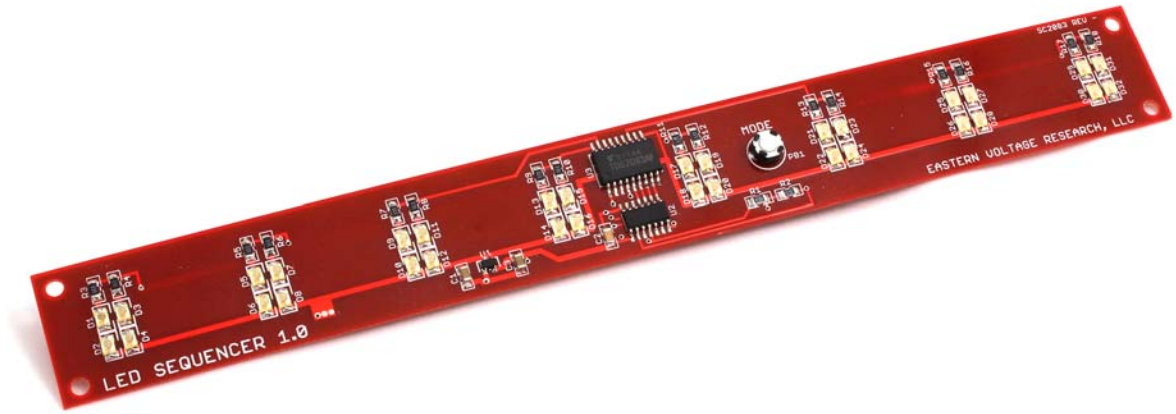
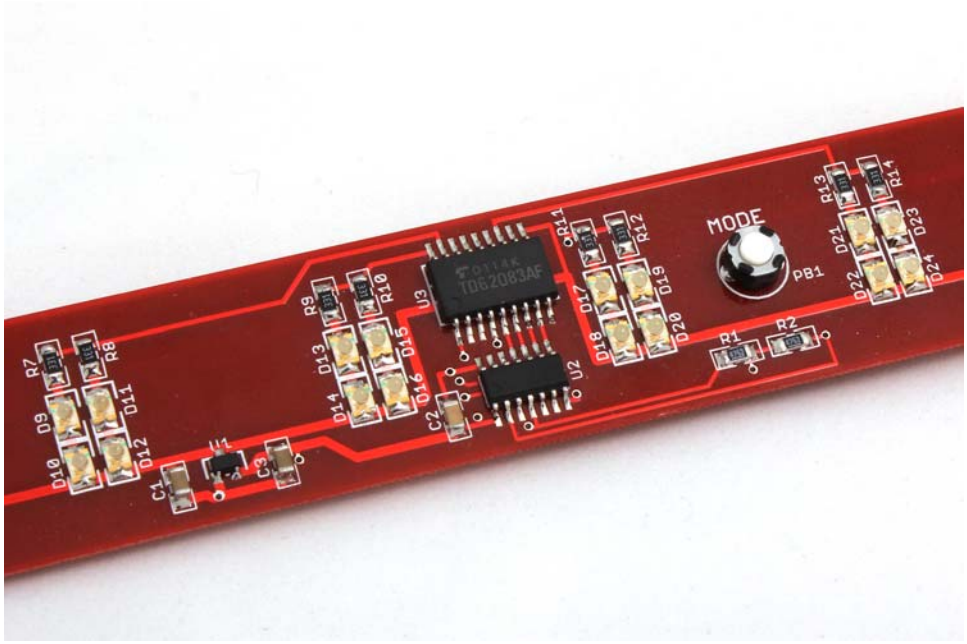
LED Sequencer 1.0 / 1.5



Instruction Manual

Eastern Voltage Research, LLC



Introduction to the LED Sequencer 1.0

Thank you for purchasing the LED Sequencer 1.0 Kit. The LED Sequencer 1.0 Kit is a simple LED chaser style kit that features an array of 16 LEDs (1.0 Kit) or 32 LEDs (1.5 Kit) (in 8 separate segments) that are displayed in a variety of user selectable patterns. The kit features all surface mount (SMT) components and is an excellent introduction to surface mount technology and soldering techniques for those who have never used surface mount components before. The sequenced LED display is quite impressive and extremely bright. Many of our purchasers have used this kit as a helmet mounted taillight for bicycle use as it provides excellent visibility. Others have used it for automotive decoration as well as costume use.

The kit is driven by a 16-bit microcontroller and features a variety of user selectable modes and flash rates. A single onboard pushbutton allows the user to change these display patterns with a single click and also to adjust the flash rates and speed of which those patterns are displayed.

Notice to Beginners: If you are first time kit builder, you may find this instruction manual easier to understand than expected. Each component in this kit has an individual check box, while a detailed description of each component is provided as well. If you follow each step in the instruction manual in order, and practice good soldering and kit building skills, the kit is next to fail-safe.

Please read this manual in its entirety before building, testing, or operating your kit!

Circuit Description

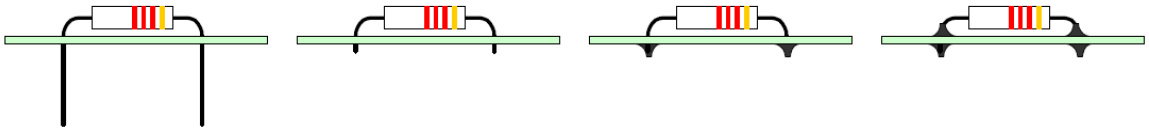
The LED Sequencer 1.0 is a very simple circuit comprised of only a few major components. The brains of the circuit is a 16-bit PIC16F505 microcontroller, U2. The microcontroller contains the code and information required to drive the LEDs and create all the different patterns and illumination styles. U3 is a high current darlington transistor driver which provides the high current necessary to power the eight (8) LED segments comprised of 16 LEDs (1.0 Kit) or 32 LEDs (1.5 Kit). U1 is a linear voltage regulator which converts the 9V input voltage to 5V which is required by the PIC microcontroller. Finally a pushbutton, PB1, allows the user to turn the unit ON and OFF as well as select which lightning pattern to display.

Kit Building Tips

A good soldering technique is key! Let your soldering iron tip gently heat both the wires and pads simultaneously. Apply solder to the wire and the pad when the pad is hot enough to melt the solder. The finished joint should appear like a small shiny drop of water on paper, somewhat soaked in. If the pads have not heated up sufficiently, melted solder (heated only by the soldering iron itself) will form a cold solder joint and will not conduct properly. These cold joints appear as dull beads of solder, and can be easily fixed by applying additional heat to the pad and wire. All components, unless otherwise noted, should be mounted on the top side of the board. This is the side with the silkscreen printing.

When installing components, the component is placed flat to the board and the leads are bent on the backside of the board to prevent the part from falling out before soldering. The part is then soldered securely to the board, and the remaining lead length is clipped off. It is also extremely important to place the components as close to the board as possible. This is necessary for proper operation over the wide frequency range of the various kits we provide. Also be sure that component lead lengths are always as short as possible. This will avoid adding any stray capacitances or inductances that can be detrimental to circuit operation.

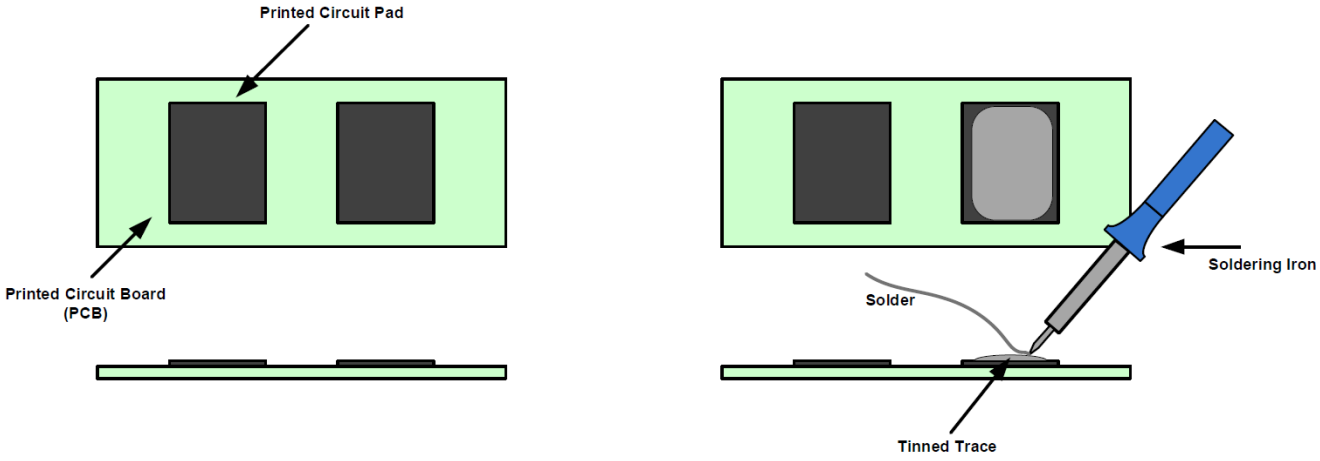
An alternative approach (which is actually the one I use) is to install the component into the board and then apply a piece of masking tape on the topside to the hold the component in place temporarily. The leads on the backside of the board are then trimmed leaving about 0.10" lead protruding through the backside of the board, and then soldered from the backside. You can then remove the masking tape, and finally apply a small amount of solder on the top to complete the joint on both sides. This is shown in the figure below.



Surface Mount (SMT) Component Soldering Instructions

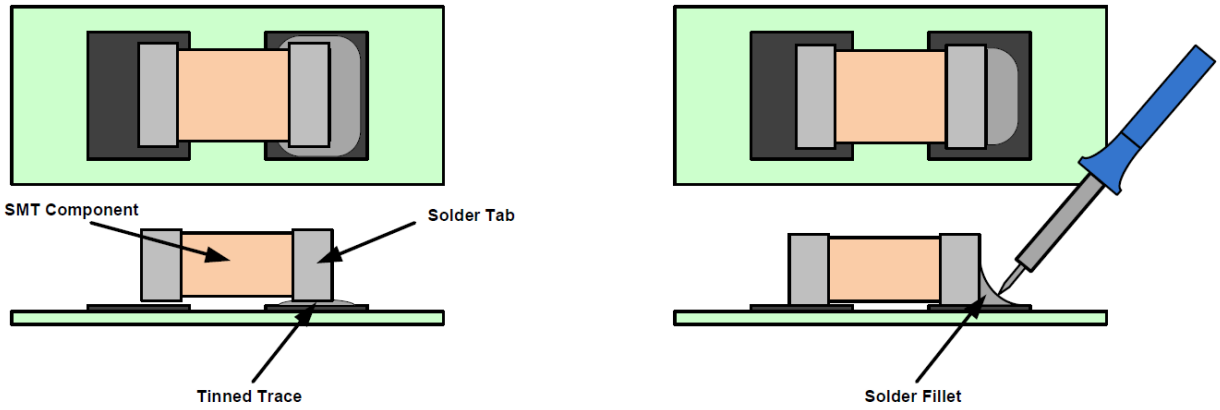
One of the first things you'll notice with your electronics kit is that many of the included components are surface mount components. These components do not have conventional leads, as is the case with thru-hole components, and instead solder directly to pads located either on the top or bottom of the PCB board.

One of the first things to remember when soldering surface mount (SMT) components to the board is that patience is a must! The first step when soldering a SMT component to the board, after properly identifying both the component and the location where it will be installed on the PCB board, is to slightly "tin" one of the pads on the PCB board that will connect to the component. This is accomplished by simply applying a very small amount of solder directly to the pad with the soldering iron as shown below.



The next step is to pick up and hold the component in place on its tinned pad using tweezers. While holding the component in place with tweezers, briefly re-heat the solder

with the soldering iron so that it flows onto the component solder tab and forms a nicely shaped solder fillet. For the remaining solder tabs on the same component, briefly heat up the component tab using the soldering iron and apply a small amount of solder directly to the pad, again creating a nicely shaped solder fillet. It is important to note that when reheating the solder, the soldering iron tip should contact the solder tab of the body of the component and not the solder directly. This will allow the solder to flow as efficiently as possible and form a proper solder fillet.



