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Halloween Blinky-eyes Soldering Kit

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This project is intended to introduce youngsters to electronics and soldering. In retrospect the solder pads should be larger for such a project. But with guidance, close observation, and perhaps some assistance the project can be completed by 10 year olds and older in less than 60 minutes.

This document and corrections to it will be posted on the web at URL: <http://aj0ml.org/files/halloween-blinky-eyes.pdf>.



NOTE: Do not open the kit yet.



WARNING: Before you begin to work on this kit and during construction, please keep safety in mind.

Soldering irons are very hot and can cause severe burns. They can instantly burn you and easily melt surfaces and some types of clothing.



WARNING: When cutting wire leads ensure they don't hit people. Always clip leads with them facing away for you and others. You should cup your hand over the lead while cutting them.



SAFETY: Wear safety goggles or safety glasses while building this kit.



SAFETY: Children, who may assemble this kit, must be supervised by an adult.



NOTE: Keep your work area clean and tidy so parts (some of them are small) do not get misplaced or lost.



ELECTROSTATIC DISCHARGE SAFETY: The LM555N (or similar) integrated device is sensitive to static electricity. Please ensure proper safeguards for the device and your work area are observed prior to and while handling this or any integrated circuit.



ELECTROSTATIC DISCHARGE SAFETY: You should wear an anti-static strap while working on this kit, but most people don't have those. Instead, ground yourself out before working on the kit but touching a water faucet or metal doorknob or the best yet, the little screw on a light switch. Also, do not wear wool or polyester while working on this kit.



NOTE: This kit contains polarized components. A kit that does not operate correctly is most likely to occur due to a part being installed backwards or in the wrong orientation.



NOTE: Review all steps before proceeding.

What you will need to complete this kit.

1. ____ This kit and these instructions
2. ____ Flush-cut wire cutters
3. ____ Needle-nose pliers
4. ____ Solder
5. ____ Soldering gun with small tip
6. ____ Anti-static wrist band
7. ____ Damp sponge
8. ____ Small towel
9. ____ Isopropyl Alcohol
10. ____ Small penlight or flashlight

Kit components list

1. ____ 1 ea., High-quality printed circuit card
2. ____ 2 ea., Light Emitting Diodes (LED), D1 and D2
3. ____ 1 ea., LM555N (or similar) 8-pin Dual Inline Package Integrated (DIP) Circuit – Timer, U1
4. ____ 1 ea., 1M ohm resistor, R1
 - a. Brown, Black, Green
5. ____ 1 ea., 10K ohm resistor, R2
 - a. Brown, Black, Orange
6. ____ 2 ea., 330 ohm resistors, R3 and R4
 - a. Orange, Orange, Brown
7. ____ 1 ea., 10uF Radial Electrolytic Capacitor, C1
 - a. 10uF, 16 to 25V, polarized
8. ____ 4 ea., Black tubes, 3/32" x 3/8" long
9. ____ 1 ea., 8-pin DIP socket, U1 socket
10. ____ 1 ea., 9 VDC battery snap connector

Preparing to assemble the kit

Go through the list of items needed and the list of kit components to ensure you have everything to get started. Check the items off of each list to ensure everything is on hand before you begin.

Check items off of the assembly instructions as you go to ensure no steps are overlooked or skipped.

Ensure your soldering gun is properly heated before you begin.

Clean the soldering gun tip frequently on the damp sponge during the construction of this kit.

Before attempting to solder, ensure the soldering gun tip is properly whetted. Always place a very small amount of fresh solder on the tip before attempting to solder a component.

Assembly

1. ____ Open the kit.
2. ____ Understand the circuit card. **All** components are mounted on the top of the circuit card. See **Helpful Hints** below – Side Identification.



NOTE: The top has four circles – one in each corner! This is the COMPONENT SIDE.



NOTE: The side with component markings; .e.g, R1, R2, D1, et cetera, is the SOLDER SIDE.

Inserting the 8-Pin Dual Inline Package Socket

3. ____ Locate the 8-pin DIP socket.
4. ____ Locate the set of eight (4 and 4 parallel holes in a row) on the COMPONENT SIDE of the circuit card. One hole has a square pad and there is a diagonal trace between two other pads.



NOTE: For proper identification the parallel set of holes have a diagonal trace between two of the holes.



NOTE: EXTREMELY IMPORTANT. The square solder pad is Pin 1 for U1. Please make a note of this.

5. ____ Set the 8-pin DIP socket on the table with the pins facing down. There is a small depression on one end of the 8-pin DIP socket – face it away from you. Pin 1 is on the left side, furthest from you. See **Helpful Hints** below – 8-pin DIP Socket Pin-1.
6. Align the square solder pad on the circuit card with the 8-pin DIP socket's Pin 1 and insert the 8-pin DIP socket into the circuit card. Ensure all the pins go through (none are bent). It should fit easily.
7. ____ On the SOLDER SIDE of the circuit card, bend each corner pin outward slightly to hold the DIP socket in place so it doesn't fall out.



NOTE: The solder side of the circuit card has most of the traces and all component markings.

8. ____ Solder each of the 8 pins. Solder the part on the SOLDER SIDE of the card.

Inserting the resistors

9. ____ Locate the two 330 ohm resistors (Orange, Orange, Brown bands).
10. ____ Using needle-nose pliers, bend the lead closest to the orange band over a down along the side of

the resistor. It will be somewhat U-shaped. Do this for both resistors. See **Helpful Hints** below – Forming Resistors.

11. ____ Insert one resistor from the TOP of the card in the holes for R3.
12. ____ Bend the leads outward slightly to hold the resistor in place. The bottom of the resistor should touch the card.
13. ____ Solder the resistor leads.
14. ____ Cut the leads on the solder side with the flush-cut pliers.
15. ____ Repeat steps 8 through 12 for the second 330 ohm resistor – The second resistor is for R4.
16. ____ Locate the 10K ohm resistor (Brown, Black, Orange bands).
17. ____ Bend the lead closest to the brown band as you did before.
18. ____ Insert the 10K ohm resistor from the TOP of the card in the holes for R2.
19. ____ Bend the leads outward slightly to hold the resistor in place. The bottom of the resistor should touch the card.
20. ____ Solder the resistor leads.
21. ____ Cut the leads on the solder side with the flush-cut pliers.
22. ____ Locate the 1M ohm resistor (Brown, Black, Green bands).
23. ____ Bend the lead closest to the brown band as you did before.
24. ____ Insert the 1M ohm resistor from the TOP of the card in the holes for R1.
25. ____ Bend the leads outward slightly to hold the resistor in place. The bottom of the resistor should touch the card.
26. ____ Solder the resistor leads.
27. ____ Cut the leads on the solder side with the flush-cut pliers.



NOTE: This completes all tasks for the resistors. You should have no remaining resistors in your work area. R1, R2, R3, and R4 should have resistors now and all the leads should be cut.

Inserting the capacitor

28. ____ Locate the 10 μ F electrolytic capacitor.
29. ____ Noting its polarity (negative is marked with a minus sign [-] on the case, the positive side has no

marking, insert it from the TOP of the circuit card in the holes for C1.



NOTE: Ensure the positive lead goes through the hole next to the + sign for C1.

30. ____ Bend the leads outward slightly to hold the capacitor in place.



NOTE: The bottom of the capacitor does not have to touch the circuit card.

31. ____ Solder the capacitor leads.

32. ____ Cut the leads on the solder side with the flush-cut pliers.

Inserting the LEDs

33. ____ Locate the two yellow LEDs.

34. ____ Locate the four black 3/8" plastic tubes.



NOTE: LEDs are polarized. They have an anode (+) and cathode (-). The cathode is the longer lead on the LED. Also the cathode is noted by a flat spot on the bottom edge of the LED's epoxy case. See Helpful Hints below – LED Cathode Identification.

35. ____ Place one black 3/8" tube on each lead of the LED. Each LED receives two tubes – one per lead.

36. ____ Locate the longer LED lead. It will be inserted into the circuit card first.

37. ____ Locate the markings for D1 and D2 on the circuit card.



NOTE: The LED anode (short lead) must be in the holes closest to the D1 or D2 markings. The longer LED lead goes in the hole without markings. If you follow the tracing for the other holes you will note that they go to – DC connections. These holes are for the cathode.



NOTE: Ensure you have the LEDs inserted into the circuit card and oriented properly. Anode (short lead) must be next to D1 or D2 and the cathode connects to the traces for – DC.



NOTE: Ensure the black tubes are still on the LEDs and that the LEDs are inserted in the circuit card using the tubes as spacers.

38. ____ Bend the leads outward slightly to hold the LEDs in place.

39. ____ Solder the LED leads.

40. ____ Cut the leads on the solder side with the flush-cut pliers.



NOTE: This completes all tasks for the LEDs. You should have no remaining LEDs in your work area.

Inserting the 9V battery snap connector leads

41. ____ Locate the 9VDC battery snap connector and leads.



NOTE: The positive lead is RED and the negative lead is BLACK.



NOTE: There are two sets of power connections on the circuit card. They are marked +DC and –DC. For this kit, use the connections closest to the words "Cut for sw."



NOTE: The power connections have solder pads that are larger than other pads.

42. ____ Fully insert the RED lead in the hole marked +DC.

43. ____ Ensuring that it doesn't move solder it in place.

44. ____ Cut the lead on the solder side with the flush-cut pliers.

45. ____ Fully insert the BLACK lead in the hole marked -DC.

46. ____ Ensuring that it doesn't move solder it in place.

47. ____ Cut the lead on the solder side with the flush-cut pliers.

Clean-up



SAFETY: The next step involves cleaning around sharps. Be very careful because the ends of the component leads may be extremely sharp and can easily cut your fingers.

48. ____ Using the alcohol and small towel clean the solder residue from the circuit card.

Inserting the Integrated Circuit



ELECTROSTATIC DISCHARGE SAFETY

49. ____ Locate the LM555 integrated circuit timer chip.



NOTE: The legs (pins) of the integrated circuit are bent slightly outward during manufacturing. They should be bent perpendicular to the bottom of the device prior to assembly in this kit.

50. ____ Using a flat surface carefully bend four pins (per side) at one time by very carefully pressing them against a flat surface. Repeat for the other four pins. See **Helpful Hints** below – Properly Formed 555 Timer.



NOTE: The pins on integrated circuits, like the LM555 and all integrated circuits, are numbered.



NOTE: Pin 1 can be located by looking at the top of the device. Often you will see a U-shaped depression in the surface of the device or a small dot next to a pin, or both. With the U-shaped depression oriented away from you and with the part sitting on the desk or table Pin 1 will be on the left side furthest from you. Pin 2 is next, then Pin 3, then Pin 4; which is the last pin on the left side and is closest to you. Across from Pin 4 is Pin 5, then 6, 7, and 8. Pin 8 is across from Pin 1 and is in the upper right hand corner. On some devices a small dot denotes Pin 1 with no other mark. See Helpful Hints below – Pin-1 Identification for Integrated Circuits.

51. ____ Locate pin 1 on the LM555.
52. ____ Carefully set the LM555 onto the 8-pin DIP socket. Pin 1 of the device goes in the socket with a square solder pad noted at Step 3.
53. ____ Inspect the LM555 carefully to ensure that each pin of the device is properly aligned with a socket hole in the 8-pin DIP socket.
54. ____ Once you are sure the pins are properly aligned set the circuit card down on the table.
55. ____ With even, steady pressure carefully press the LM555 into the socket with your finger. IT SHOULD NOT TAKE MUCH FORCE. If it does not go in relatively easily, check the alignment and try again.
56. ____ After the LM555 is inserted, inspect all eight pins of the device. All the pins should be straight, none bent or not in their respective socket holes.

Checking your work.

57. ____ Double check the LM555 pin alignment.
58. ____ Double check all your solder connections.
59. ____ Check for solder bridges – especially between the pins for U1, then LM555.

Testing

60. ____ Obtain a new 9 VDC battery.

61. ____ While observing its polarity and with the LEDs in view, BRIEFLY TOUCH the battery against the battery snap connector installed earlier. The LEDs should immediately turn on. If they do not immediately light up, quickly disconnect the battery and go to the **Troubleshooting Section**.

62. ____ The LEDs are be illuminated.
63. ____ Check for proper operation.
64. ____ The LEDs should stay on and turn off once every few seconds. If not, see the Troubleshooting section below.
65. ____ If the device appears to be working you can now press the 9VDC battery and its connector together.



NOTE: This circuit will operate about 1 day on one fresh battery.



NOTE: If you so choose, this circuit can accept a switch (not supplied). It can be attached to the solder pads next to “Cut for sw.” Unless you have a very small switch the switch should be connected to small wires then connected to this circuit. After the switch is installed, cut the trace between the solder connections with a sharp knife or Dremel™ Tool. Doing so will put the switch in the circuit.



NOTE: Although the LED’s epoxy case is clear yellow, the LEDs will glow RED! Surprise!



NOTE: Pin 5 of the LM555 is not connected in this circuit.

Troubleshooting



NOTE: Do these steps with the battery disconnected!

If the LEDs do not light go to Step 1, or if the LEDs light, but don't blink go to Step 11. They should blink once about every 5 to 7 seconds as referenced in the frequency formula.

1. Do these steps if the LEDs do not immediately illuminate when the battery is touched to the connector.
2. ____ Check the battery's connection.
 - a. ____ Ensure the RED wire connects to +DC and the BLACK wire connects to –DC on the connections near “Cut for sw.” and that you connected the wires to the large round solder pads.
3. ____ Check the polarity of D1 and D2. If these are reversed the circuit may be working but the LEDs will not turn on.
 - a. ____ Ensure the flat side of the LED is in the hole for D1 or D2 that is connected to the –DC. Another way to tell is that the negative (cathode or flat side of the LEDs) are interconnected by a single trace between D1 and D2 that runs parallel to the words “Halloween Blinky-eyes.”
4. ____ Turn on the penlight or flashlight.
5. ____ Shine it through the circuit card with the light on the component side.
6. ____ Examine all the solder connections on the SOLDER SIDE of the circuit card.
 - a. Double check all your work.
 - b. ____ Examine the circuit card for solder bridges – these are connections that should not be there. You should be able to see light shining through on all the pad to pad connections!
7. ____ Examine the circuit card for poor solder joints – cold joints, bad joints, missing solder connections. Shine the penlight or flashlight on the SOLDER SIDE of the circuit card. All the joints should be shiny and present.
8. ____ Double check U1 (the LM555 [or similar]) to ensure it is properly installed.
9. ____ Check C1 for proper polarity

- a. ____ The non-marked lead of the capacitor should be connected to the + solder pad for C1.



NOTE: The LM555 was tested in a working kit to ensure proper operation before packaging.

10. ____ If you did not detect any errors, the LM555 may be defective now. Any LM555 will work in this circuit. They can be purchased locally at Radio Shack™ (Catalog #: 276-1718) or through your favorite electronic parts distributor.
- LEDs don't blink.**
11. Do these steps if the LEDs do not blink.
 12. ____ Check that the LM555 is inserted properly. No pins are bent, broken, or not in their respective socket holes.
 13. ____ Check that C1 is inserted properly and that the positive lead is in the solder pad next to the small plus sign.
 14. ____ Check that R1 and R2 are no reverse and that their leads are in the correct holes. R1 must connect to Pins 7 and 8 of the LM555, and R2 must connect to Pins 2 and 7 of the LM555.
 15. ____ Check that you that R1 and R2 are the correct values by verifying their color bands as indicated in the parts list.
 16. ____ The LM555 is likely defective. Refer to Step 10.

You can learn more about the 555 Timer Chip at http://en.wikipedia.org/wiki/555_timer_IC.

Helpful Hints

1. Resistor Color Code Cart

Band Color		1 st Band	2 nd Band	3 rd Band
BLACK		0	0	
BROWN		1	1	x 10
RED		2	2	x 100
ORANGE		3	3	x 1,000
YELLOW		4	4	x 10,000
GREEN		5	5	x 100,000
BLUE		6	6	x 1,000,000
VIOLET		7	7	
GRAY		8	8	
WHITE		9	9	

330 Ohms = orange, orange, brown OR

$33 \times 10 = 330$ ohms

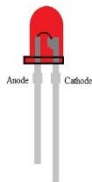
2. Pin-1 Identification for Integrated Circuits



3. 8-Pin DIP Socket Pin 1 Identification



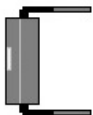
4. LED Cathode Identification



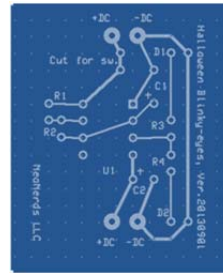
5. Forming the resistors.



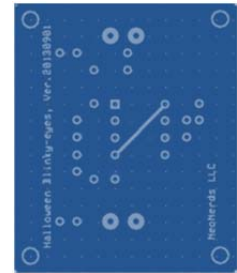
6. Properly formed 555 Timer. Showing perpendicular leads (bent square to the bottom of the case).



7. Side Identification



Solder Side



Component Side

8. LM555 Timer Calculation Formula.

Determining timing frequency, the amount of time the LEDs stay on (high time), the amount of time the LEDs stay off (low time), and the duty cycle can be done here.

The duty cycle of this circuit with the values selected above is approximately 97%. That means the LEDs stay on for 97% of the time and are dark for 3% of the time.

$frequency = 1 / (.693 \times C \times (R1 + (2 \times R2)))$, as in

Work R2: $2 \times 10,000 = 20,000$

Work R1 & R2: $1,000,000 + 20,000 = 1,020,000$

Work Rs & C: $1,020,000 \times .00001 = 10.2$

Denominator: $.693 \times 10.2 = 7.0686$

Final Answer: $1 / 7.0686 = .14 \text{ Hz} (\sim 7 \text{ seconds})$

$high \text{ time} = .693 \times (R1 + R2) \times C$

For this circuit the high time is ~ 6.75 seconds.

$low \text{ time} = .693 \times R2 \times C$

For this circuit the low time is $\sim .25$ seconds.

$total \text{ time} = high \text{ time} + low \text{ time}$

For this circuit the low time is ~ 7 seconds.

also $frequency = 1 / total \text{ time}$

$duty \text{ cycle} = high \text{ time} \times 100 / total \text{ time}$