Easy Laser Alarm Kit

JAMECO PART NO. 2169580

Protect your home and possessions with the Easy Laser Alarm kit. It uses a 741 op-amp and 4017 decade counter as the brain and is powered by a 9V battery, or add your own wall transformer to save batteries.

The kit works by sensing the light from the laser hitting a photoresistor which lowers the resistance. If the beam is broken, the resistance increases, and the 741 chip sends a pulse to the 4017 which sets off the piezo buzzer. To reset the circuit, the laser must shine back on the photoresistor then push the reset button.

If you add mirrors, you can reflect the laser beam to protect multiple areas.

Time Required: 1 hour, depending on experience
Experience Level: Beginner with very basic solder skills
Required tools and parts:

- Soldering Iron - only two wires to solder and two wires need "tinning"
- A knife is helpful for dressing out the holes
- A drill and bits to drill out holes in your project box
- Philips screwdriver for project box
- Wire cutters and wire, solid 22 AWG or the jumper wires that came with your breadboard
- Hot glue gun
- Battery holder for 2xxAA or AAA plus the batteries (for laser diode)
- **Optional** - a pair of needle nose pliers for making the wire look neat or lead forming tool)

Bill of Materials:

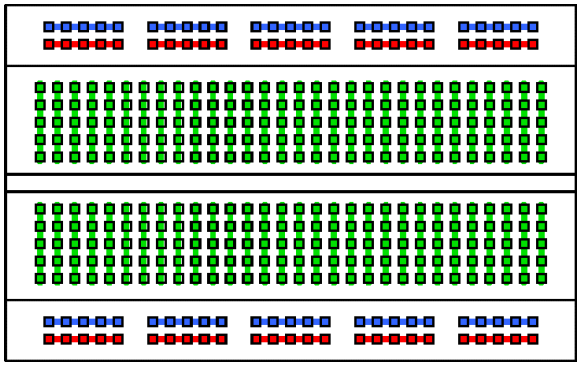
Qty	Jameco SKU	Component Name
1	45891	CD4017 Decade counter or equivalent
1	24539	LM741 Op-amp
1	315660 or 315678	Momentary (ON) push button switch
1	2128067	9V battery clip with switch
1	138713	12v DC buzzer
1	2157159	1K Ohm resistor 5% (Brown - Black - Red Gold))
1	18922	Project Box
1	202403	Photo-Resistor 3K ohm - 200K ohm
1	2155452	Mini Protoboard
1	2151128	Laser diode module

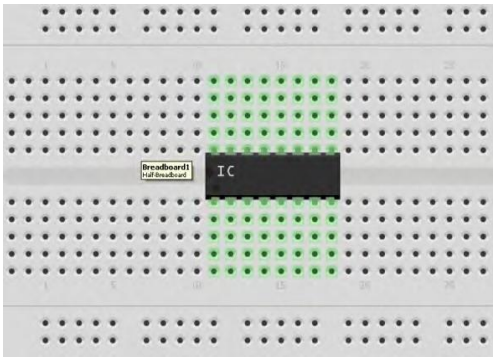
Understanding the Circuit

This kit works by sensing the light from the laser hitting the photoresistor which lowers its resistance. Once the beam is broken, the resistance increases and the 741 chip senses the resistance is now higher than our 1k resistor standard. This results in the chip sending a pulse to the 4017, which sets off the buzzer and turns off the power to the photoresistor, so the buzzer will not stop when the beam is back on the sensor. To reset the circuit, the laser must be back on the photocell then you can push the reset button.

How Breadboards Work

Each hole has a spring-loaded contact which grips the wire or the component plugged into it. If one could remove the back, this is how we would see each hole is wired to the next:





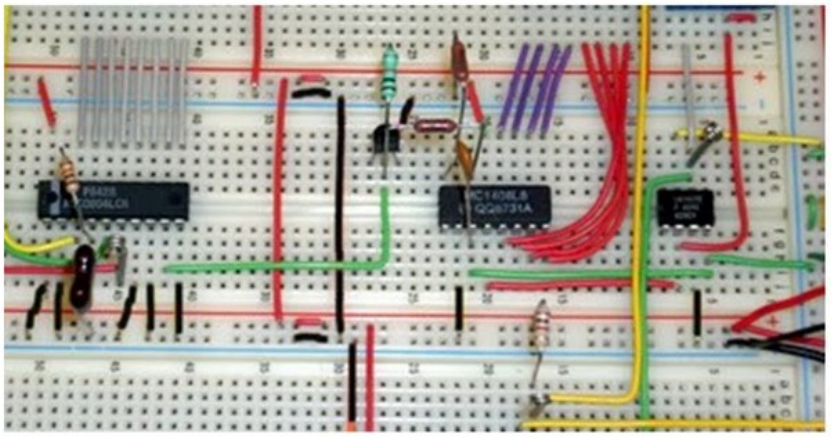
Note how each hole is connected by the colored lines representing how each hole is connected to the hole next to it in a strip called a buss.

The red and blue lines/holes are meant to be used as DC power "rails", red for positive, blue for negative. Our ICs will straddle that trough in the middle allowing each IC pin a row of connection shown in green here. In other words, each IC pin plugged in has a row of only four connections to work with.

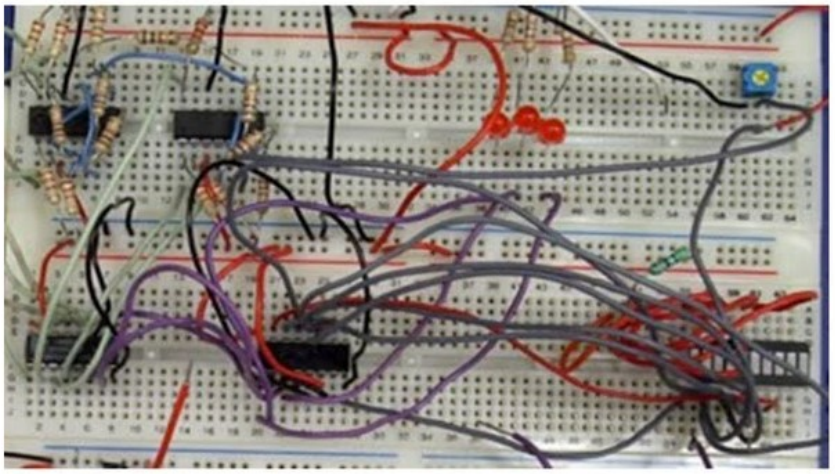
How to Breadboard

Now that you know how the connections are made in the back, here are some examples of good and bad breadboarding:

GOOD



BAD



As you can see, using good wiring techniques can help keep the work organized and tracked. Having neat wiring also helps when the project does not work and needs troubleshooting.

Step 1 - Review Components

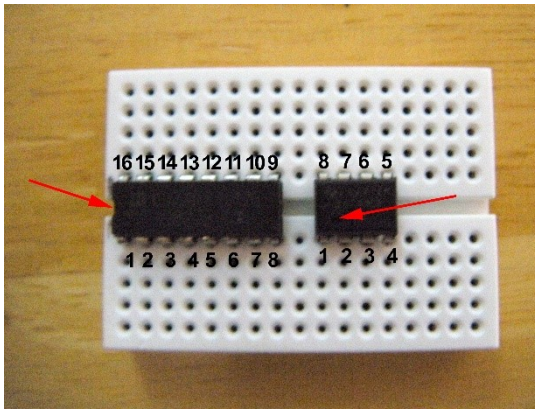
First, check that you have all your parts and tools. The only part that is not included is the wire. You may already have some 22awg solid wire around or some of the pre-made jumpers made for breadboarding. If not, a small spool our part number 2152905 is recommended.

The tools you need include a soldering iron (to solder leads on the reset switch and to tin the wires of the 9V battery clip), a knife, a drill to drill out holes in your project box, a Philips screwdriver to close the project box, and a hot glue gun.

Step 2 - Build Your Circuit

First, push your two ICs into the breadboard in the center with one space in between making sure that the notch at the top of both IC s are pointing in same direction. This will allow us to follow the pin numbers correctly and avoid confusion while connecting pins.

