RAIN ALARM

Super-simple project saves a lot of washday hassles.

MARCH WINDS AND APRIL showers bring forth May flowers, runs an old saw which obviously applies much better to Britain than Australia. This old meteorologist's tale actually applies quite well over there, but if you require something a bit more scientific, and generally applicable, it's not so hot. Additionally the bit about April showers is likely to bring forth more than the odd May bud if one of these unpredictable periods of precipitation disrupts a busy housewife's washday by relegating her almost-dry laundry to the ranks of the wet-behind- the-eiderdown brigade.

Singin' in the...

The problem of rain showers is an annoying one, but here we come to the rescue with a Rain Alarm. This little gadget might well upstage any canine companion as a housewife's best friend, at least on washday, by giving a warning at the first sign of rain, leaving plenty of time to get the laundry in before it gets wet.

The rain alarm should be placed out in the open and a length of two core wire run between it and a box containing the battery, on/off switch and speaker. We used an old intercom substation to provide a home for our speaker but a car extension speaker or indeed any suitably boxed eight ohm device would be fine.

Any rain falling on the sensor track, which is formed as part of the PCB (neat innit?), will set off the alarm and produce a distinctive intermittent beep-beep.

Construction

Although the project is very simple, we recommend use of the PCB layout shown, as this is (we feel) much more attractive than a hacked-up piece of Veroboard.

Assemble the components onto the board using the overlay, remembering to solder pins 7 and 14 of IC1 before the others, to allow the device's internal protection circuitry to work.

In our prototype we used a value of 4M7 for R1 which acts as a sensitivity adjustment. This value leads to a 'hair-trigger' alarm and could well be reduced taccording to the level of sensitivity required.

When construction of the board is complete and the alarm has been tested, the area of the PCB that holds the components should be covered, front and back, with some suitable non-conductive potting compound to render it waterproof. We used Epirez 135 epoxy resin to encase the base of the board in a wedge shape so that it will stand up, thus obviating the need for a case.

More Power to Your...

Power consumption of the unit is so low when the alarm is not triggered that an on/off switch is not needed for that reason, but we recommend one unless you enjoy being woken up in the middle of the night by some light rain (or even mist)!

While this unit is not as effective as a device to control the weather (we're still working on that one), it should at least prevent some of those washday blues.

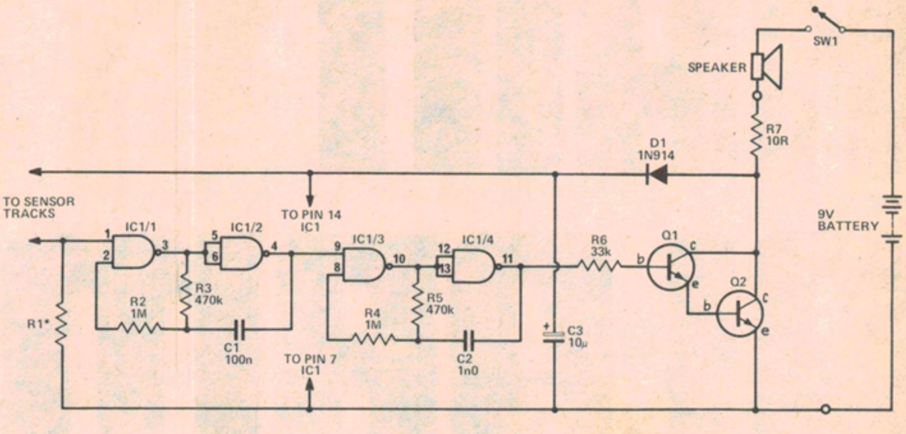

Fig. 4. Circuit diagram of the Rain Alarm.