At first, surface mount soldering may seem a bit difficult, but its actually much easier than thru-hole soldering once you get the hang of it. Good luck and take your time!

LED Sequencer 1.0 Parts List

RESISTORS

❒	8	330 ohm Resistor, 1206 (marking 331), R3, R5, R7, R9, R11, R13, R15, R17 (1.0 Kit)
❒	16	330 ohm Resistor, 1206 (marking 331), R3-R18 (1.5 Kit)
❒	2	47k, Resistor, 1206 (marking 473), R1, R2

CAPACITORS

❒	2	1uF Ceramic Capacitor, 1206, C1, C2
❒	1	0.1uF Ceramic Capacitor, 1206, C3

DIODES

❒	16	LED, Red or Blue, D1, D2, D5, D6, D9,D10,D13,D14,D17,D18,D21, D22,D25,D26,D29,D30 (1.0 Kit)
❒	32	LED, Red or Blue, D1-D32 (1.5 Kit)

INTEGRATED CIRCUITS (ICs)

❒	1	5V Regulator (marked HJ18), U1
❒	1	PIC16F505 Microcontroller (marked PIC16F505), U2
❒	1	High-Current Darlington Driver (marked TD62083AF), U3

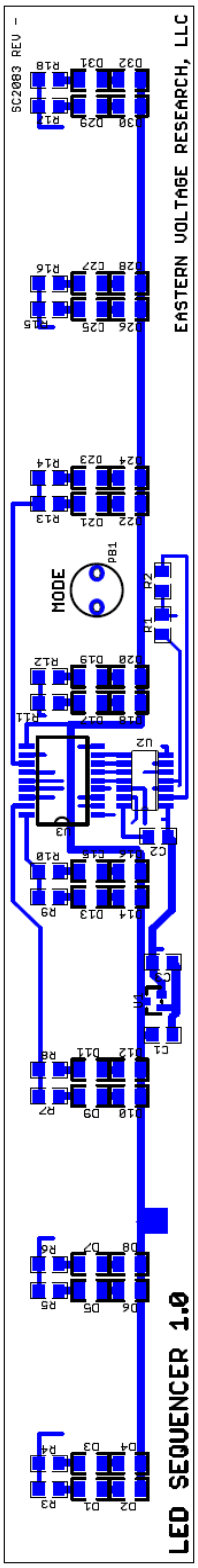
MISCELLANEOUS

❒	1	Pushbutton, PB1
❒	1	9V Battery Connector
❒	1	LED Sequencer 1.0 PCB Board

REQUIRED, NOT SUPPLIED

❒	1	9V Battery or 9VDC AC Adapter

LED Sequencer 1.0 Component Layout Diagram (Rev – PCB)



KIT Building Instructions

Now we will begin building the kit. There are just a few more important things to know before we install the first components.

For each component, the word "install" always means the following:

1. Pick the correct value to start with.
2. Insert the component into the correct printed circuit board (PCB) location.
3. Orient the component correctly – especially when there is a right and a wrong way to solder it in. (i.e. electrolytic capacitors, diodes, ICs, transistors, etc…)
4. Solder all connections unless directed otherwise. Ensure enough heat is used to allow solder to flow for clean, shiny, and completed connections.

Also, please be sure to take us seriously when we say that good soldering is the key to the proper operation of your circuit!

- Use a 25W soldering pencil with a clean, sharp tip. DO NOT USE a high power soldering gun such as those trigger activated units.
- Use only rosin core solder intended for electronics use
- Ensure your work area is clean, and has plenty of bright lighting
- Build your kit in stages, taking breaks to check your work. Be sure to clean the board periodically with a brush or compressed air to remove any excess wire cuttings, etc…

Okay, so lets begin!

