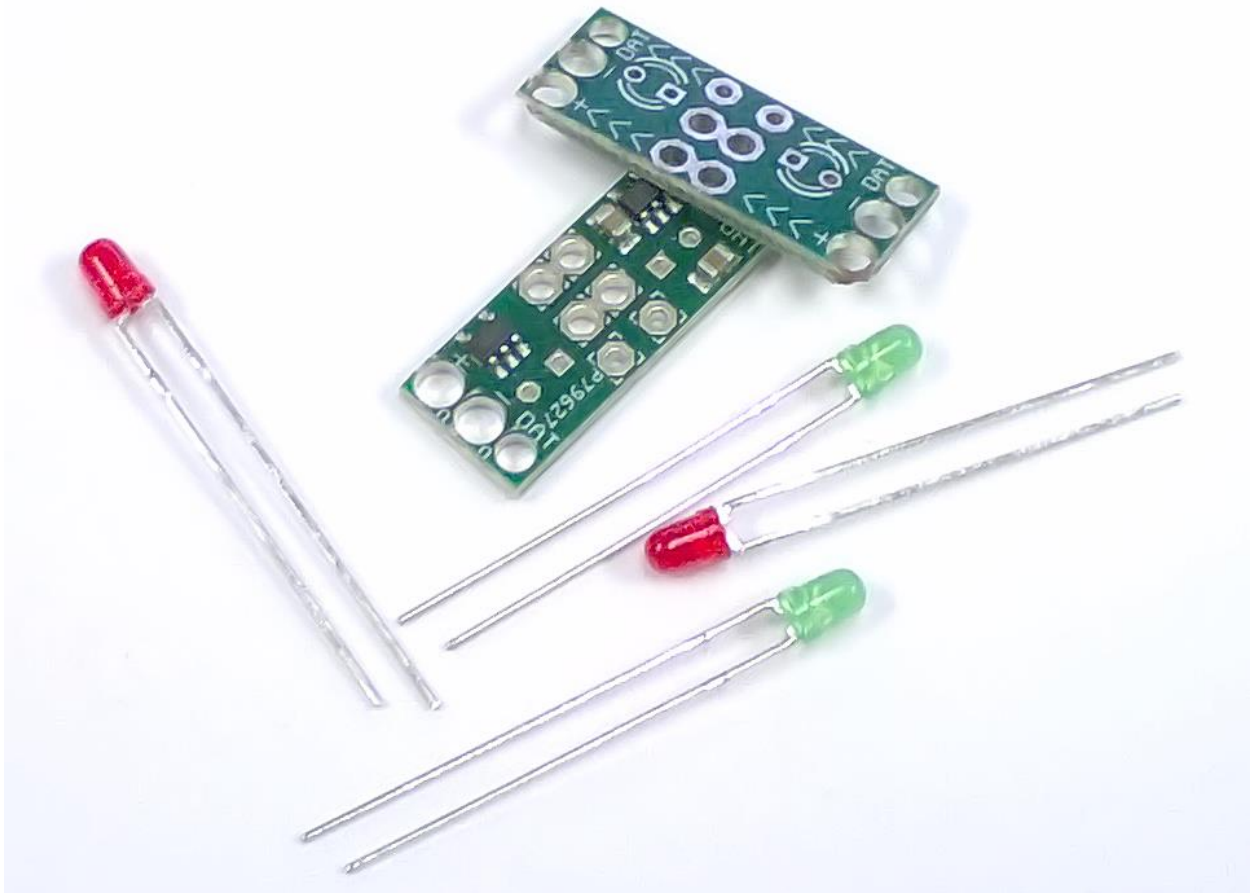


Owner's Manual – Revision 1.0
for
μAmp 'Microamp' Version 1



Foreword

The μ Amp or 'Microamp' was designed to perform three basic functions:

- Clarify, amplify and regenerate any 0-5V square wave signal
- Adjust the 0-5V square wave signal to 'local' ground conditions
- Provide visual indication of power and data transmission at the point of regeneration

To perform these tasks, several features were designed into the μ Amp circuit board:

- Optimized design to get board small as practical
- Power / ground attachment points are placed at the center of the board for maximum current carrying capability and minimal voltage drop
- Uses all SMT on the basic board for small size, cost effective components.
- Optional LEDs provide easy troubleshooting and confirmation of power input as well as data output.
- Selected components optimized for the job. Cold weather operation, data transmission capability, MOSFET driver, ESD protection, etc
- All strain relief holes big enough for the 3-4 pin connectors on the market, bundled Cat5, or most any other wire you need
- On board voltage regulator provides self-regulating / auto shutdown overload protection.
- Large value filter capacitors insure sufficient smoothing even when capacitance drops due to cold weather
- MOSFET driver output section: Schmitt triggered, ESD and short circuit protected, true push-pull output for solid data transmission through long wires. (Not recommended, but bench tested for weeks with 90 foot μ Amp-to-first-node distance)
- Robust design, generally tolerant of ESD / static discharge, shorting data out to up to 16V or ground.

****NOTE: While the μ Amp is generally tolerant of short circuit of the data output to power or ground - to maintain the small size and low cost of the μ Amp board, reverse voltage protection of the input is not provided on the board itself. It is up to each individual user to either confirm proper polarity of the circuit before energizing, or add external reverse current protection such as a suitable diode or other protection method.**

Failure to provide proper input polarity may result in damage to the μ Amp.

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1. Typical Application

Several possibilities are present with the μ Amp.

If you wish to send data from an unmodified SSCV1 or SSCV2 more than a few inches, or an SSCV3/V4 more than a few feet, a μ Amp can be added to the output line. Once installed, the low power, 'messy' SSC data is amplified and clarified so the controller can now be 50, 60, 70 or more feet to the display element.

[SSC] <few inches> [μ Amp] <.....50+ feet.....> [Node]...[Node]...[Node]...

"Null Node" - Data transmission between nodes is limited to around 6-15 feet (regardless of string controller*). Installing a μ Amp after a node will condition and boost the data signal strength so gaps between elements can be 50, 60, 70 feet or more if needed. Because the μ Amp processes data and does not use the "take one and pass it on" format a node does, the μ Amp does not need to be programmed into the display as a null node does.

.....Data.....[Node] <few inches> [μ Amp]<.....50+ feet.....> [Node]...[Node]...[Node]...

*Note - The data stream is regenerated and retransmitted by each node. Due to this a controller with a strong output (such as the uSC) can send data quite a far distance to the first node, however, when that data is retransmitted by the first node, the distance is again limited to around 6-15 feet.

"Multiply" a single data stream - Since the μ Amp has very high input impedance it does not put considerable load on the data line so multiple μ Amp boards can be added to even a weak data stream. If you wish to have multiple display elements showing the exact same data/colors, multiple μ Amps can be tied to the same data stream. Each μ Amp will then deliver its own high power data stream for use with display items. You would not need to use a separate uSC or SSC for each element, though you may need to take appropriate measure to insure adequate power delivery for the nodes.

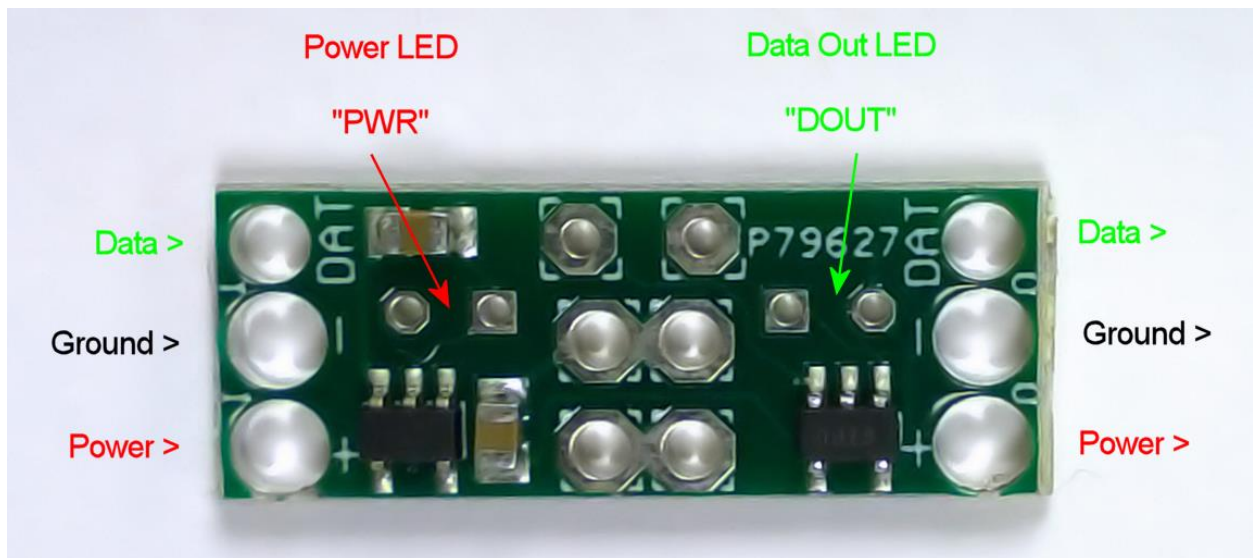
[μ Amp]<.....50+ feet.....> [Node]...[Node]...[Node]...
.....Data.... [μ Amp]<.....50+ feet.....> [Node]...[Node]...[Node]...
[μ Amp]<.....50+ feet.....> [Node]...[Node]...[Node]...

CAUTION

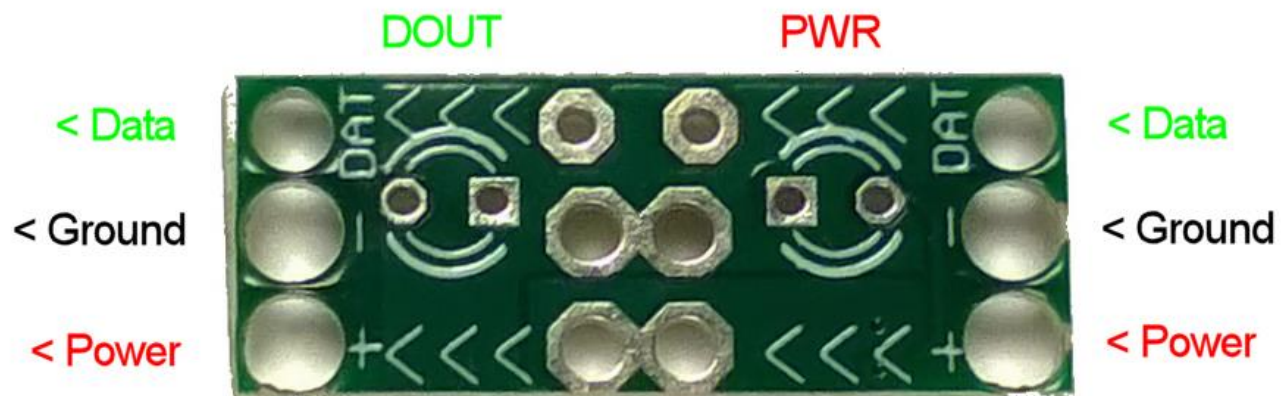
The μ Amp is capable of substantially increasing the distance of data transmission to a node. In some instances, the extended length of wire may result in additional voltage drop possibly putting voltage out of tolerance for the wire or nodes. It is up to each user to evaluate the individual situation and apply the μ Amp accordingly.

μAmp Layout and Features

Front / Component Side



Rear / Solder Side



2. Adding Optional Components

Items and Tools Required to Install Optional Components

The μ Amp was designed so all optional components can be installed with a typical set of hobbyist electronic tools. A list of required tools as well as some optional equipment is detailed below:

(I have purposely tried to avoid recommending specific brands or equipment)

Minimum Requirements

Wire Stripper – Used to strip insulation from Cat 5, Node Wires, etc before attaching to the board.

Solder – Typically, “60/40” rosin core solder approximately 0.031” diameter works well at this scale of assembly. Other alloys could also be used as could solid solder with separate flux, etc.

Soldering Iron – A simple/typical hand held iron will work fine in this application. A long/thin tip is recommended to aid access in tight spaces of the board, such as around the LED lead area. Various ‘soldering stations’ can also be used.

Soldering Iron Tip Cleaner – Some method to clean excess flux from the soldering iron tip. This can be as simple as a wet, lint free towel, wet non-synthetic sponge, etc. A brass ‘brillo-pad’ can also be used and has the advantage of pulling excess solder off the tip of the iron.

Diagonal / Side Cutters – Used to trim excess leads from LEDs after soldering. I recommend a pair which can trim very close to the circuit board. Some ‘diagonal cutters’ for general shop use have a large bevel at the cutting edge and can only trim to within $\sim 1/8$ inch from the board.

