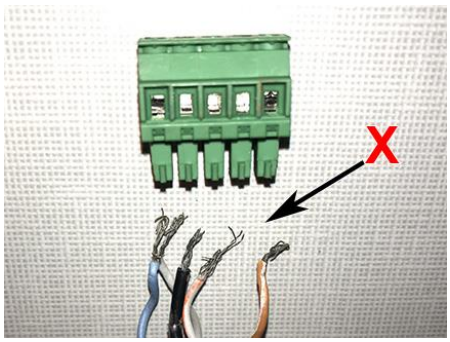



**Note:** No exposed conductors!

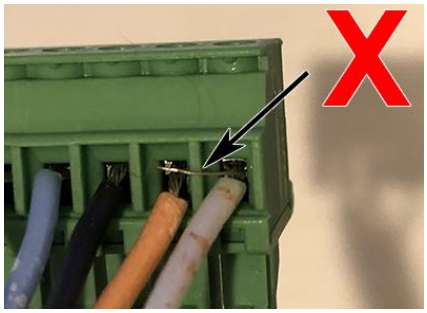
The improperly terminated connector below has exposed shielding at the edge of the cable jacket as well as exposed conductors. Exposed conductors can touch adjacent wires.



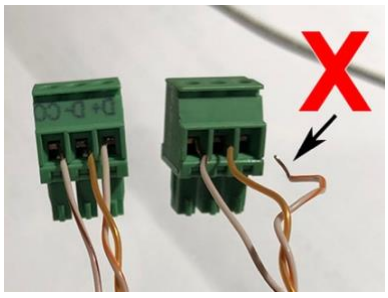




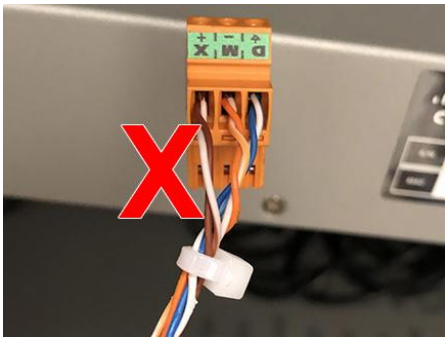

Stray strands from the connections can also short to other wires or ground.




Using Cat5e solid core is not recommended when using compression screw terminal connectors (CSC). This combination results in unstable connections as the clamp can shear the wire and creates a point, where when flexed, the wire will break.

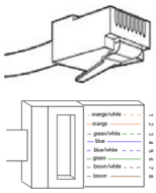


Do not put a pair of wires in one terminal; one wire per connection:



In permanent installations, DMX512-A cables may cables specified as EIA/TIA568 Category 5 or higher. The E1.27-2 Standard specifies the orange pair, with light orange being Data + and dark orange Data -. The light brown is to be used for data common. **The two data wires can not be from different twisted pairs.**

