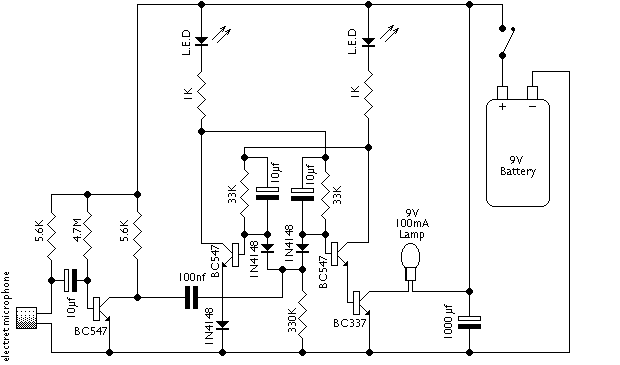
**Clap Switch**

**Sound operated switch using a simple transistor circuit**

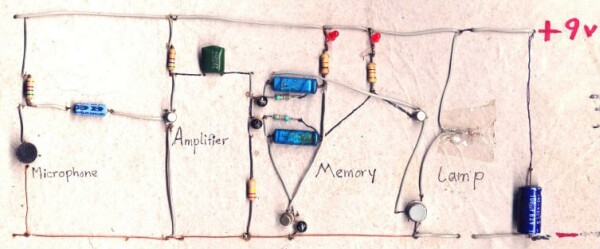


The operation is simple. Clap and the lamp turns on. Clap again and it turns off.

The electret microphone picks up the sound of your claps, coughs, and the sound of that book knocked off the table. It produces a small electrical signal which is amplified by the succeeding transistor stage. Two transistors cross connected as a bistable multivibrator change state at each signal. One of these transistors drives a heavier transistor which controls a lamp.

I built my prototype on a cardboard cover from an old notebook. Punched holes using dividers and placed the components down flat. It might look neater if you draw the circuit diagram on to the board before you begin. A photo is included below. The components are from my junk box and I found that it works even if you omit that 4.7 Megohm resistor. Your results may vary.

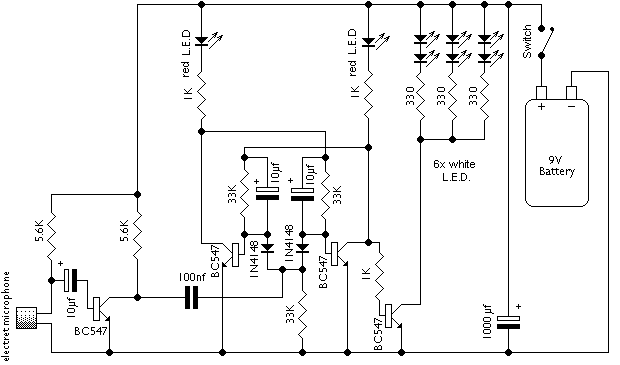
The transistor types are not critical and any n-p-n silicon transistors should work.



**Clap Switch II**

**A revised version**

Based on the comments of the many people who built this circuit successfully, and the few who tried to and failed, the circuit was revised. Two changes, mainly: the filament lamp was replaced by a bunch of LEDs, and the output stage was coupled to the collector instead of the emitter of the bistable.



**How it works**

**Input Transducer**

The sound of your claps is picked up using an electret microphone. Some people call it by the name "condenser microphone" which usually refers to exhorbitantly priced things intended for the recording studio. If you could buy yours and still have your shirt on your back relax - it's an electret mike all right. Inside it is an electret film - which is the electrical analogue of a magnet - stretched so that it will vibrate in sympathy with any sound falling on it. These vibrations cause the electrical charge on a perforated plate nearby to change, and a field effect transistor converts these into corresponding changes in current.

This microphone has a stage of amplification built in. The power for this built in amplifier is supplied by connecting a resistor to a positive source of voltage, and the changes in current get reflected as changes in voltage across this resistor according to the familiar relation V = I\*R. A larger resistor will give you a larger voltage, but then, the current into the device gets reduced which brings down the gain. The value of 5600 ohms (usually abbreviated to 5.6K, and written down in schematics as 5K6) seems to work all right.

**Amplifier**

A transistor stage, biased near cut-off (that is, almost no current with no signal) amplifies the signal from the microphone. The output of the microphone is coupled to the base of the transistor using an electrolytic capacitor (note: using a better capacitor here will not work). The top of the electret microphone is at a few volts, the base conducts at around half a volt, so the leakage current of the capacitor (all electrolytic capacitors leak at least a little bit) will eventually cause the steady state condition in which the leakage of the capacitor goes into the base terminal of the transistor. So the collector will have Hfe times this leakage, which can usually be ignored.

The first time the microphone output goes positive, however, (because somebody clapped) this change gets coupled to the base entirely due to the action of the capacitor. This causes the current through the transistor to increase, and this increase in current causes the voltage at the collector, which was sitting near the supply voltage, to fall to nearly zero. If you clapped loudly enough, of course.

This is not a high fidelity audio amplifier. Its function is to produce no output for small sounds and large output for (slightly) bigger sounds, so the customary biasing network can be omitted. The 4.7 Megohm resistor in the previous version was as good as an open circuit, and its omission does not affect the operation of the clap switch in any way. Provided, of course, that you use that 10 microfarad electrolytic capacitor.

**Memory**

Two cross connected transistors in a bistable multivibrator arrangement make up a circuit that remembers. You can set it to one of two possible states, and it will stay in that state until the end of time. When one transistor conducts, its collector is near ground, and a resistor from this collector feeds the base of the other. Since this resistor sees ground at the collector end the base at the other end receives no current, so that transistor is off. Since this transistor is off, its collector is near supply potential and a resistor connects from this to the base of the other transistor. Since this resistor sees voltage, it supplies the base with current, ensuring that the transistor remains on. Thus this state is stable. By symmetry, the other state is, too.

**Changing state**

On a clap, the state of the bistable changes. The output of the amplifier is converted to a sharp pulse by passing it through a (relatively) low valued capacitor, of 0.1 microfarads (100 nanofarads). This is connected through "steering" diodes to the base of the transistor which is conducting. This transistor stops conducting, and the other transistor was not conducting anyway. So at a clap, both transistors become off.

Then, those two capacitors across the base resistors come into action. The capacitor connecting to the base of the transistor which was ON has voltage across it. The capacitor connecting to the base of the transistor which was OFF has no voltage across it.

As the sound of the clap dies away, both bases rise towards the supply voltage. But, due to the difference in the charges of the two capacitors, the base of the transistor which was previously not conducting reaches the magic value of half a volt first, and it gets on, and stays on. Until the next clap.

Two red Light Emitting Diodes have been placed in the two collector circuits so that this circuit can be made to work by itself. If you cover up one LED, and display the other prominently, you have it there - a clap operated light.

**Output Stage**

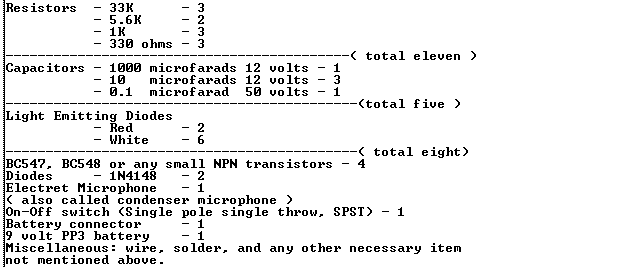
In order to have a decent amount of light from this circuit, I propose to use six white LEDs in three groups of two each. Each series connected string of two LEDs is arranged to draw around fifteen milliamperes or so by using a series resistor of 330 ohms. Two LEDs in series will drop about five or six volts, and the remaining battery voltage drop across this resistor determines the current through the LEDs. You can get more brightness from the LEDs by reducing the value to 220 ohms or even 150 ohms, provided you keep within the ratings of the LEDs. Do so at your own risk.