❒ 1. Install R1, 47k, 1206 resistor (marked 473 or 4752)

❒ 2. Install R2, 47k, 1206 resistor (marked 473 or 4752)

❒ 3a. Install 330 ohm, 1206 resistors (marked 331) in the following locations.
(1.0 Kit)
R3,R5,R7,R9,R11,R13,R15,R17

❒ 3b. Install 330 ohm, 1206 resistors (marked 331) in the following locations.
(1.5 Kit)
R3,R4,R5,R6,R7,R8,R9,R10,R11,R12,R13,R14,R15,R16,R17,R18

❒ 4. Install C1, 1uF, 1206 capacitor

❒ 5. Install C2, 1uF, 1206 capacitor

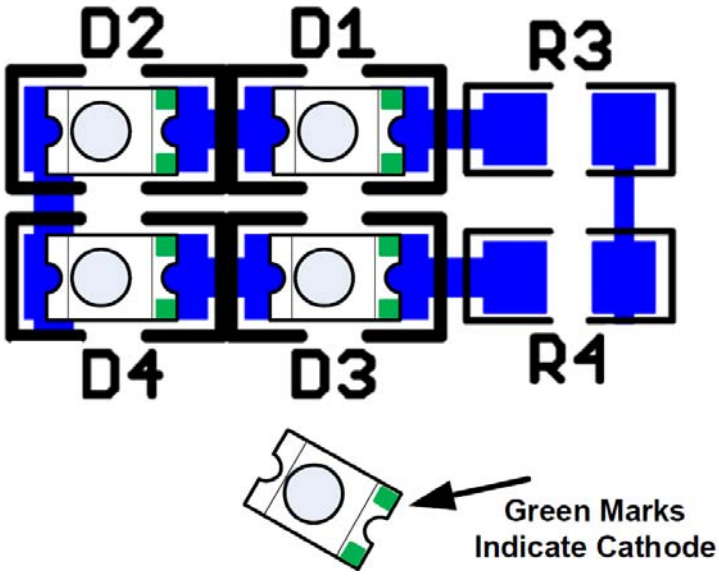
❒ 6. Install C3, 0.1uF, 1206 capacitor

❒ 7a. Install LEDs in the following locations. **(1.0 Kit)**
D1,D2,D5,D6,D9,D10,D13,D14,D17,D18,D21,D22,D25,D26,D29,D30

❒ 7b. Install LEDs in the following locations. **(1.5 Kit)**
D1,D2,D3,D4,D5,D6,D7,D8,D9,D10,D11,D12,D13,D14,D15,D16,D17,D18,D19,
D20,D21,D22,D23,D24,D25,D26,D27,D28,D29,D30,D31,D32

The LEDs have polarity and should be installed so that the cathode end of the LED is pointing towards the resistor. The cathode end of the LED is designated by two colored green squares as shown in the picture below.

The figure below shows how the LEDs should be installed for a single array. Again, note that the cathode end (designated by the green squares) should be pointed towards the resistor in each LED string. The figure below is shown for the 1.5 Kit version. Note that the 1.0 Kit only utilizes two (2) LEDs per single array, so only D1 and D2 would be populated with LEDs in the 1.0 Kit version.



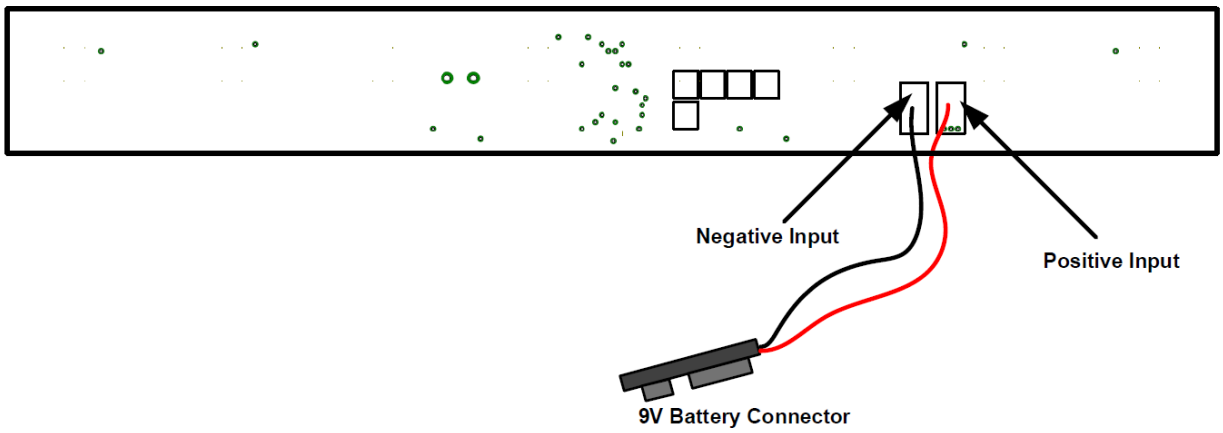
❒ 8. Install U1, MCP1702 Linear Regulator. This component has three leads and can only be installed one way on the board so no confusion there.