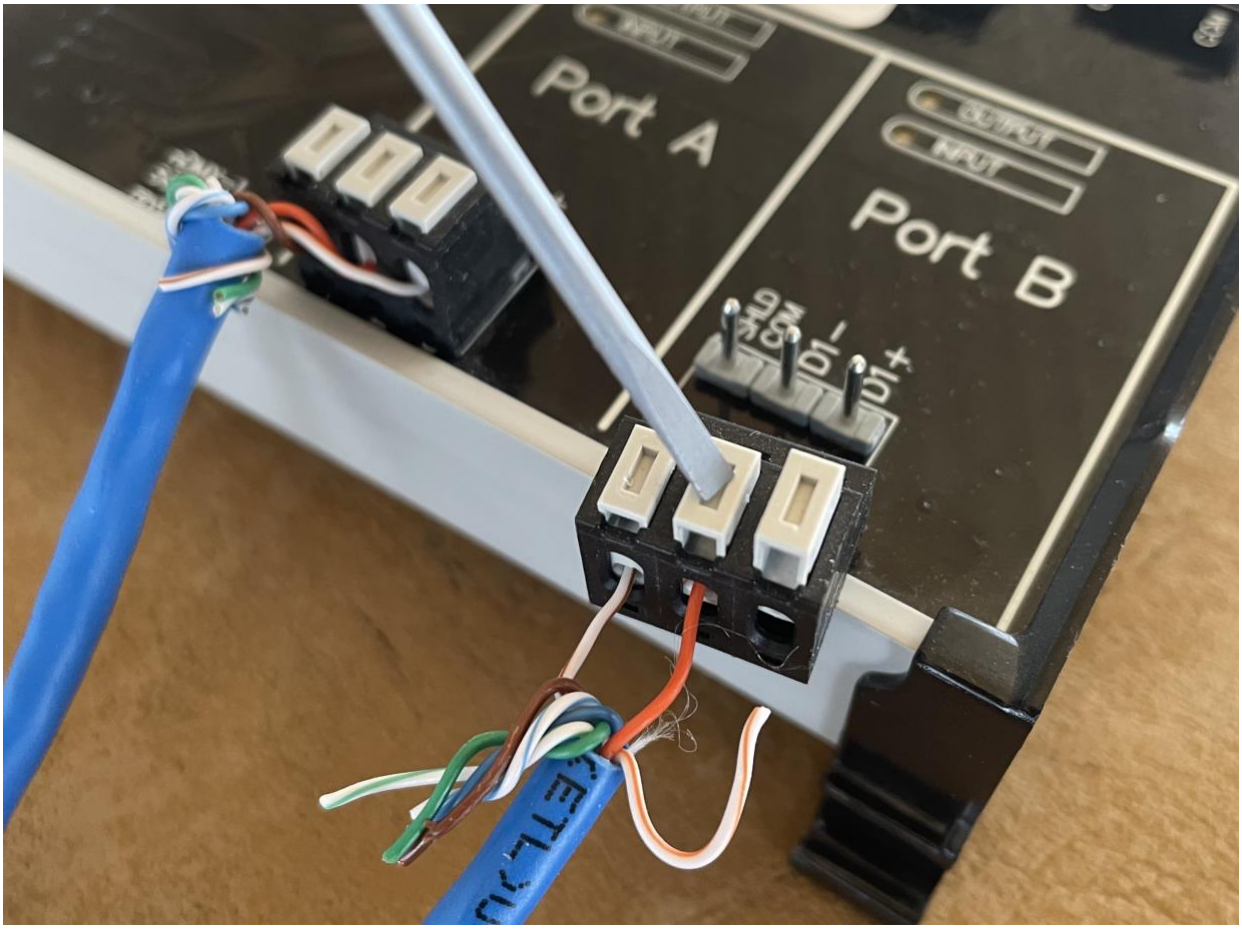
| ISO/IEC Category 5 cables Use Insulation Displacement Contact Connectors | | | | |
|---|---|---|---|---|
| **RJ45 T-568B** | **Wire Color** | **Function** | **Pathway Term IDC** | **XLR5 Equivalent** |
| 1 | White Orange | Data + (true) | 3 | Pin 3 |
| 2 | Orange | Data – (complement) | 2 | Pin 2 |
| 3 | White Green | Not Assigned | | |
| 4 | Blue | Not Assigned | | |
| 5 | White Blue | Not Assigned | | |
| 6 | Green | Not Assigned | | |
| 7 | White Brown | Data Common | 1 | Pin 1 |
| 8 | Brown | Not Assigned | | |
| Shell | Bare Silver | Not Assigned | Not Connected | Shell |



Abbreviated notes from the ANSI Standard:

- RJ-45 Patch Bays should comply with all of the applicable requirements of E1.11, and the use of a Patch Bay with RJ-45 connectors that complies with E1.11-2004 Clause 7.3 does not relieve the system specifier or installer from the requirement to use 5-pin XLRs for all other user connection points.
- Shields and drain wires exposed by the process of preparing the cable for termination should be insulated from accidental contact with earth ground, data +, data - and data common.
- Do not use shield as data common unless the cable only has a single pair. In such cases, do not connect the shield to earth.
- Under no circumstance should any twisted conductors be connected to earth ground. Only connect the shield, if present, to earth ground at the transmitter if is not being used as data common. See note above.
- Direct termination of a permanently installed cable on a male RJ-45 should not be allowed. Use PWACC RJPatch.

All Pathway Connectivity DIN mounted devices come with specially designed IDC (insulation displacement contact) connectors for solid core category cable. Unstripped solid wires are inserted in the upper holes. The “buttons” are then fully depressed pushing the wires into a internal metal “V” which cuts through the insulation making the connection.




See a video on how to terminate solid core Category cable using Pathway’s IDC connectors. Search YouTube for “Pathway Connectivity IDC” or scan this code.

If using non-Category cable for non-permanent use, use XLR 5-pin connectors at wall outlets and for temporary cables to fixtures and Compression Screw (CSC) connectors to Pathway DIN cards. Follow this chart.

| EIA-485 type cables (i.e., Belden, Proplex, etc) Use Compression Screw Connectors | | | |
|---|---|---|---|
| **XLR5 Pin** | **Wire** | **Function** | **Pathway Term CSC** |
| Pin 1 | Shield | Data Common | 1 (black) |
| Pin 2 | Pair 1 | Data – (complement) | 2 (green) |
| Pin 3 | Pair 1 | Data + (true) | 3 (red) |
| Pin 4 | n/a | Not Assigned | |
| Pin 5 | n/a | Not Assigned | |
| Shell | Not Connected | | Not Connected |

## Fixture troubleshooting CAN NOT be done until a valid DMX run has been established.

A valid DMX run is defined as three continuous conductors with a 120 ohm resistor across the twisted pair at the end of the run. There are to be no shorts between the Data lines (the twisted pair) to Common and no shorts from any line (Data+, Data-, Common) to building ground. Testing the run is a simple process using a standard multimeter.

For each run, perform the electrical checks/measurements described below
To measure remove the run from the controller or splitter and measure the lines going out to the run

| Data + | Data - | Data Common | Earth Ground | Short Yes | Short No | Measurement Ohms | |
|---|---|---|---|---|---|---|---|
| X | X | | | | | | Measure resistance acceptable range 120- 190 ohm[1] |
| X | | X | | | | | Check Continuity, should be open |
| X | | | X | | | | Check Continuity, should be open |
| | X | X | | | | | Check Continuity, should be open |
| | X | | X | | | | Check Continuity, should be open |
| | | X | X | | | | Check Continuity, should be open |

[1] **If measuring resistance with power on, take two measurements. One with the meter + lead to Data +, then reverse the leads so meter + is to Data -. The average of these to is equivelent to the non-powered resistance reading.**

Note: If the reading in #1 above is in the K ohm or M ohm range this means either there is no resistor or one of the Data lines has a break.

## If the Data +/- reading is outside the 120-190 ohm range, and/or there are any shorts these must be resolved prior to troubleshooting the fixtures!

## Fixture Troubleshooting

Once the run parameters are met (no shorts and a reading between 120-190 ohms between the DMX Data lines) fixture/driver troubleshooting can begin.

### Fixture will not energize and does not respond to DMX/RDM

1. Check power to fixture
2. Verify correct wiring at DMX Run/Fixture interface
3. If both #1 and #2 are good, the issue is likely internal to the fixture

**Fixture energizes but does not respond to DMX/RDM**

***Note: Some fixtures will not energize until they receive a DMX signal***

1. Verify correct wiring at DMX Run/Fixture interface (a reversal of wiring will prevent a DMX device from responding)
2. If #1 is good, the issue is likely internal to the fixture

**A variety of fixture issues are noted in a run**

1. Verify run parameters
2. If #1 is good, possible driver issue, troubleshoot run to isolate the issue fixture

Suggested method would be to disconnect the DMX at a fixture in mid-run to see if the issue resolves.

- If yes reconnect the fixture and repeat further down the run
- If no leave that fixture temporally disconnected and move toward the beginning of the run and repeat the process

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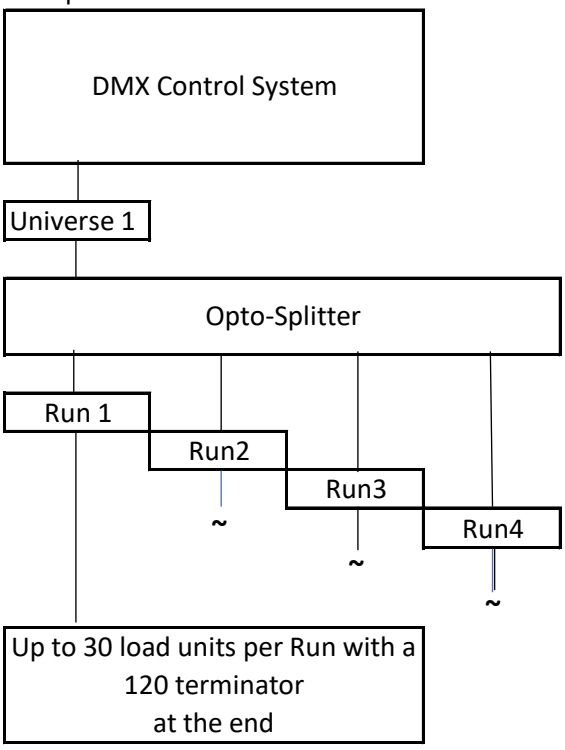
## A little DMX Background

**DMX-512 (Digital Multiplex)** - DMX512 is a unidirectional protocol which means that the data flows in one direction – from the control desk to the lights. It is defined by ANSI E1.11

**RDM -** Remote Device Management is a protocol that sits on top of the normal DMX512 data standard. It is defined by ANSI E1.20. With the addition of RDM, the DMX512 system becomes a bi-directional (half-duplex) system, still using only one data pair. The controller can send out a question to devices on the wire, which can then respond with an answer.

A basic DMX system would have one Universe which has 512 slots or control channels. Complex systems can have multiple Universes. Each Universe can have one or multiple DMX Runs. Each run can have up to 30 DMX unit loads.




There are 512 DMX control Slots (channels) per universe. The system can send individual values to each Slot up to 44 times per second. The terminator resistor absorbs this data energy at the end of a run preventing reflections back to the run causing erratic operations.

<u>Example: a DMX system with a single universe:</u>
There are a total of 100 DMX devices (lights) that need to be controlled. This would mean there would need to be a minimum of 4 Runs, each with no more than 30 devices. (i.e., 30+30+30+10)

Every light may have its own DMX Address (that is, it listens to one of the possible 512 slots), but a DMX system broadcasts all the date to every devices independent of the Run.

You may also address multiple lights to the same Slot. Then all the lights would respond in unison when a signal was sent to that Slot. If all the lights in this system were addressed to Slot 001 and a command to turn on at 100% was sent to Slot 001 all 100 would turn on at 100%.