Flux Cleaner – Some fluxes can be left in place after soldering, however it is always good practice and a nicer appearing job to remove the flux when soldering is finished.

Optional Accessories –

Sand Paper – Typically 320-400 grit paper is ideal to smooth the rough edges of the boards after de-paneling.

Bench Vise – Works well for holding the board(s) while soldering. Modelling clay is another option.

Magnifying Glass – Can aid in seeing small details of the circuit board. A simple binocular magnifying headset can also provide a great hands-free solution and preserve depth perception.

Installing LEDs (polarity and position must be observed – read carefully)

(LED installation is detailed at this point as it may be easier to handle the boards attached in the array. Though LED installation can be performed at any time in the process)

These specific red, and green LEDs were chosen to offer a single component solution for board indicators. Each LED has a built-in current limiting resistor and needs no other components added for proper operation. You can add the red and green LEDs in any combination, in any location you choose.

ONLY THESE RED, YELLOW AND GREEN LEDS – OR AN EQUIVALENT PART WITH INTERNAL RESISTOR - CAN BE INSTALLED ON THE DIN / DOUT POSITIONS. AN LED WITH NO RESISTOR CAN NOT BE USED IN THESE POSITIONS AS IT WILL FLOW TOO MUCH CURRENT AND MAY COMPROMIZE DATA INTEGRITY.

You can mix and match colors as you wish, however the ‘standard’ colors were chosen as:

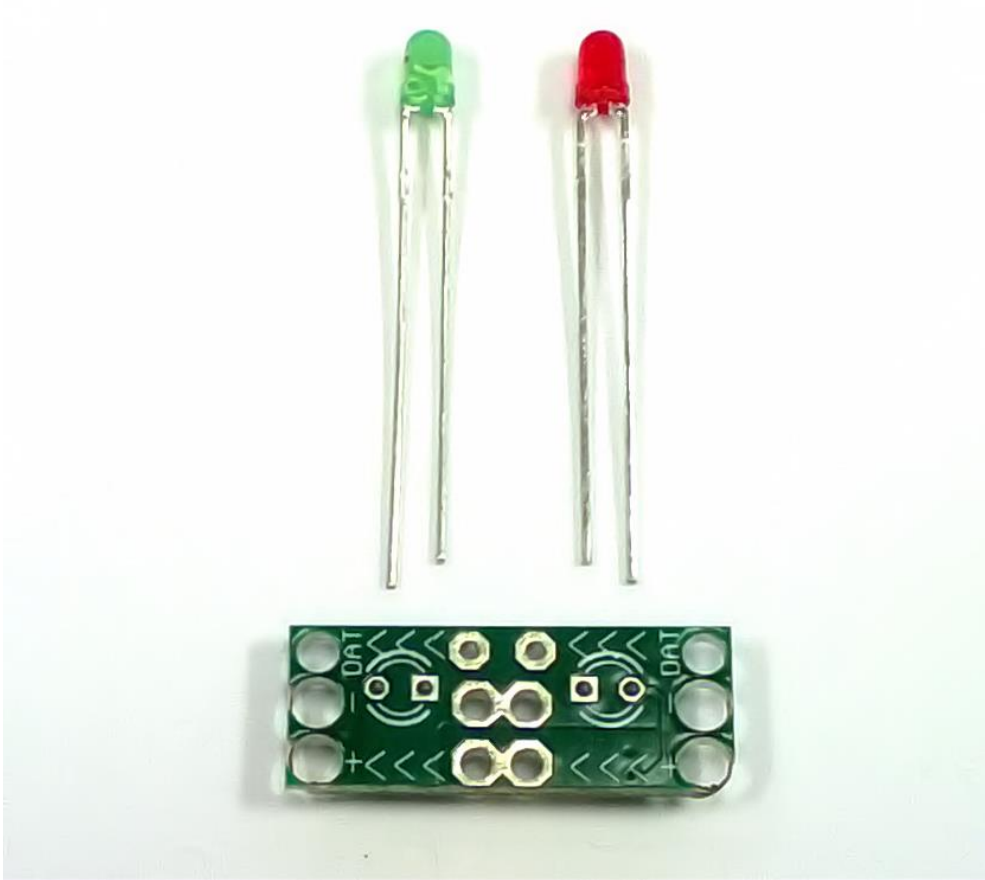
PWR – Power – Red

LED is on solid whenever power is present at the μ Amp input and the on-board voltage regulator is functioning. This color is consistent with the μ SC power LED.