Thus the output stage has to handle around fifty or sixty milliamperes. This will give you fairly long time of claplighting with a PP3 battery. The 100mA filament lamp seems to be somewhat hard to find, and people were using torch bulbs, which run at much higher current, and killing their batteries in a few minutes.

A transistor gets its base driven from the collector of one of the transistors in the bistable. With this connection, due to the base current through it, one red LED in the bistable switches between half bright and full, and the other switches between fully off and on. This is normal.

Because the LEDs do not draw as much current as a filament lamp, the output transistor, too, can be of the common small signal variety. All four could be any small signal n-p-n transistor and the circuit should work. So would it with four p-n-p transistors, provided you switch the polarity of every (polarised) component.

**Bill of Materials**

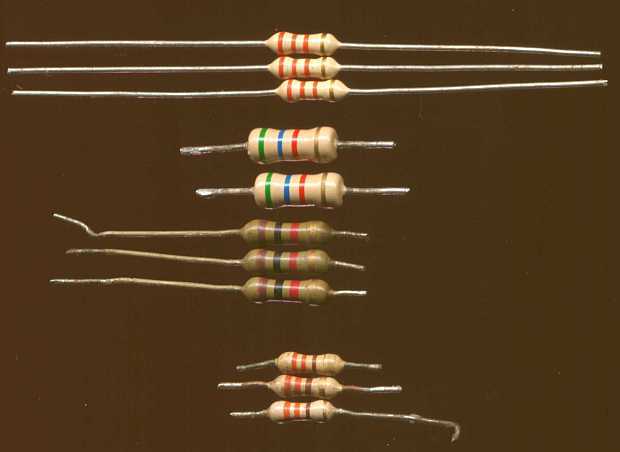


**The Resistors**

From top to bottom, these are:

33 K - orange, orange, orange.  
5.6K - green, blue, red.  
1K - brown, black, red.  
330 - orange, orange, brown.

The best way of identifying these is to use a meter and measure them. That is what I do, because most of my components are pulled off old circuit boards and they might just be pretending to be healthy. Age and ill treatment will have faded the colours so that only the meter can distinguish between, for example, a 2.2K resistor (red-red-red) and a 33K one (orange-orange-orange).



**The Diodes**

The 1N4148 diodes are extremely small, glass, and most likely have just the polarity marking. The current flow is towards the band. That is, when the banded end is made negative, current flows. And, in sharp contrast, when that end is made positive current does not flow. So this component has to be inserted the right way around in the circuit.

**The Transistors**

Four transistors, the same type number, but of different manufacture. The middle lead is the base, and the others two are as marked in the photo for one of the transistors. Flat side down, leads towards you, it goes Emitter-Base-Collector.

**The Capacitors: 100n**

A bunch of capacitors, all 0.1 microfarad. The markings range from bands as in resistors to various combinations of numbers: brown, black, yellow (or 1-0-4) would be the marking on such a capacitor, though a rummage through my collection for a banded one was not successful. Any of these in the picture can be used. The round ones are disc ceramic. The rectangular one is rolled plastic film. The smallest two are multilayer ceramic.

**The Capacitors: 10µF**

Electrolytic capacitors always have three markings on them: The capacitance value, the voltage rating, and an indication of the negative lead.

**10µF capacitors: a collection**

Here they are, all shapes and sizes, all of them of capacity ten microfarads, but of different voltage ratings

**The Capacitors: 1000µF**

Here, you can see the arrow pointing to the negative lead. All aluminium electrolytic capacitors indicate the negative lead in this way. These have to be connected up the right way around in a circuit, or else grief would ensue.

