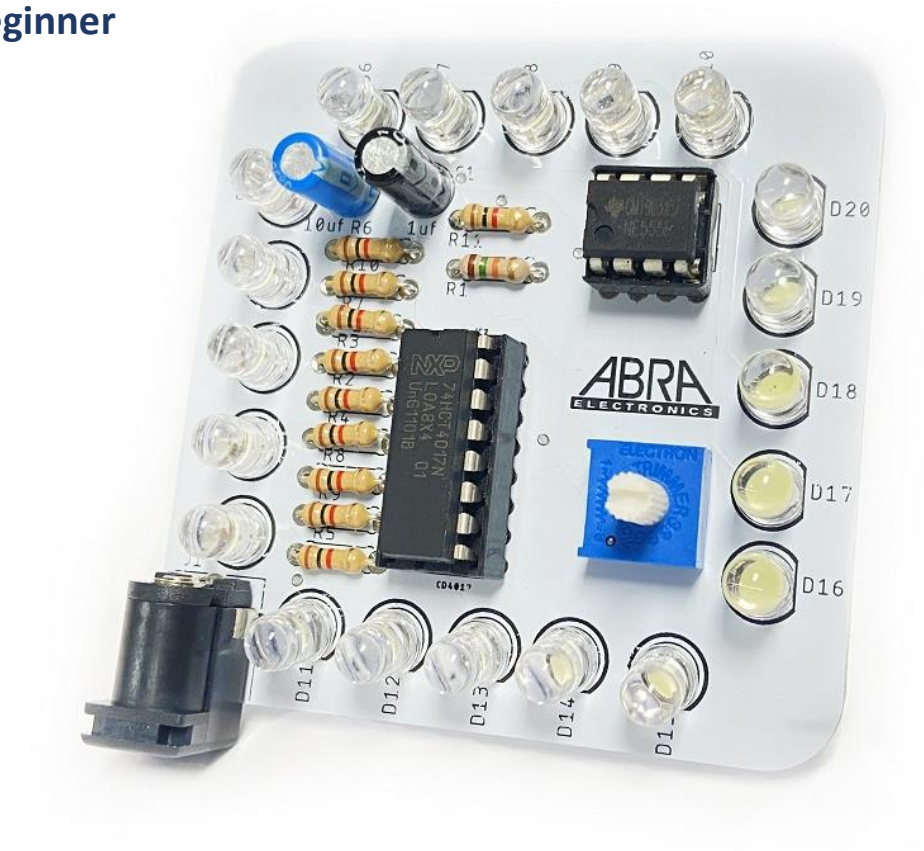
D.I.Y. Square LED Kit

Part Number: **AK-76**

Level: Beginner



- *Assemble your very own Square LED circuit Kit and enjoy the liberty of adjusting the sequence frequency to your liking.*
- *Frequency can be controlled via the on-board potentiometer.*
- *Learn how the NE555 precision timing circuit works.*
- *Battery powered for reliability and portability.*

ABRA

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1. Description:

This is the upgraded version of our popular AK-75 LED Ripple Kit with a well-thought-out PCB layout with varying colors of solder masks on both sides. It uses 20 LEDs that light up in a sequence in a square formation. It also uses a NE555 precision timing circuit IC to allow adjustable frequencies controlled by the user.

The frequency can be altered upon rotating the potentiometer to obtain frequencies ranging from 1Hz – 10Hz.

This is a D.I.Y. kit that requires soldering through-hole components on the double-sided printed circuit board. Users with minimal soldering tools can easily assemble this module.

2. Specifications:

- **Operating Voltage Range**: 5 – 12VDC (9VDC recommended)
- **PCB Dimensions:** 60.3mm x 60.3mm x 1.6 mm / 2.37 x 2.37 x 0.06”

3. Advantages:

- Obtain a circuit that emits a visually pleasing pattern of LEDs.
- Assemble your very own Square LED Kit and take your first steps into becoming a soldering master.
- Can be controlled manually by rotating the Potentiometer.
- Learn how the NE555 precision timing circuit works.
- Battery powered for reliability