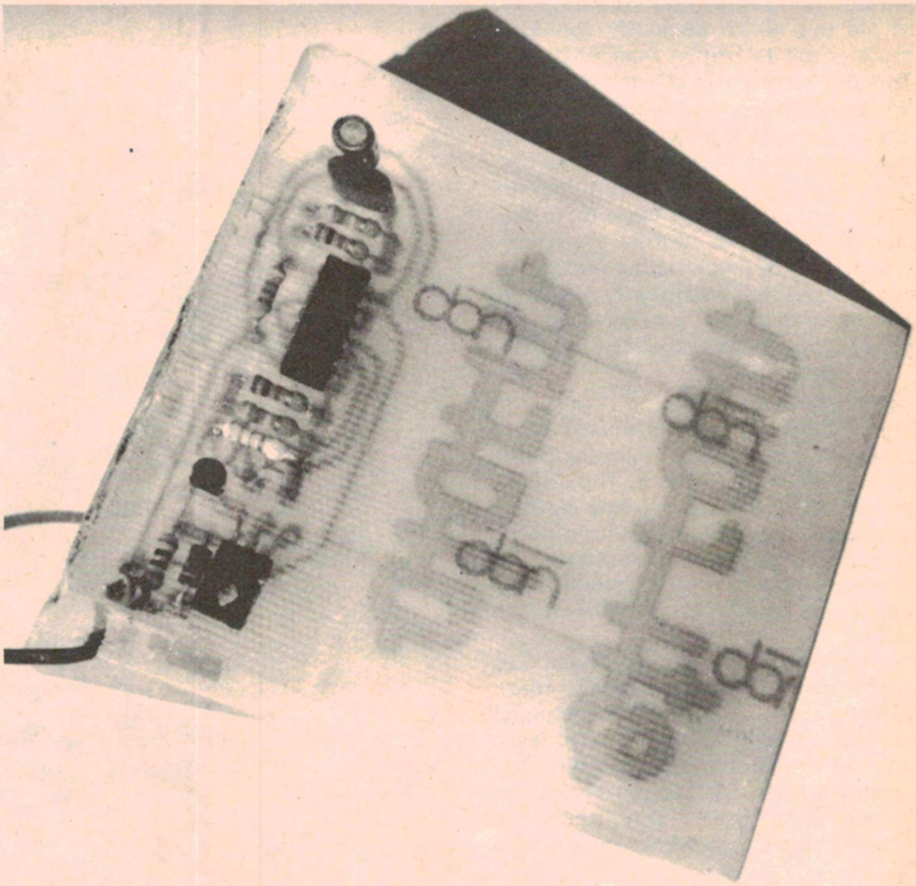

Fig. 5. The epoxy resin which encapsulates our board can just be seen in this photograph.

PARTS LIST – ETI 246

Resistors all ¼W 5%

R1	see text
R2	1M
R3	470k
R4	1M
R5	470k
R6	33k
R7	10R

Capacitors

C1	100n polyester
C2	1n0 polyester
C3	10µ electrolytic

Semiconductors

IC1	4011
Q1	BC107
Q2	BD139
D1	1N914

Miscellaneous

PCB as pattern, 8R speaker, switch, battery.