❒ 9. Install U2, PIC16F505 Microcontroller. Note that one end of the IC is marked by a dot, notch, or band; this end MUST be oriented as shown on the PCB layout.

❒ 10. Install U3, TD62083 Darlington Driver. Note that one end of the IC is marked by a dot, notch, or band; this end MUST be oriented as shown on the PCB layout.

❒ 11. Install pushbutton, PB1.

❒ 12. Install the 9V Battery connector to the bottom of the PCB board as shown in the figure below. Be sure to observe proper polarity when installing the battery connector as reverse voltage will damage the components on the board. Note, that you can use an 9VDC AC adapter as well instead of a 9V battery, especially if you want to run for extended periods of time. If you do use a 9VDC AC adapter, be sure to verify proper polarity with a multimeter prior to installing and applying power as well as ensuring the AC adapter is indeed provides 9V DC output, as opposed to 9V AC output. DO not connect the 9V battery to the connector at this time.



DO NOT connect the 9V battery to the battery connector at this time.

Congratulations! You have just completed your LED Sequencer 1.0 / 1.5 Kit. Please take a few moments to look over the board and ensure that all the components are installed properly with the correct orientation. Since some of the parts may be unfamiliar to you, you may want to be extra sure that they have been inserted correctly. After you are sure that everything seems to be properly installed, move on to the set-up and testing section.

Set-up and Testing

Okay, so lets begin!

RECOMMENDED TEST EQUIPMENT, NOT SUPPLIED

❒ 1 None required

Be careful not to connect the 9V battery backwards into the circuit. Reverse polarity could potentially damage the circuits on the LED Sequencer. If there is concern about this, a diode could be placed in series with the battery connector to prevent reverse polarity. Simply use a 1N4001, 1N4148, 1N5819, etc… if you feel the need to install a diode.

❒ 1. Connect a new 9V battery (not supplied) to the 9V battery connector. At this time, nothing on the LED Sequencer board should be illuminated. You can also use an external 6V-9V power source if desired. Just make sure the voltage is 6-9VDC, and that you ensure proper polarity when connecting this source to the board, otherwise, you could damage it with reverse polarity. Again, by installing a diode in series with the 9V input, you can protect against reverse voltage protection if desired.

❒ 2. All LED modes are controlled by the user by a single pushbutton. The pushbutton has three modes of operation. The function selected by the pushbutton depends on how long the pushbutton is pressed by the user. The first thing we will do is to show you how the LED pushbutton feedback system works. Go ahead and press the pushbutton and hold it down. You will notice that on the left side of the board, the 1st LED segment will illuminate, then the 2nd LED segment, and finally the 3rd LED segment. Release the pushbutton after the 3rd LED segment illuminates, and the LED Sequencer should remain in the OFF state. What do these LED segments mean? Great question. The following paragraphs describe the functionality.

1st SEGMENT – If you release the pushbutton after only the 1st segment has illuminated, then the pattern rate (speed) will increment. There is a total of (4) four speeds per pattern, so once you reach the highest speed (rate = 4), it will reset back to the lowest speed.

2nd SEGMENT – If you release the pushbutton after the 1st and 2nd segments have illuminated, then the pattern type will increment. There are a total of (7) separate modes, which are listed below. Once you reach mode 7, it will increment back to mode 1 which is the OFF state.

MODE 1	OFF
MODE 2	Cylon Eye Sweep (Single LED)
MODE 3	Cylon Eye Sweep (Dual LED)
MODE 4	Flash Mode (ALL LEDs)
MODE 5	Dual Eye Sweep Inward
MODE 6	Dual Eye Sweep Outward
MODE 7	Alternate Flash Left/Right

3rd SEGMENT – Finally, if you release the pushbutton after all three segments illuminate, than the LED Sequencer will be disabled and enter the OFF state.

One final note, is that because the microcontroller being used does not have interrupt capability (i.e. a pushbutton that can be read at any time during operation), pushbutton inputs are only detected by the microcontroller when the LED sequences are at the left side of the board. So when you decide to change display modes, simply hold the pushbutton down, and once the LED sequence returns back to the left side of the board, you'll see all LEDs turn off and the LED feedback system begin to operate illuminating the sequence of 1st, 2nd, and 3rd LED segments, again depending on how long you hold the pushbutton.

Congratulations! Your LED Sequencer 1.0 Kit is now complete and operational.

Troubleshooting

PROBLEM: Some LEDs are not working
SOLUTION: This is typically due to an LED being installed backwards. Check the LEDs to ensure they are installed in the proper orientation.

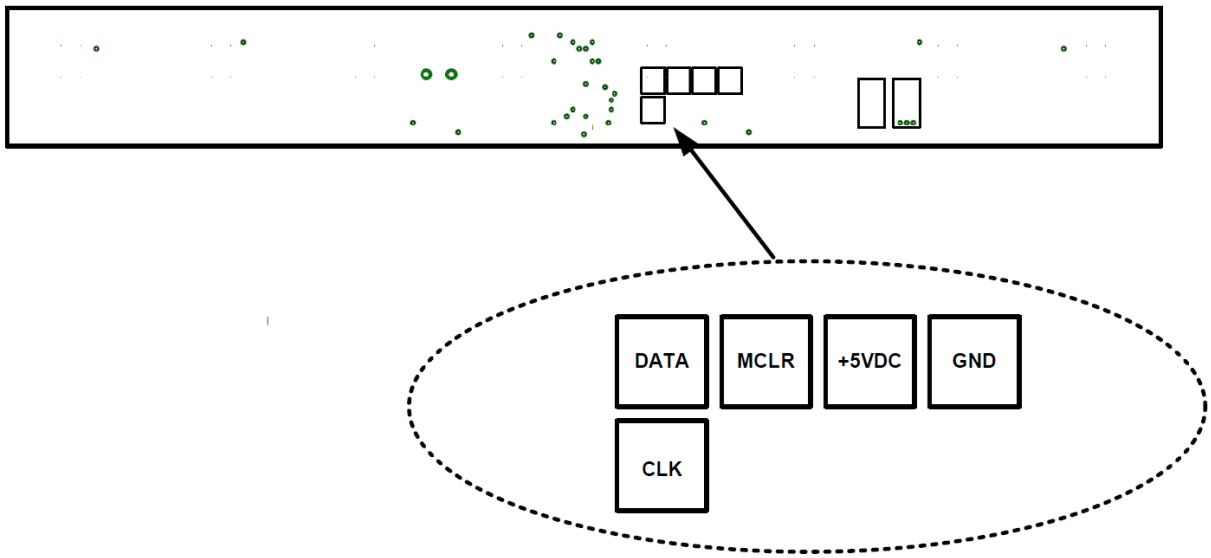
PROBLEM: LEDs are very dim.
SOLUTION: This is due to a bad battery, or an AC power adapter that cannot put out much current.

PIC Microcontroller Code Modification

One of the cool options of this kit is that we have made the code open source and have also supplied the kit with an unprotected PIC microcontroller. This allows you, as the end user, to modify and reprogram your LED sequencer with whatever patterns, or other functionality you wish. All that is required is an appropriate FLASH programmer which can be connected to the board as shown below.

To connect a FLASH programmer to the LED sequencer board, simply connect the appropriate programmer to the board as shown below. Pads for each of the necessary signals are provided on the underside of the LED sequencer board.

PIC microcontroller code is available as download from the ordering page of the LED sequencer board in .C format.



Conclusion

We sincerely hope that you have enjoyed the construction of this Eastern Voltage Research Kit. As always, we have tried to write this instruction manual in the easiest, most "user friendly" format that is possible. As our customers, we value your opinions, comments, and additions that you would like to see in future publications. Please submit comments or ideas to:

Eastern Voltage Research, LLC

Technical Support
support@easternvoltageresearch.com

Thanks again from the people here at Eastern Voltage Research.

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