4. Bill of Materials

Component	Label	Value / Type	ABRA Part Number	Quantity
Resistors And Potentiometer	R1	1/4 Watt 4-band 15KΩ ±5%	R1/4-15K	1
	R2-R11	1/4 Watt 4-band 1KΩ ±5%	R1/4-1K	10
	R12	50kΩ Potentiometer	3386P-1-503SH	1
Capacitor	C1	Polarized 1µF	1R50	1
	C2	Polarized 10µF	10R50	1
Diodes	D1-D20	5mm Light-Emitting diode	----	20
IC	IC1	NE555 Precision timing circuit	NE555	1
	IC2	CD4017	74HCT4017/4017	1
Connectors	J1	DC Barrel Jack Adapter	PRT-10811	1
	----	Low Profile Socket - 16 Pins	16LP	1
	----	Low Profile Socket - 8 Pins	8LP	1
	----	9V Battery Clip to 2.1mm DC plug	BAT-C-01	1
PCB	----	Double-sided Printed Circuit Board	AK-76-BRD	1

5. Assembly:

1) In order to assemble the module, you need the following tools:

Must Have

Soldering Station

60/40 or 63/37 Tin-Lead Solder

Flush Cutters

Tweezers/Pliers

Wire Stripper

Vice

Recommended

Isopropyl Alcohol

Rosin Flux/Pen

Soldering Brush

Lint Free Wipers

***It is recommended to have some isopropyl alcohol and a fine soldering brush handy to clean off the excess flux on the circuit board when the soldering is done.**

***ATTENTION* DO NOT USE RUBBING ALCOHOL, IT WILL DAMAGE THE COMPONENTS.**

2) Open the package and verify the components. (refer to section **4. Bill of Materials** on **page 2**)
3) Lay down all the components on your workbench and proceed to the next step.
4) Prepare your soldering tools.
   a) Use an appropriate tip for the application. Also, make sure the soldering tip is clean. Gently use a brass wool or a brush to clean the tip when needed. Another way of cleaning the soldering tip by using a wet sponge.

b) The soldering iron temperature depends on the type of solder used. If you are using a typical **60/40 lead solder**, depending on the thickness the temperature should be set anywhere between **370 to 500 °F (187 to 260 °C)**. If you are using a lead-free solder, increase above temperatures **by 40 to 70 °F (5 to 20 °C)**.

***ATTENTION* HIGHER TEMPERATURES WILL DAMAGE THE COMPONENTS AND THE PRINTED CIRCUIT BOARD.**

***ATTENTION* DO NOT TOUCH THE SOLDERING IRON WHEN IT IS HOT.**

c) It is recommended that you clean the board with a fine brush, isopropyl alcohol, and lint-free cloth to get rid of any pre-existing residue, glue or dirt. This way the solder will create a better joint with the pad surface.

d) Have your flush cutter, needle nose plier or tweezers handy.

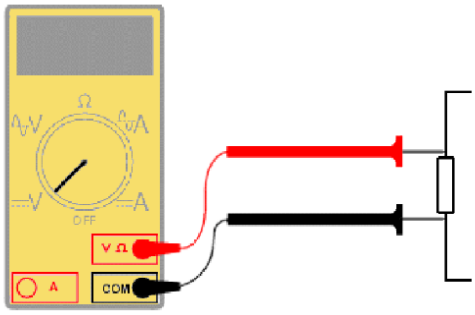
e) Having a roll of paper tape helps you to keep the components in place when soldering on the bottom side of the board.

f) Have a rosin flux pen or paste handy. Adding flux to the pads before soldering the components makes the wetting process easier by letting the melted solder flow better on the pad and create a better joint.

***ATTENTION* SOLDERING SHOULD BE DONE IN A VENTILATED AREA. BREATHING SOLDER FUMES WILL HARM YOU.**

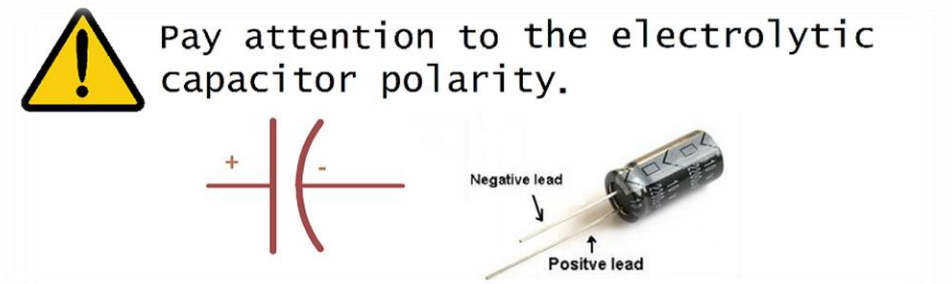
g) Always cut the excess leads with a flush cutter once a component is soldered on the PCB. At least 1mm of the lead should stick out from the solder joints.