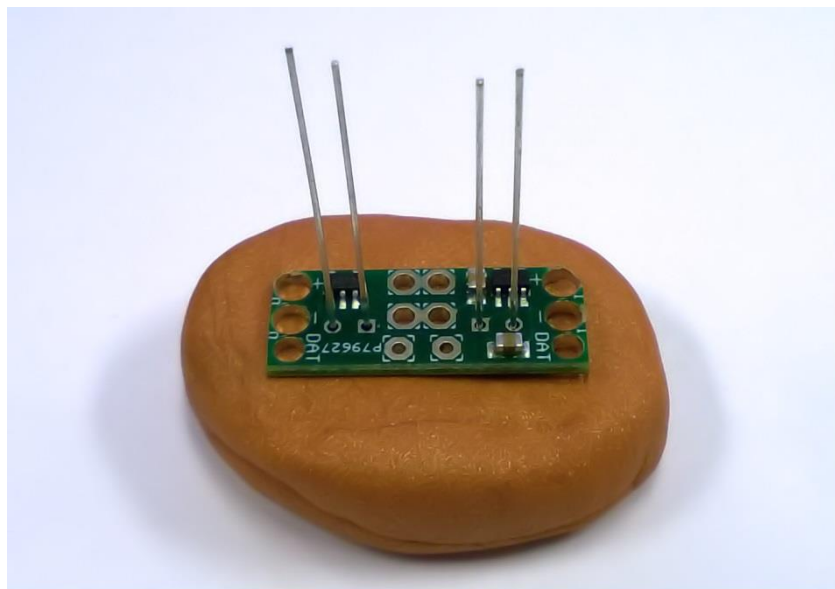
DOUT – Data Transmitting – Green

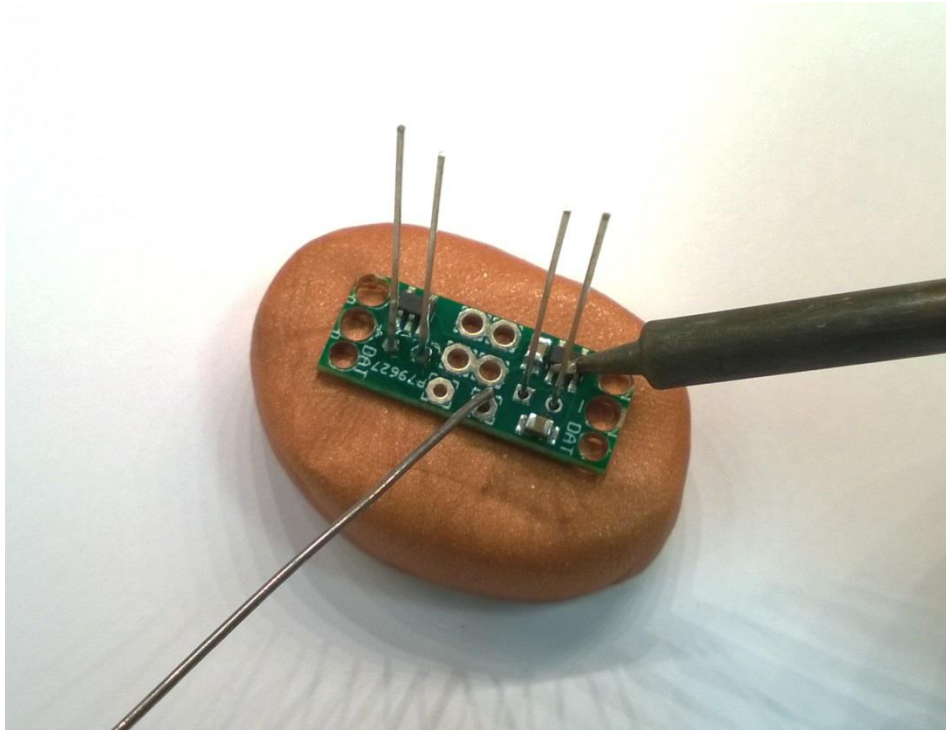
Reminiscent of yellow/green LEDs on most network jacks. With a ‘green light blinking’, you should have data output to the nodes. This color is consistent with the μ SC data output LED.

To add LEDs simply insert the colors of your choice in the spaces you wish to use. The 'standard' combination is displayed below. The long lead should enter the round solder pad on the outboard side of the board. The short lead should enter the square solder pad on the inboard side of the board.



The LEDs will be soldered on the front or 'component' side of the board. Be sure not to bridge solder between the individual LED terminals, or between either LED terminal and surrounding components. 0.031" diameter solder and a narrow soldering iron tip are recommended. A bench vise or small pad of modelling clay can be useful in holding the components in alignment prior to soldering.





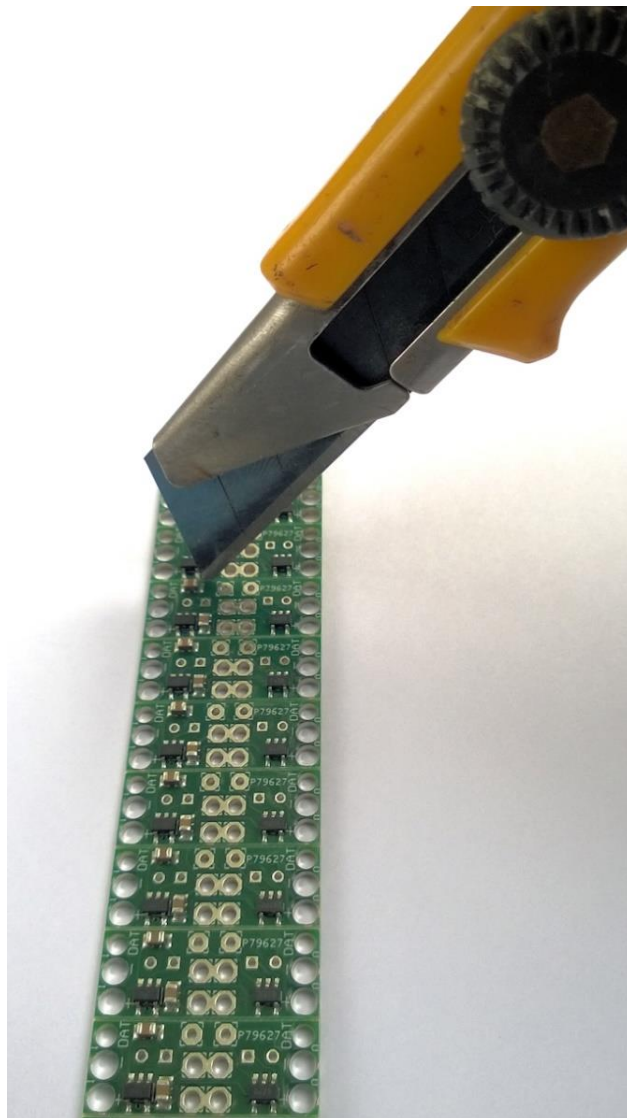
Once soldered, neatly trim the LED leads close to the circuit board.

3. Removing Boards from the Array

If you ordered more than one μ Amp board, it likely came in a group or array. The boards were sent this way to facilitate slightly easier handling and quicker / easier installation of optional components.