You may notice that the pins on the ICs may be too wide to plug into the rows closest to the center trough of the breadboard. This means you will need to bend the pins inward, so they are straight. Rock the chip over on a flat surface so all the pins bend equally like shown at right.

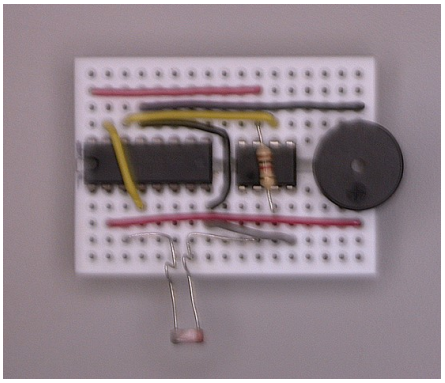


Plugged in, they now should look exactly like the photo on the left. The small IC, the 741 op-amp, will have a dot showing pin one, and have the dot facing the same direction as the 4017 chip as shown at right by the red arrows.

You'll notice we also added the IC pin numbers which will be a great help when you are wiring this up!

Use the circuit schematic and the above pin numbers to match each connection from the schematic to the breadboard. Build the rest of your circuit adding the jumper wires, resistor, buzzer and photoresistor. We don't need to attach the power leads or the button just yet. Later we'll want to drop the board into the box and see where we want to drill the hole for the photoresistor and push button. Note that the beeper has a polarity +/- mark that needs to be observed. If there is a sticker that covers the hole on the beeper, it should be removed as well.

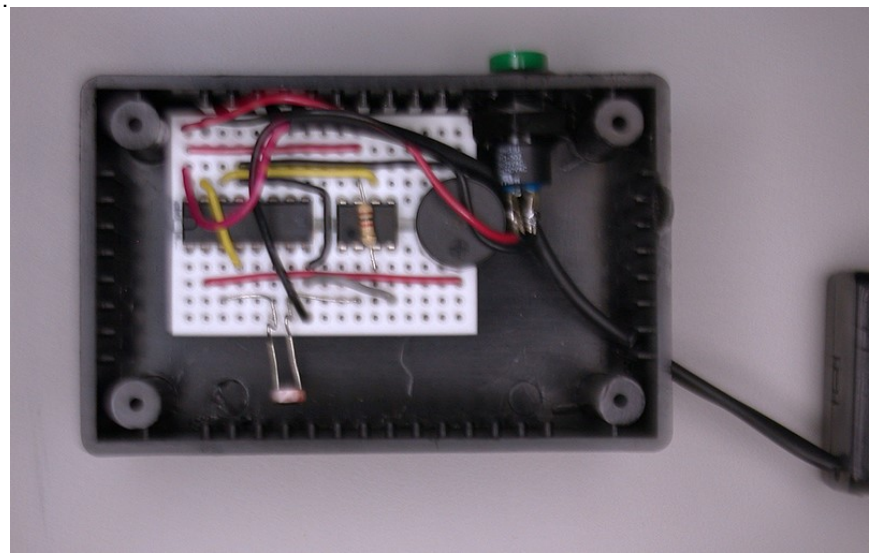
The board at this point should look like this when all connections except power and reset button are applied.



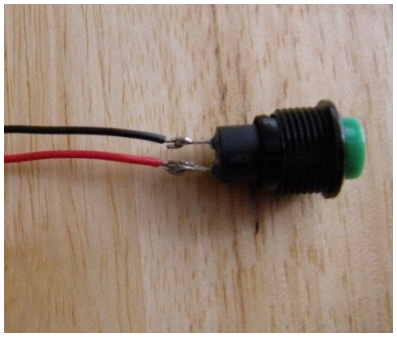
Notice we laid one resistor over the top of the 741 IC that needed that connection. For the photoresistor, same thing except it is connecting the two ICs together.

If you have the larger buzzer in your kit, it can plug into the same very last row, but it will overhang a bit and make sure you account for this when drilling holes in the box.

Now let's see how it looks in the box and eyeball where we will drill the holes. Here's how this project looks with everything connected and working.:



Step 3 - Reset Switch and Drilling Holes in Your Project Boxx



Attach two pieces of wire to the button and solder them into place. Strip the ends about 4-mm long. While you have the soldering iron hot, tin the ends of the wires of the 9-volt battery holder because they use stranded wire (not good for breadboards). Then, starting with smaller bits, eventually use a 7/16"drill bit to drill out a hole for the button.

You are free to place the button wherever you d like but be careful that the body of the switch when mounted is not going to get in the way of the breadboard or buzzer. Then, use your knife to chamfer the hole and smooth it out.

Make the hole for the photoresistor by dropping the board into the box and eyeball where the hole should go. Use a little smaller size drill bit than the size of the component so it will not pick up stray light from anywhere else but the laser.

Finally, you need to make another hole for your battery box leads or, optionally, mount a DC powerjjack if you wanted to use a wall wart power supply. Our part number 281851 is the perfect DC power jack while our part number 2236498 DC power supply would work well as an alternative to using battery power.

Step 4 - Fitting the Outside Components

Next, thread the wires from the 9V battery box/wall transformer through the hole and into your project box and connect the wires to your protoboard. At this point, one should be able to test the unit. Make sure your reset button is plugged into the breadboard as well.

For the included laser diode, an arrangement of either two AA or AAA batteries connected in series with or without a switch can power the 3V laser diode. A battery holder with a switch is not included but any laser pointer or device you already have can work as well. For a AA battery holder with switch, use our part number: 216120, for AAA, our part number: 216292. For a box to mount the laser and batteries, try our part number 18914 plastic enclosure.

IMPORTANT --TTest your circuit before applying any hot glue to your project as hot glue is hard to remove from components and wires. Hot glue the photo-resistor to the project box to keep it in place as well as maybe the power supply cables.

Step 5 - Finishing Up

Install the lid of your project box and you're done! Shine your laser pointer on the photoresistor then turn on your project. Break the beam and you should hear the buzzer. TTo reset the alarm, press the reset button while the laser is on the sensor.

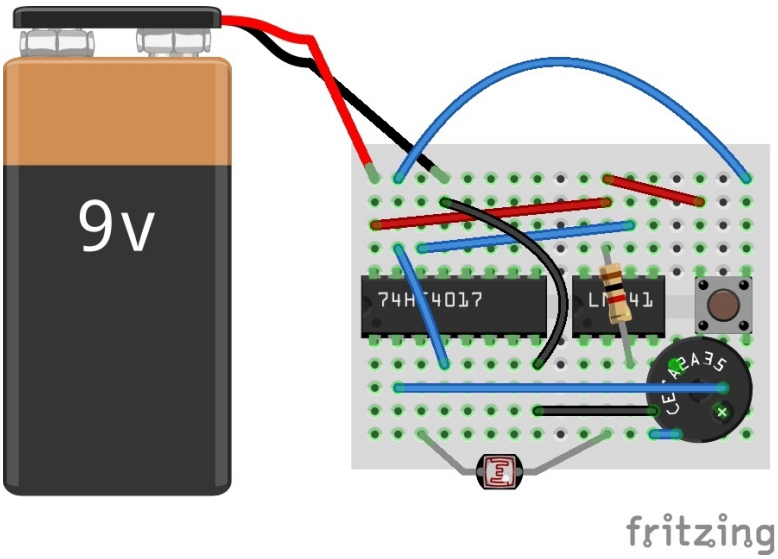
Tips:: To make your project more like a security system, you can remove the 9V buzzer and use the circuit to trigger a relay. The relay could then connect to an established alarm system.

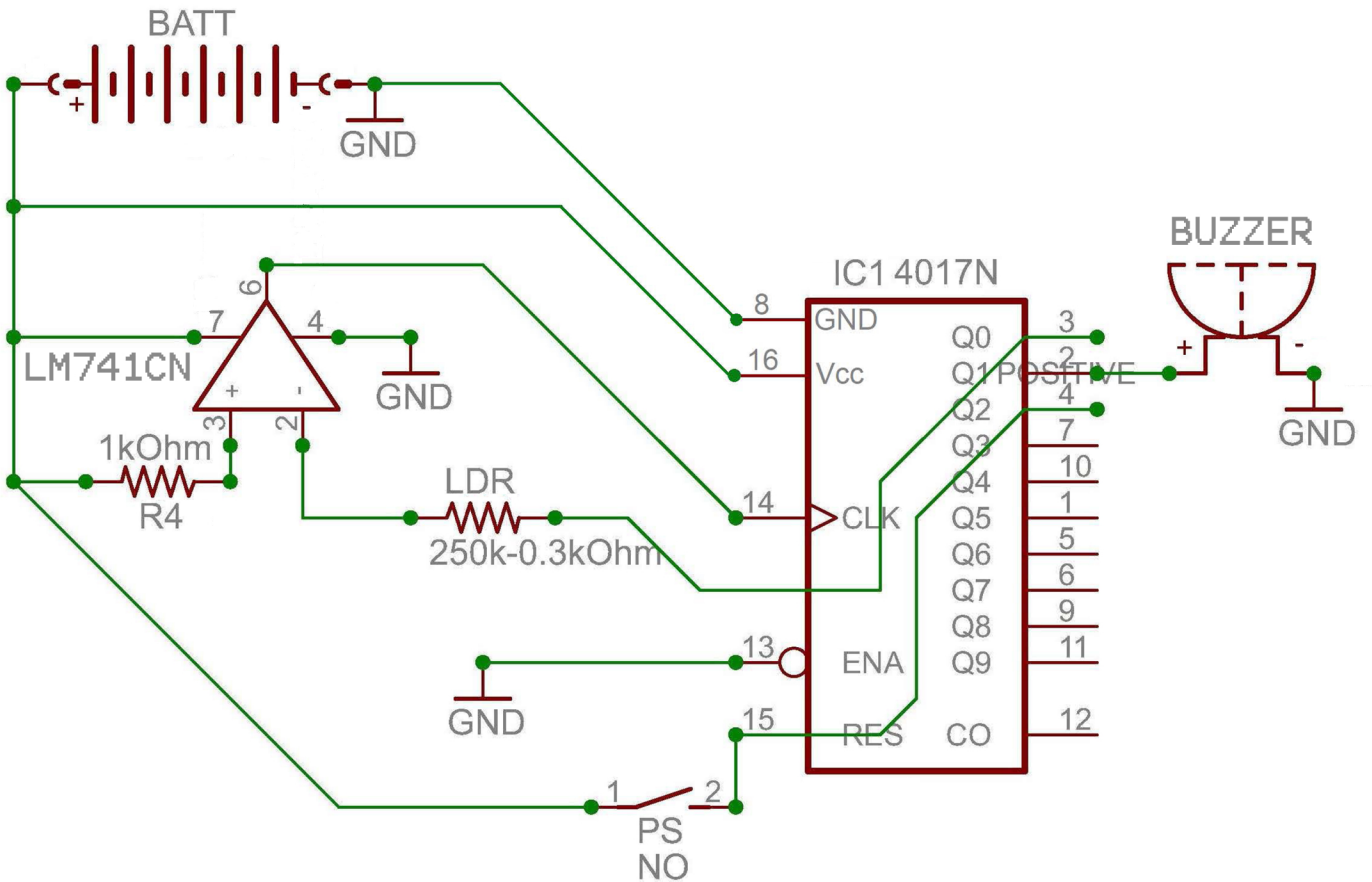
Additionally, replacing the battery power with a power supply for the laser would increase reliability. Another idea would be to use mirrors to reflect the laser beam across multiple areas. YYet another idea would be to extend the wires of the reset switch for an easier remote reset.

Troubleshooting

If the buzzer stays on and never stops, and you have checked all your connections, it is possible that the 4017 caught some static or failed for whatever reason. If you want to replace your 4017 IC, order the part number 893611.

Rev2 Updated April 2020




BATT
+
-
GND
BUZZER
IC1 4017N
8
GND
16
Vcc
14
CLK
13
ENA
15
RES
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
CO
3
2
4
7
10
1
5
6
9
11
12
POSITIVE
GND
LM741CN
6
7
4
3
2
GND
1kOhm
R4
LDR
250k-0.3kOhm
GND
1
2
PS
NO