Optional
Use a digital multimeter to measure the resistor values



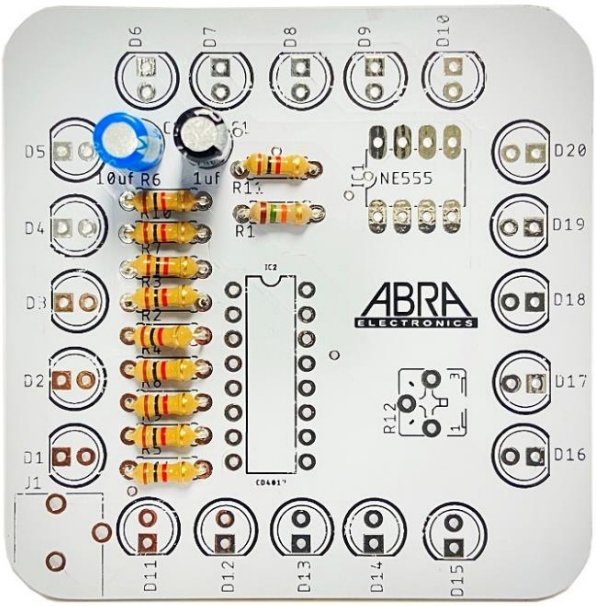
Step 1:

Insert the resistors (R1 and R2-R11) onto the board and solder them from the bottom.



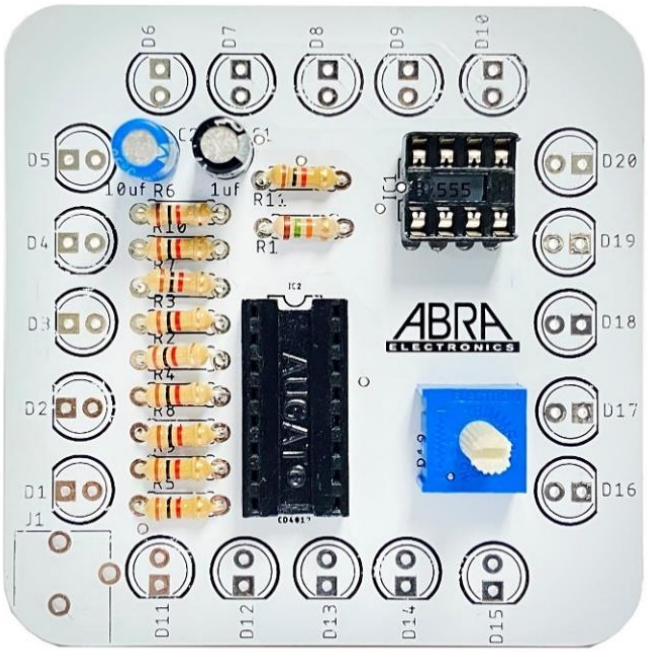
Step 2:

Solder both capacitors (C1 and C2) onto the board in the proper position. Refer to the picture above for the correct orientation.

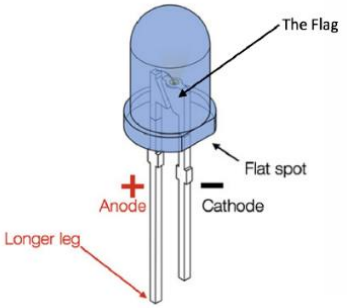


Step 3:

Insert both low-profile pin sockets (8-pin and 16-pin) onto the board along with the potentiometer (R12) and solder them as you did on the previous steps.



Pay attention to the LED polarity.



Step 4:

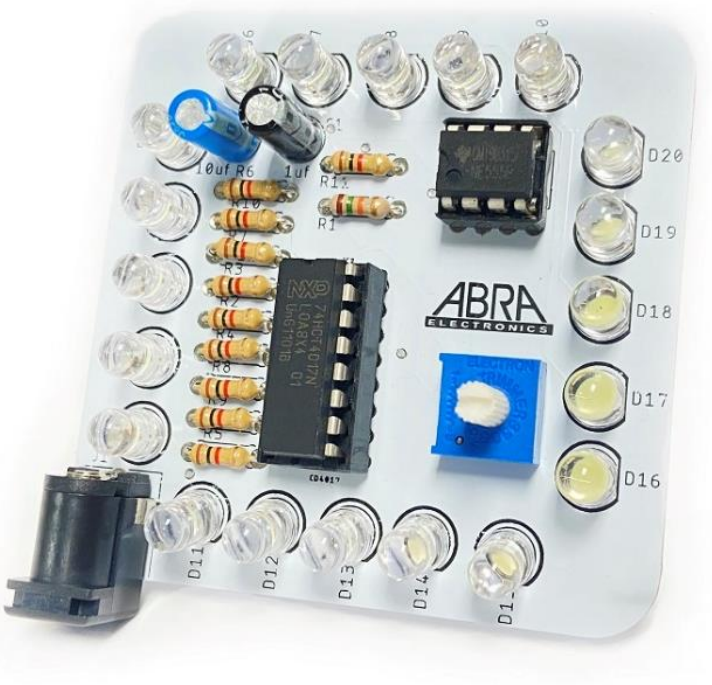
Solder all the LEDs (D1-D20) around the perimeter of the board. Refer to the picture above for the correct orientation.

Step 5:

Insert the DC barrel jack (J1) onto the board and solder it to the board.

Step 6:

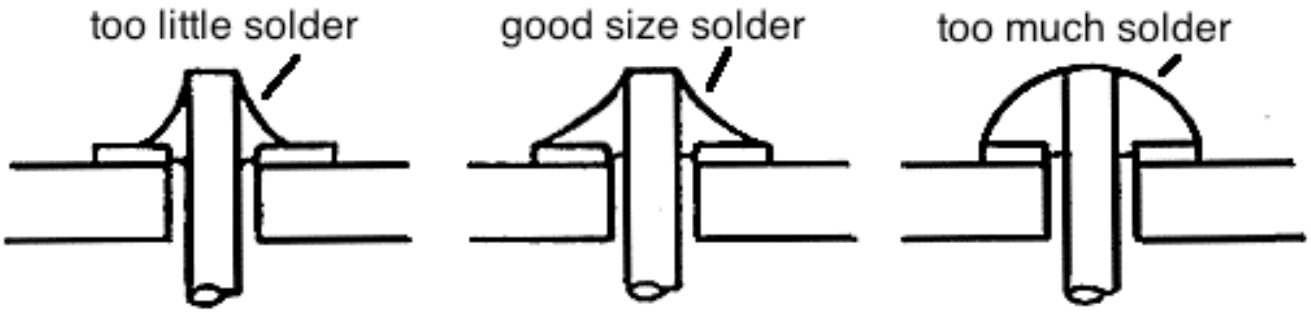
Finally, insert the CD4017 chip into the 16-pin header and the NE555 chip into the 8-pin header.



To verify the quality of your soldering, refer to the adjacent picture:

Assembly Check out:

- Before installing the 9V battery it is highly recommended to inspect the PCB carefully.
- Check for proper placement of components.
- Check that the LEDs and the capacitors are installed in the correct directions.
- Check that all connections are soldered with a shiny appearance.
- Redo any solder connection that is dull looking or in a ball.



- Check that there are no solder bridges touching adjacent connections together.

Operation:

- Install a 9V battery onto the battery connector. (Battery is not included in this kit)
- Insert the DC jack end of the connector into the DC barrel jack.
- Twist the potentiometer to obtain your desired frequency.

What Is the NE555 chip and How Does It Work?

- The NE555 precision timer acts as a waveform generator whose output frequency relies on the values of a few components. Theses components consist of two resistors (R_A, R_B) and a capacitor (C).
- When the trigger input falls below the trigger level, the flip-flop is set, and the output goes high.
- When the trigger input level is above the trigger level, the flip-flop is reset, and the output is low.
- The formula of the output frequency is the following:

$$\text{Frequency} \approx \frac{1.44}{(RA+2RB)C}$$

Other useful equation are as follows:

Output high-level duration = $T_H = 0.693(R_A + R_B)\ C$

Output Low-level duration = $T_L = 0.693(R_B)C$

Period = $t_H + t_L = 0.693(R_A + 2R_B)\ C$

$$\text{Output driver duty cycle} = \frac{TL}{TH+TL} = \frac{RB}{RA+2RB}$$

$$\text{Output waveform duty cycle} = \frac{TH}{TH+TL} = 1 - \frac{RB}{RA+2RB}$$

$$\text{Low-to-high ratio} = \frac{TL}{TH} = \frac{RB}{RA+RB}$$

6. Schematic Diagram: