Sound Activated Flash for 'Stop Action' Photography

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Here's how to capture those different stages of the bursting of an electric bulb, or the impact of a milk drop in a bowl. Recording these transient moments would be rather difficult by any technique other than 'stop action photography'.

This technique is not half as difficult as it seems at first glance—the camera is first focussed at the place of 'action' (action implying the bursting of the bulb or the drop striking the bowl). The room is then completely darkened, and the camera's shutter is kept at 'B' (shutter open).

The sound made by the action triggers the flash after a delay which can be altered by the circuit. The flash duration is normally 0.25 to 1 millisecond which is sufficient to freeze even the fastest action.

Once the flash is triggered, the shutter is closed, and a fresh photograph can be taken with a different delay to record another stage of the event

The circuit

The main component of the circuit is an LM324 quad op-amp. The use of just one IC and the PCB design simplifies fabrication. It is to be used in conjunction with a capaci-

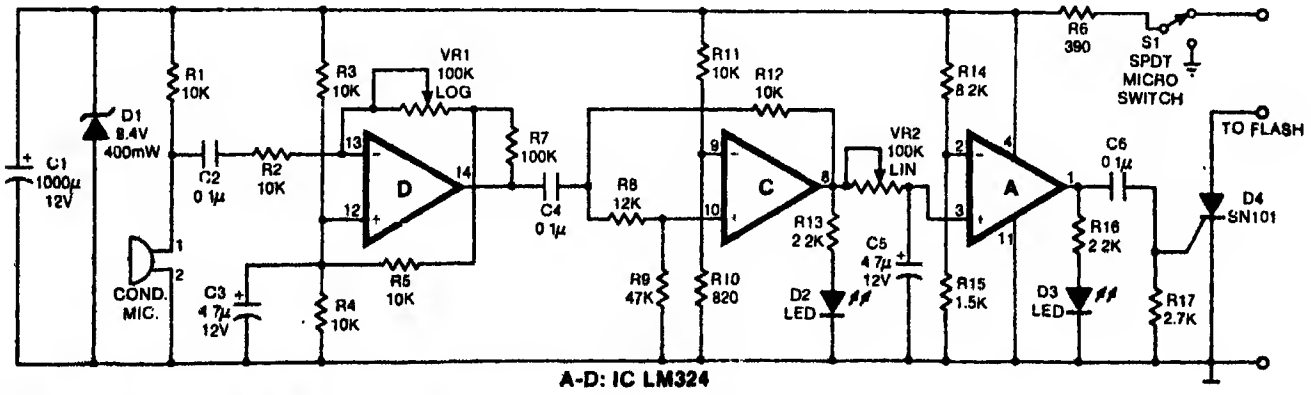


Fig. 1: The circuit diagram of the sound activated flash.

PARTS LIST

Semiconductors:

IC1	— LM324 quad op-amp
D1	— 8.4V, 400mW zener diode
D2, D3	— Light emitting diode
D4	— SN101 silicon control rectifier

Resistors [all 1/4 watt, ±5% carbon]:

R1, R2, R3, R4, R5, R11, R12	— 10-kilohm
R6	— 390-ohm
R7	— 100-kilohm
R8	— 12-kilohm
R9	— 47-kilohm
R10	— 820-ohm
R13, R16	— 2.2-kilohm
R14	— 8.2-kilohm
R15	— 1.5-kilohm
R17	— 2.7-kilohm
VR1	— 100-kilohm log. potentiometer
VR2	— 100-kilohm lin. potentiometer

Capacitors:

C1	— 1000μF, 12V electrolytic
C2, C4, C6	— 0.1μF ceramic
C3	— 4.7μF, 12V electrolytic
C5	— 4.7μF, 16V electrolytic (see text)

Miscellaneous:

S1	— SPDT microswitch
	— Condenser microphone, PCB, shielded wire, enclosure, hardware etc.

tor discharge flash gun.

Broadly, the circuit can be divided into the following stages:

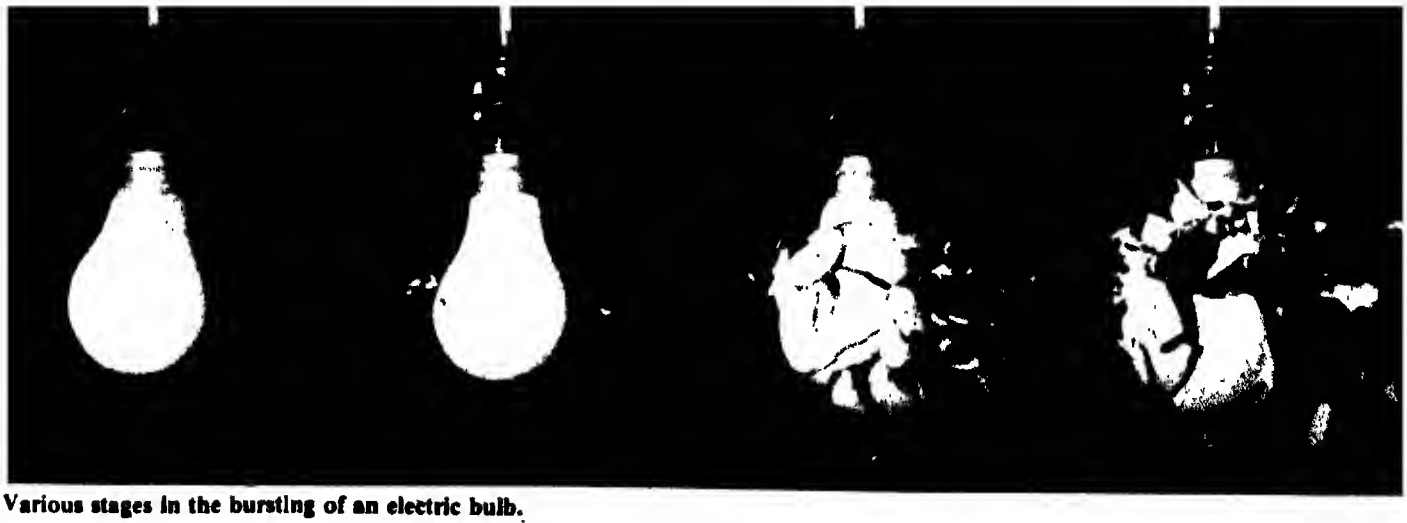
Sound amplifier. A condenser microphone serves as a sensitive and economical transducer. Resistor R1 provides bias for the in-built FET amplifier of the condenser microphone. Op-amp D is connected in the inverting amplifier configuration.

Gain of this stage, and hence the sound level at which the circuit triggers the flash, can be set by potentiometer VR1. In case the gain is not sufficient, replace resistor R2 with 4.7k or 2.2k or R7 with 4.7k by trial and error. In the prototype, this arrangement for gain was found to be more than adequate.

Latch. A noise impulse causes the voltage at the non-inverting (+) pin of op-amp C to exceed that at the inverting (-) terminal, and the output swings high. Due to positive feedback of R12, the output latches to positive saturation. The LED lights up indicating latching action. This enables reliable triggering of the next stage, and prevents re-triggering once a photo has been taken.

Delay. The output of op-amp C in the untriggered state is low, and capacitor C5 is in the discharged condition. Once the previous stage latches, the timing (delay) cycle is initiated. The rate of charging is controlled by the resistance of potentiometer VR2 and the capacitance of C5.

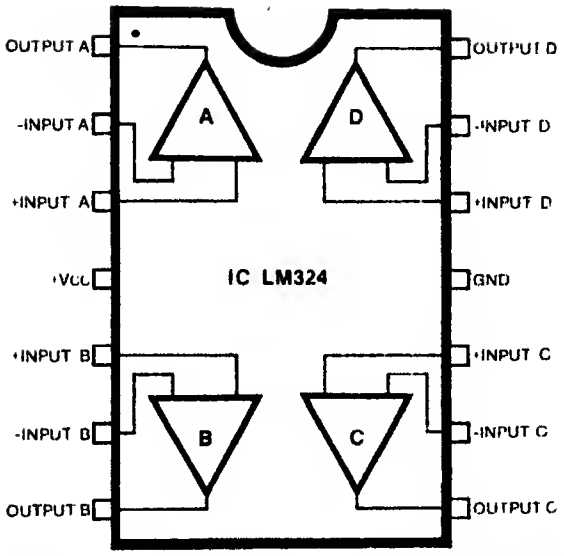
When the voltage across C5 exceeds that set by the poten-



Various stages in the bursting of an electric bulb.

1. DELAY ≈ 5mS **2. DELAY ≈ 25mS** **3. DELAY ≈ 55mS** **4. DELAY ≈ 100mS**

Various stages recorded after the impact of a milk drop in a shallow bowl.



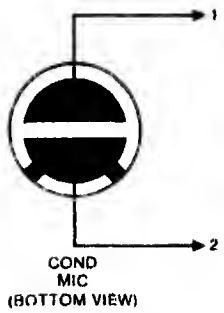


Fig. 2: The pin configuration of LM324 and the condenser microphone connections.

tial divider comprising R14 and R15, the output of op-amp A goes high, and the LED lights up. This delay is linearly dependent on the position of potentiometer VR2. (The maximum delay is given by the formula T=20C, where T is in milliseconds and C is in microfarads. Thus, by changing the value of C5 the maximum delay can be varied.)