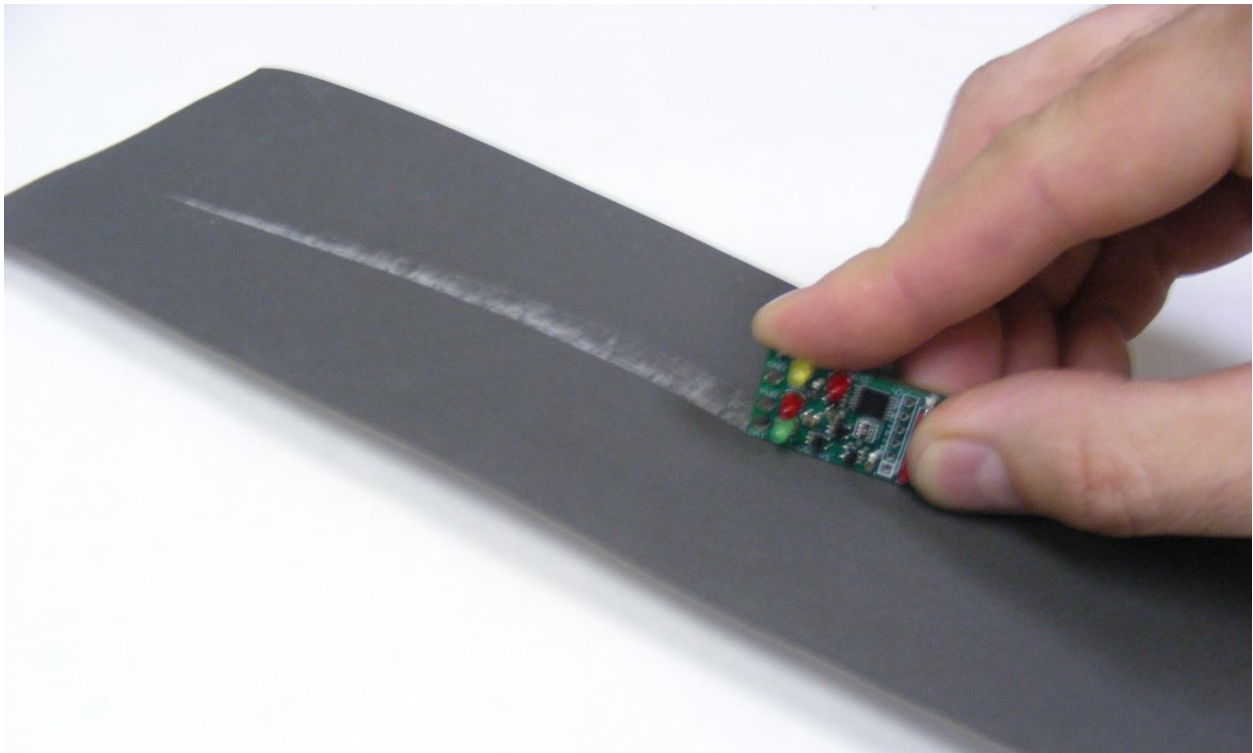
In examining the production boards, it appears there was a 'stack up' of factors combined to place the wire strain relief holes closer to the edge than anticipated. During production, the board dimension was rounded down to the next closest increment and the specified hole size was rounded up. Additionally, the board scoring process creates a 0.010-0.020 inch wide track at each board edge. This does not affect the functionality of the board, but does introduce the possibility of breaking the board at the strain relief holes if care is not used during separation.

In most instances, I have tried to make this critical "end-to-end" separation and ship only "side-by-side" attached boards. If you feel the boards offer too much resistance to bending, you may wish to deepen the score line using a sharp utility or hobby knife.



To remove the boards, carefully bend the array along the pre-formed score lines. You can flex the entire array to help weaken the score lines while you have the extra leverage of all boards still attached. Again, use extra caution when separating boards attached 'end-to-end' as the strain relief holes also slightly reduce the strength of the board at that location. Gentle back-and-forth bending typically works best.

Separation may leave a slightly roughened edge where the boards were joined. This does not affect the performance of the board, however if you wish to clean up the edge, a single 6 – 8 inch long pass across 320 – 400 grit sand paper will quickly smooth down any loose fibers and roughness.



4. Attaching Leads

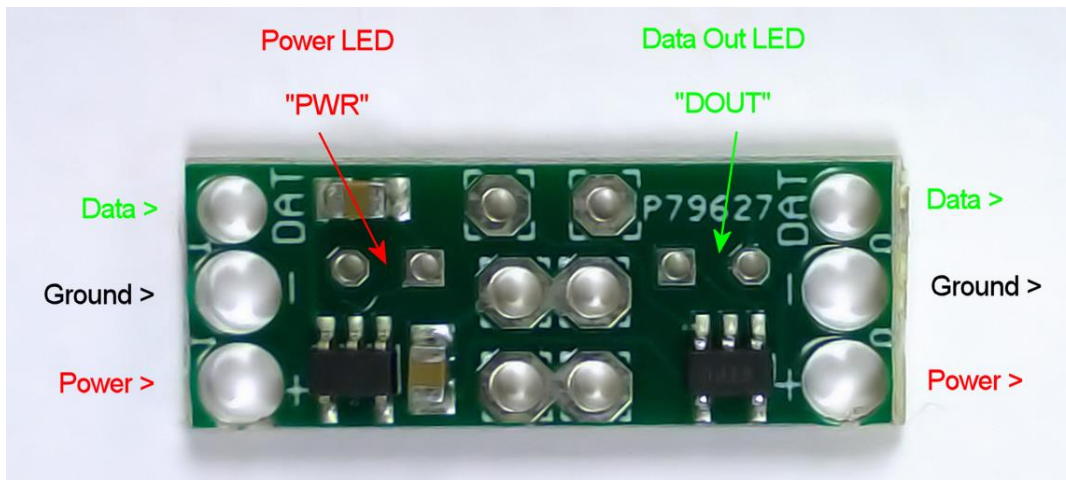
Take a moment to familiarize yourself with the layout of the board. The input and output configuration is marked on both the front and back side of the board as detailed below:

Front Silk Screen – “I” Denotes Input Side, “O” Denotes Output Side

DAT : Data Input

– : Ground / Negative Input

+ : Positive voltage Input (5-16 VDC)



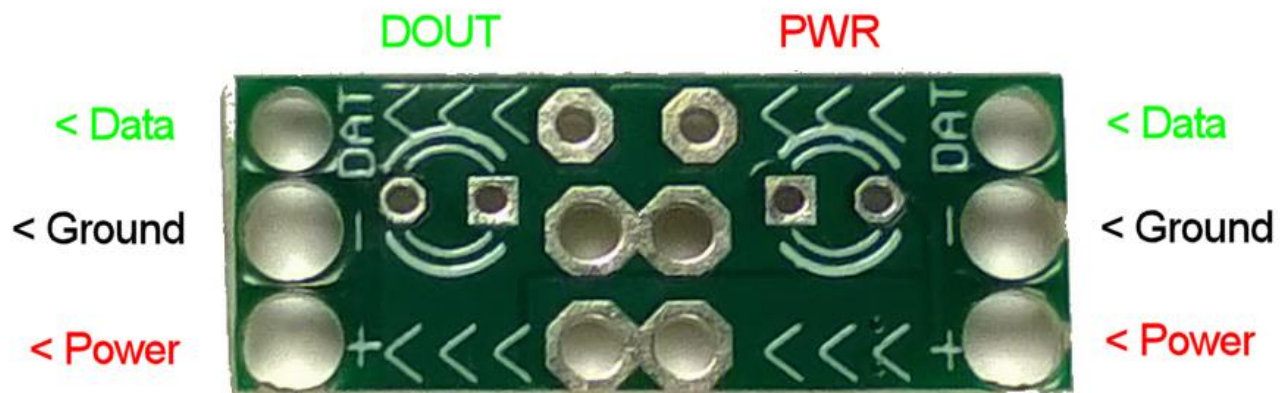
Back Silk Screen

DAT : Amplified / Clarified Data Output

+ : Positive voltage Output (Same as Input)

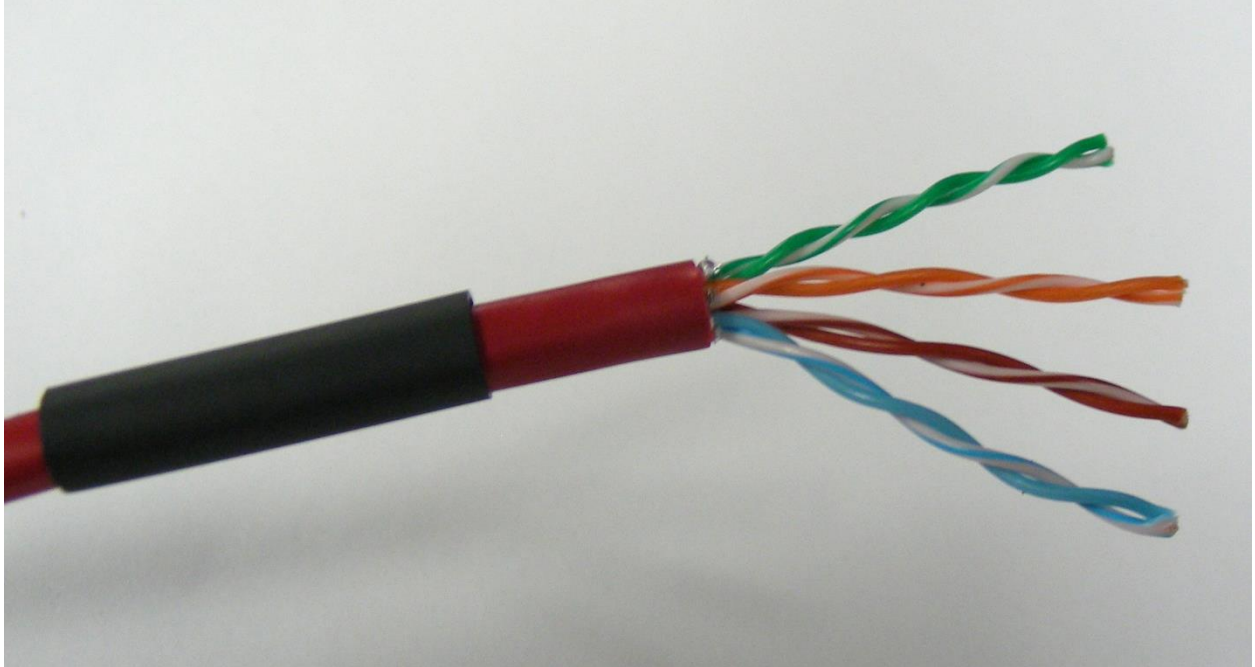
– : Ground / Negative Output

Several sets of arrows “<<<” also indicate the flow of data.

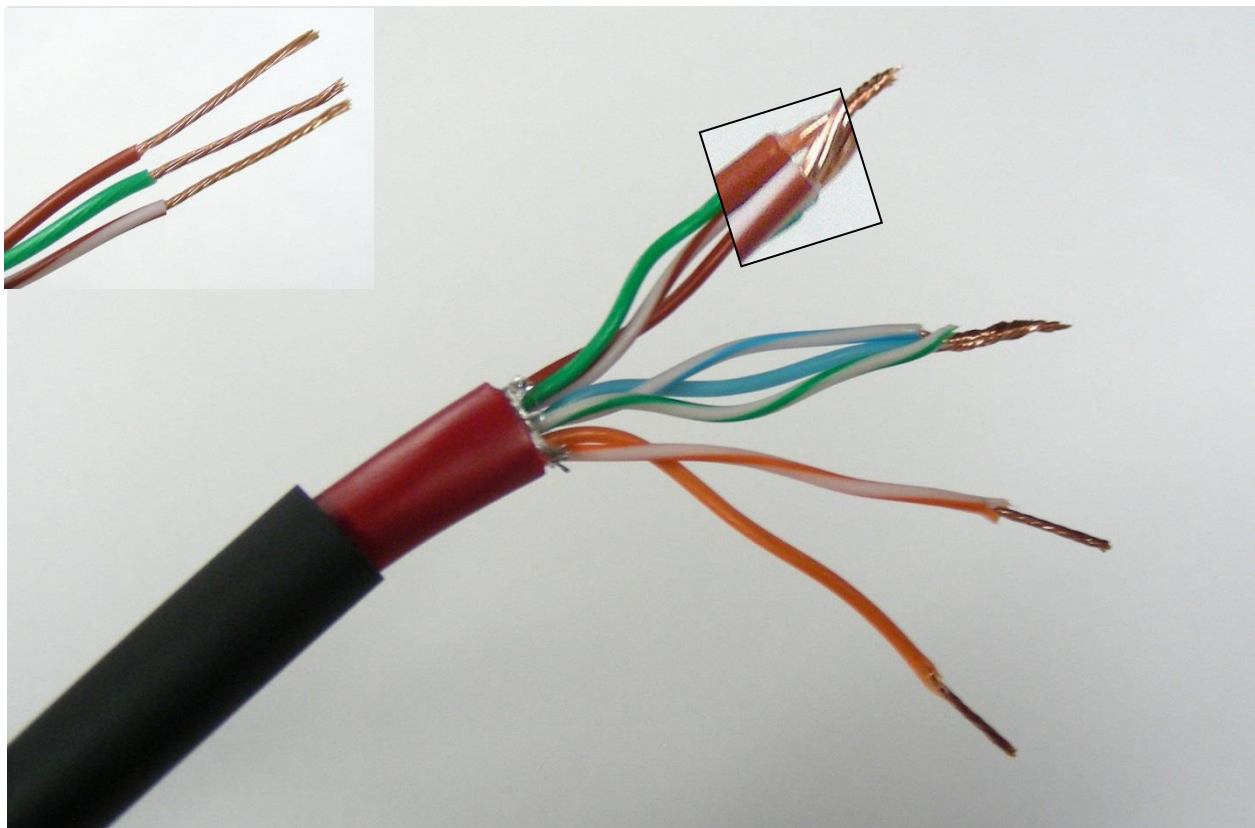


Cat 5 cable shown – others similar

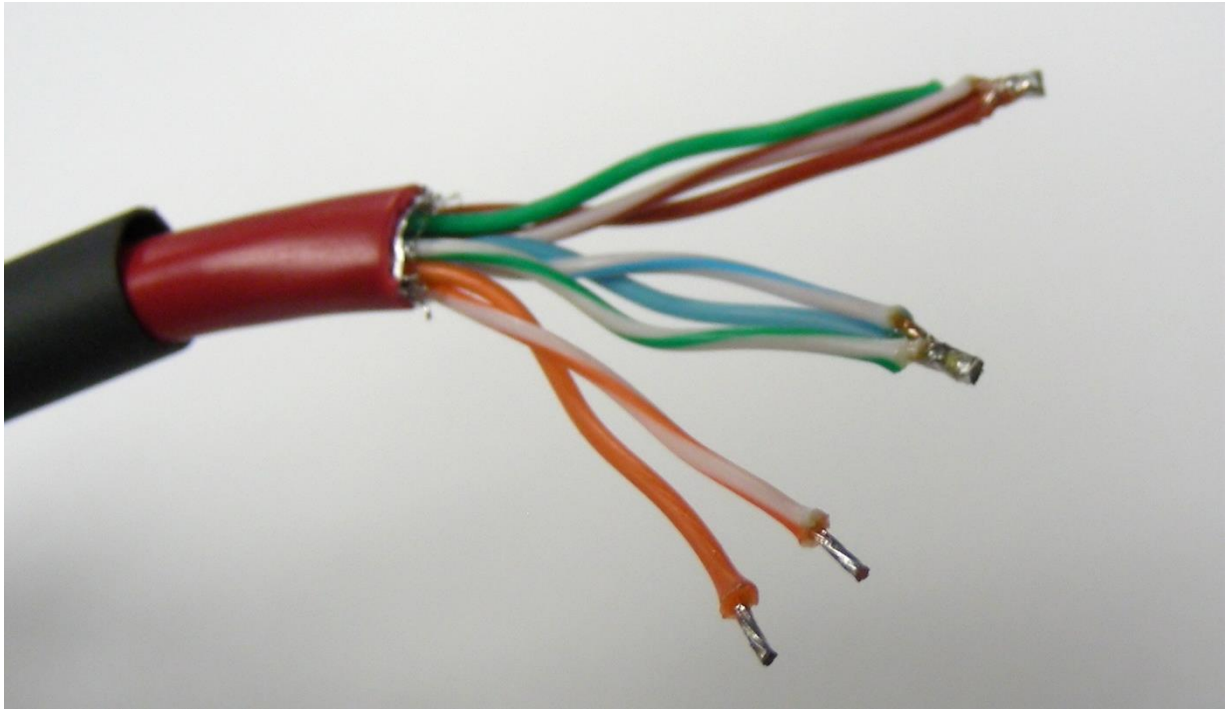
To attach the leads, remove approximately 1 inch of outer covering / insulation from the wire bundle. Remove any inner liner or tin foil as well (Cat 5e). If desired, slide a piece of heat shrink tubing over the wire bundle at this time.



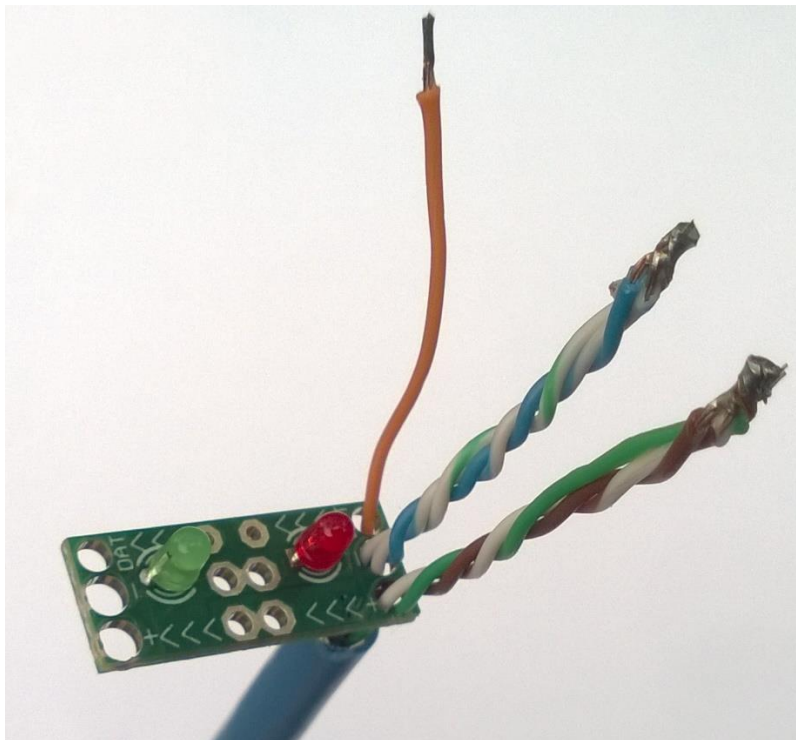
Strip approximately 1/4 inch of insulation off the wire to be soldered and group the wires (NOTE: your wire grouping may be different) by twisting the strands together. Insure the insulation of the grouped wires is aligned as evenly as possible so no bare wire will be exposed outside the solder pad outline.



Tin the twisted wires with solder being sure to minimize any melting of the wire insulation. Finally, trim the exposed wire leads to approximately 1/16 to 1/8 inch length. Note – You may or ma

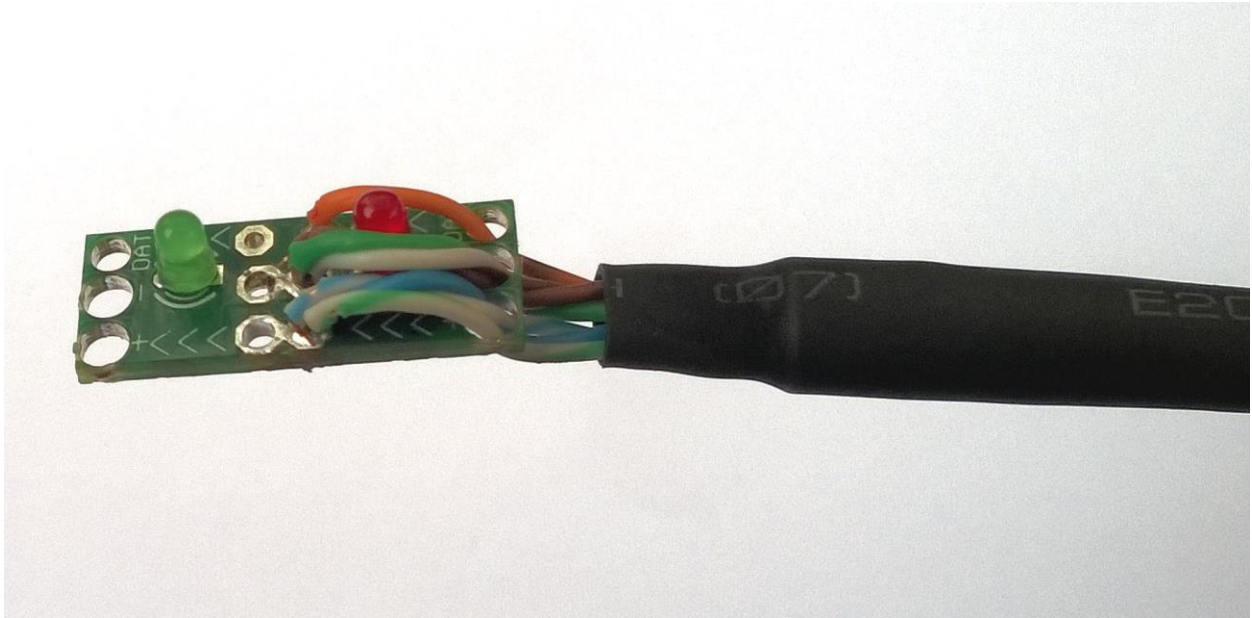


Insert Power, Ground and Data wires through the 'front' side of the μ Amp strain relief hole, then loop and place through the correct solder hole.



Repeat this attachment process for each of the wires in turn. When complete with both input and output wires, clean the board with a suitable flux removing solvent. Inspect each of the wires to insure there are no 'solder bridges' between adjacent pads. Though power in/out and ground in/out wires are designed to be bridged between the in/out sides.

If you added heat shrink tubing prior to starting the job, slide it into position and apply heat to complete the shrinking process. Repeat this process as needed for other wire attachments to the board.



Also note:

The μ Amp requires a maximum of approximately 16mA for operation. If your lead wires are too large or too stiff to fit in the microamp, you may run small wires to tap power for operation. That is to say, the high current power running the nodes does not specifically need to run through the μ Amp.

6. Troubleshooting μ Amp Indicator LEDs

LED Indications	Possible Causes	Possible Solutions
1. PWR on, DOUT off	Normal when power is first applied but data is not being sent.	n/a
2. PWR on, DOUT flashing (If nodes not working, see below)	Normal operation when actively receiving and transmitting data.	n/a
3. All LEDs off	No power / no input to μ Amp	Check connections at hub and any input cable connections, check hub fuse, check any cable / connectors between string controller and μ Amp, check hub power supply and supply-to-hub connections.
4. PWR on, DOUT on solid.	Data input line is being held high (+5.0V) Possible short circuit on input line. Possible transmission error with hub or string controller.	Verify no short circuit exists on input line. Verify correct data output of string controller or hub.
5. PWR on, DOUT flashing slowly but regularly.	Low frame rate being received by μ Amp.	Insure computer / hub is not overloaded. Frame rate is set appropriately high in sequencing software.
6. PWR on, DOUT flashing normally (fast) but intermittently.	Intermittent data is being received by μ Amp.	Insure data line connections are solid between hub, string controller and μ Amp.
7. PWR flashing intermittently, dim, or flickering - may be accompanied by DOUT flashing with each new 'on cycle' of PWR	Intermittent power to μ Amp or high resistance input power connection to μ Amp	Check hub, string controller and input cable connections for loose or high resistance connections.

If you believe you may have accidentally shorted the output wires, some possible conditions are listed below:

Vin / Vout shorted to GND – Possible blown hub fuse, (indicated by PWR LED off on μ Amp) no damage to μ Amp

DOUT shorted to Vin/Vout – Possible damage to node if connected and $V_{in} \geq 5.5V$, no damage to μ Amp

DOUT shorted to GND – No damage to node, no damage to μ Amp

In summary – shorted wires may have the possibility of blowing a fuse on the hub, or damaging a node, though due to the robust nature of the μ Amp design with MOSFET driver output, no damage should occur to the μ Amp board itself.

7. General and Electrical Specifications

Voltage Input: 5-16VDC

Voltage Output to Nodes: Same as Vin

Voltage Output on Data Line: 5V square wave across 5-16V input range

Controller Power Consumption:

Maximum consumption with 2 indicator LEDs installed

Idle (on, but not transmitting data) - 13mA

Full Tx mode - 16mA

µAmp-to-Node Data Tx Distance: Always keep as short as practical, realistically 20-40 feet, stress tested at 90 feet. **Note:** node-to-node distance is governed by the node itself and is generally 6-15 feet maximum – regardless of controller being used.

Node Compatibility: (**Note – Insure µAmp output voltage is compatible with node Vin**)

The µAmp is not “node specific” – it only clarifies, amplifies and re-transmits the data fed to it. µAmp should be compatible with any single-ended (as opposed to differential) 0-5V signal. If a single-ended signal less than 5V is received, µAmp will retransmit the signal amplified to a 5V level.

TM1804 - Confirmed

TM1809 - Confirmed

INK1002 - Likely

INK1003 - Likely

WS2811 - Confirmed

WS2812 - Likely

WS2812B - Likely

Pixabulb (WS2811) - Likely

WS280X - NO (requires additional clock signal - ie two single-ended signals...data and clock.) Though it should be possible to use two µAmp's in parallel...one for data and one for clock if needed.

Maximum number of nodes controlled: Limited only by input signal

Overall dimensions – 0.950" long x 0.375" wide

8. Revision History

Version 1.0	Original Document
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