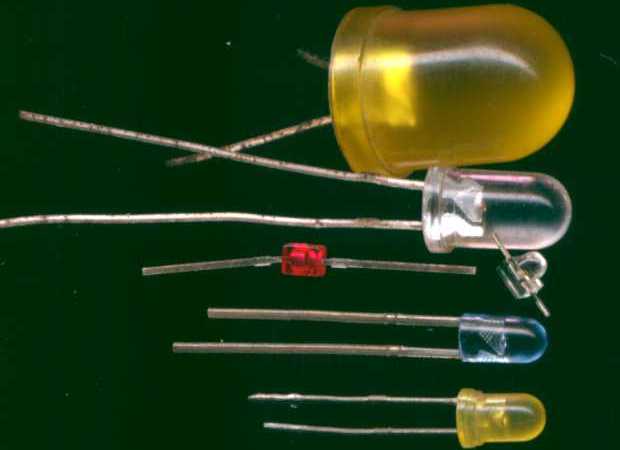
**The Microphone**

If you look closely, one terminal is connected to the body. This is the ground terminal, connected to negative. The other terminal is connected to, duh, the positive. And is also the output terminal. Some electret microphones have three terminals, but I have not used them and do not know how to.



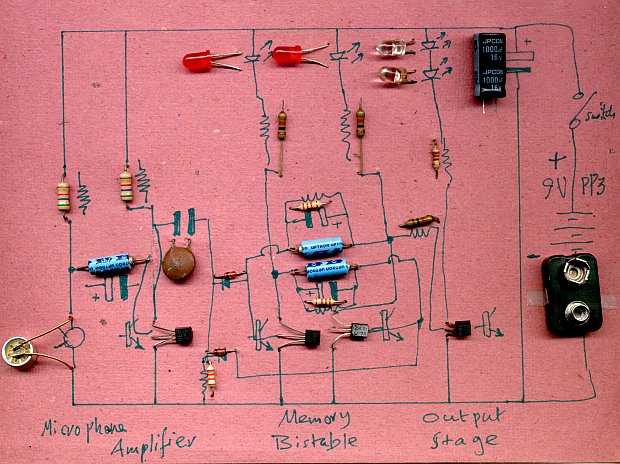
**The LEDs**

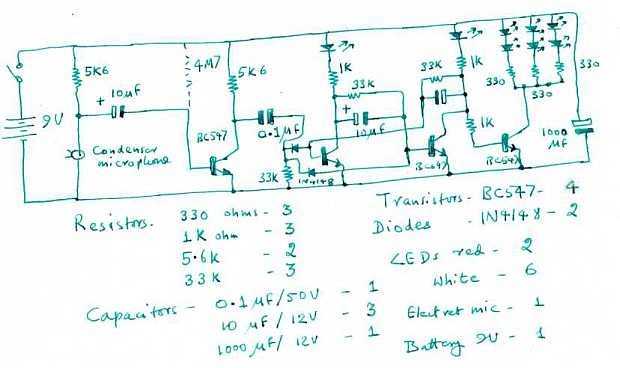
Light Emitting Diodes light when current passes through them. They pass current only in one direction, and generally this is when their longer lead (when new) is made positive. They come in all shapes, colours and sizes. A representative sample grabbed from my box of (mostly) junk is below:



**What goes where, in the circuit**

Of the six white LEDs, only two has been placed, mainly to avoid clutter. And my idea of a switch is to twist wires together to turn on, and pull apart to turn off.

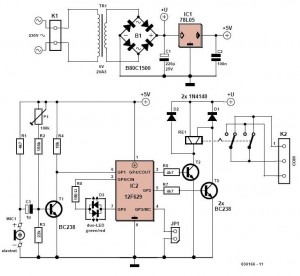




**Construction**

### WNWNWNWNWNW……………………..

### Clap switch circuit diagram

[](http://electroschematics.com/wp-content/uploads/2008/12/clap-switch-schematic.jpg)

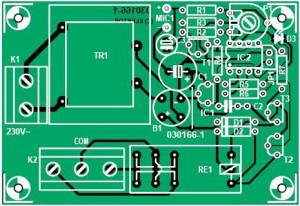
The circuit diagram in Figure 1 shows that besides the microcontroller there are very few other components. The two-pin electret microphone produces an electrical signal in response to sound pressure waves. Transistor T1 amplifies the signal and preset P1 allows some adjustment of the circuit sensitivity by altering the bias voltage of T1.

Two of the PIC output pins are used to drive a bistable relay via transistors T2 and T3. This type of relay has two energising coils. A short electrical pulse on one of the coils is enough to switch the relay in one direction while a pulse to the other coil will cause the relay to switch back. This type of relay has two main advantages: the relay is latching in both open and close direction so a short pulse is all that is necessary to switch it. Secondly the latching feature ensures that the relay retains its switched state even during a power failure. Changeover relay contacts enable the unit to be wired together with a changeover type manual switch, allowing the equipment to be switched manually if for any reason the clap switch is switched off.

Pins 2 and 7 are used to switch a twocolour LED providing a visual indication of the switched state of the relay. The last output pin of the PIC is not used and is connected to a jumper to allow switching software options.  
**Clapping relay Software**  
When the signal level at GP1 goes low (clap detected) the program waits for approximately 200 ms during which time the LED glows red. After this period the LED switches to green and the software samples the input for approximately three seconds. If a second clap is detected during this period, the controller switches the output. After switching, the controller ignores any further clap sounds for approximately 10 s and the LED lights red. The output state is stored in EEPROM so that if a power failure occurs the software will switch the correct relay coil when power is re-established.

A safety feature counts each switching event on an internal counter, which is decremented slowly in software. Should this counter exceed a threshold level, the circuit will ignore any input signals for approximately one minute and the LED blinks red. This will ensure that the circuit does not respond to an extended burst of noise (e.g., applause).

### Clap switch PCB

[](http://electroschematics.com/wp-content/uploads/2008/12/clap-relay-pcb.jpg)  
The PCB layout shown in Figure 2 accommodates all components apart from the electret microphone. This is attached to the [board](http://www.printedcircuitsboards.com) at the MIC +/– connections with a length of shielded audio lead (keep the wire length to less than around 10 cm).

Mounting the components onto the PCB should be quite straightforward. Start by fitting the single wire bridge next to rectifier B1. Ensure that all polarised components (diodes, LEDs, capacitors and the IC) are fitted the correct way round. The LED leads should be trimmed so that when it is soldered to the board it protrudes through a hole in the lid when the case is assembled; alternatively use a translucent enclosure.

Once all components have been fitted and all solder connections have been inspected the PCB can be fitted into an insulated enclosure. The mains input lead will require some form of strain relief. Be aware that some tracks carry lethal voltages. All appropriate safety guidelines must therefore be adhered to. A small hole can be made in the lid directly over preset P1 if it is necessary to adjust the sensitivity of the circuitwithout dismantling the unit. Lastly, don’t forget to add perforations in the case so that sound waves can reach the microphone capsule.

**Clap switch COMPONENTS LIST:**  
Resistors:  
R1,R6,R7 = 4kΩ7  
R2 = 150kΩ  
R3 = 22kΩ  
R4 = 10kΩ  
R5 = 150Ω  
P1 = 100kΩ preset H  
Capacitors:  
C1 = 220μF 25V radial  
C2 = 100nF  
C3 = 1μF 16V  
Semiconductors:  
B1 = B80C1500 (round case, 80V piv, 1.5A)  
D1,D2 = 1N4148  
D3 = bicolour LED (red/green)  
IC1 = 78L05  
IC2 = PIC12F629CP, programmed  
T1,T2,T3 = BC238 or BC547  
Miscellaneous:  
JP1 = 2-way pinheader with jumper  
K1 = 2-way PCB terminal block, lead pitch 7.5mm  
K2 = 3- way PCB terminal block, lead pitch 7.5mm  
MIC1 = 2-terminal electret microphone capsule  
Re1 = bistable relay, 2 x changeover (e.g., Schrack RT314F12)  
Tr1 = mains transformer 1 x 6V, min. 2VA, short-circuit proof (e.g., Marschner VN30.15/10522 or Era 030-7340.0T; Conrad Electronics # 506141)