Flash trigger. The flash gun contacts are connected to the SCR, observing proper polarity. The instant the output of op-amp A goes high, the SCR is triggered and the flash gun fires.

Once the circuit is triggered it remains in the latched state. It can be deactivated by depressing switch S1 for a period of three to four seconds.

Taking the photographs

As explained earlier, the photographs are taken in a darkened room. The most important variable is the time delay,

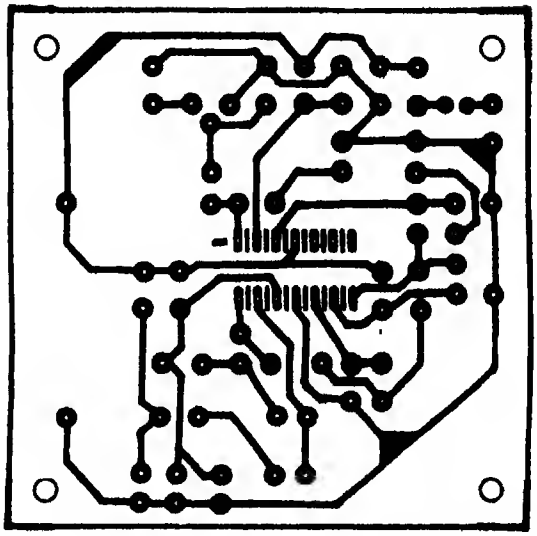
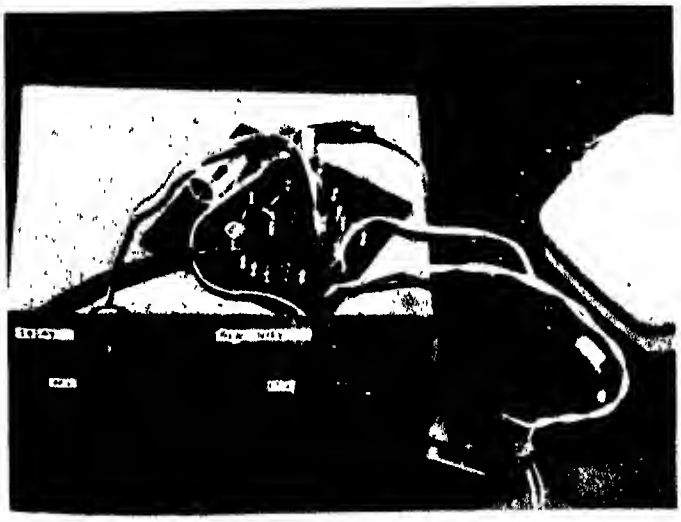


Fig. 3: Actual-size PCB layout of the sound activated flash.



A view of the author's prototype showing microswitch S1 and milk bowl in which the drops were made to fall.

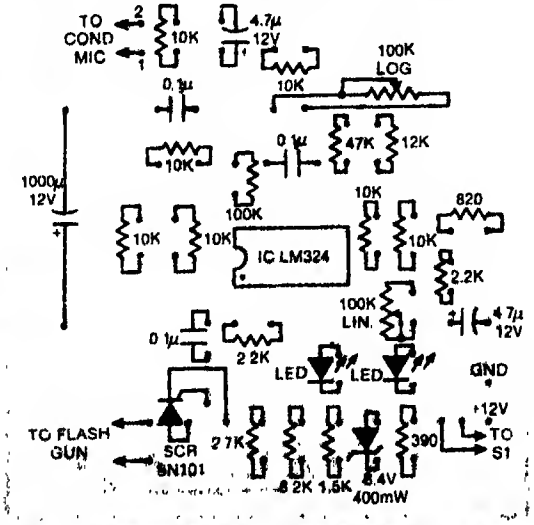


Fig. 4: Components layout for the above PCB.

which is obtained experimentally. A number of trial runs are made to set the sensitivity and delay.

In the photos of the milk drop, the drop was made to fall from a height of one metre into a bowl just filled to cover the bottom surface. As sound made by the drop was quite faint, the microphone was taped to the lower surface of the bowl. As seen in the series of photographs taken, the most interesting formation was at a delay of about 25 milliseconds after the drop struck the bowl.

In the different stages of the bulb bursting, the bulbs were shot with the help of an airgun. A thick cloth sheet was hung behind the bulb to eventually catch the pellets.

Care should however be taken to adjust the sensitivity of the circuit so that it does not trigger at the sound of the gun. This can easily be achieved by keeping the microphone closer to the bulb than to the gun.

□

This project was designed and tested by the author. The circuitry was retested 'partly' in CFY lab. The photographs were all taken by Mr Sushil Narula and the author