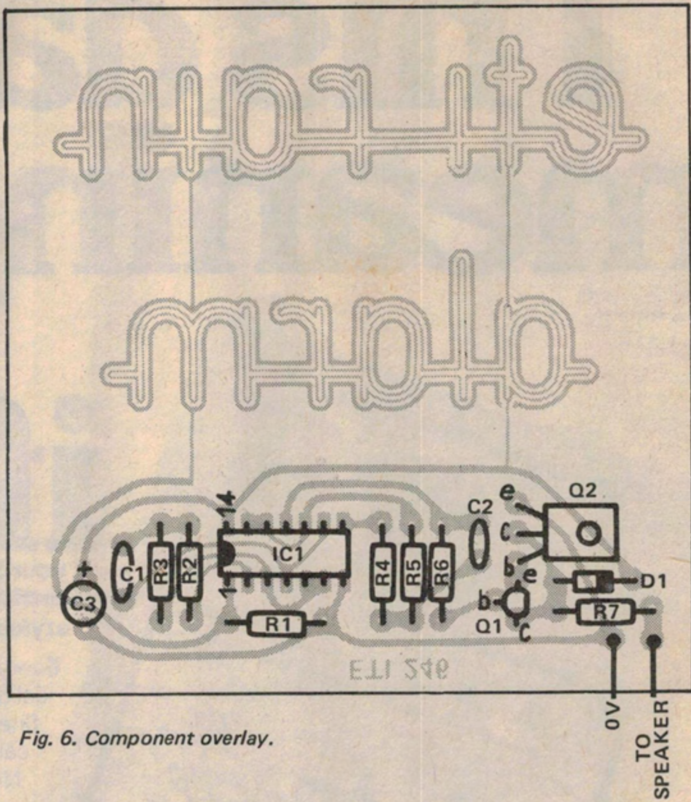

Fig. 6. Component overlay.

HOW IT WORKS – ETI 246

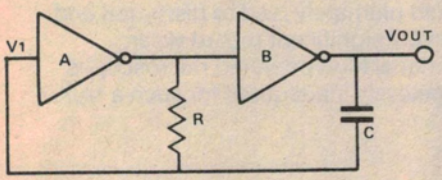

Fig. 2. A basic CMOS oscillator.

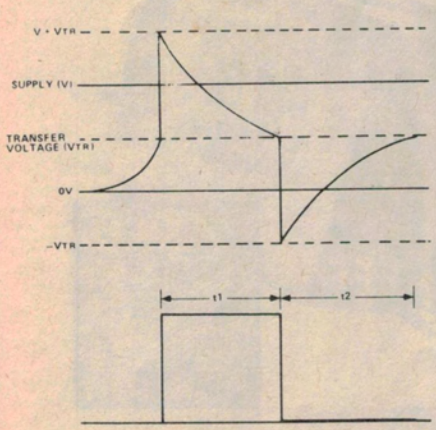

Fig. 3. Waveforms at various points in the circuit.

The rain alarm is formed by two gated CMOS oscillators and an audio output stage.

The basic CMOS oscillator is shown in Fig. 2. Upon switch on, with C discharged, the output of inverter B will be low, the input to A low and its output will go high. Capacitor C will now commence to charge towards supply, the voltage on A output, via resistor R.

We can consider a CMOS gate to be a comparator that will change output state when the level of the the input voltage reaches a specified value, the transfer voltage (Vtr), usually about half supply. Thus as the voltage on C increases due to the charge current supplied by R there will come a point when the voltage on the input of A will pass its transfer voltage and and the output of B will go high.

At this point the charge on C corresponds to a voltage level of about half supply.

As the inverters A and B change states the end of C that was held at 0 V is now at supply and the end of C that was connected to supply via R is now returned to 0 V via the same resistor.

These changes together with the charge stored on C mean that the potential across C is now supply plus the transfer voltage of gate A. This is shown in Fig. 3.

Capacitor C will now discharge via R until once again the transfer voltage of A is reached whereupon the outputs of the inverters will assume their original states.

The conditions are not quite the same as they were at switch on, as can be seen in Fig. 3, because the potential across C is now a negative value equal to A's transfer voltage.

From this point C charges via R again to repeat the cycle.

Thoe output is shown in Fig. 3 where t1 = t2 = 1.1 RC (the time taken for C to charge (discharge) via R to two-thirds of the maximum value of voltage across it).

In practice, due to the protection networks built into modern CMOS devices, it is necessary to include a resistor in series with the input of A in order to ensure that the voltages across C are allowed to reach the values shown in Fig. 3.

The final circuit diagram (Fig. 1) of the unit shows that the inverters are in fact formed from the four NAND gates of a 4011 package. In each oscillator, while one gate is configured as a straightforward inverter, the other has one input that can act as a control input, oscillator action being inhibited if this input is held low.

The first oscillator (IC1a and IC1b) has this input tied low via a high-value resistor (R1) that acts as a sensitivity control, Thus this oscillator will be disabled until the control input is taken high by any moisture bridging the track, so enabling the output, which is a 10 Hz square wave. This in turn will gate the 1 kHz oscillator formed by IC1c and IC1d on and off.

The latter oscillator drives the loudspeaker via R6, the Darlington pair formed by Q1 and Q2, and resistor R7.