

PRESSURE MAT TRIGGER ALARM

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THIS SIMPLE i.c. project has been specially designed as a control unit for pressure (or trigger) mats. The Pressure Mat Trigger Alarm has two inputs, each being a normally open pressure mat. The mat closes the circuit when an intruder steps onto it, and then an indicator lamp illuminates on the alarm unit. A warning buzzer also sounds.

Even if pressure is then removed from the mat, the lamp and buzzer will continue to operate as this design has a built-in latching action.

POWER SUPPLY

Power can be derived from the mains by means of a nine volt battery eliminator. Designs for these appear from time to time in *EE*. A rating of 9V 50mA will be more than ample.

Alternatively battery operation is possible. For short periods a PP3 battery can be used but if prolonged use is desired then a larger type is recommended.

TWO CHANNELS

The circuit diagram is shown in Fig. 1 where IC1 is a TL082 twin op-amp integrated circuit. This contains two separate operational amplifiers sharing a common power supply. One amplifier is used per channel and the circuit of just one channel will be described. The other circuit operates in an identical manner.

CIRCUIT DESCRIPTION

The resistors R1 and R2 form a potential divider holding the non-inverting input of IC1a at about 2V. The other input would be held at more than this by R3 and R4, say 3V, and so, by comparator action, the output (pin 1) of IC1a is low. This also holds the non-inverting input at a low voltage.

This means that D1, the visual indicator for channel 1, cannot therefore illuminate.

Once the normally open pressure mat on channel one is closed by an intruder standing upon it, then the inverting input is grounded to 0V, and so the output of IC1a will go high. The voltage at the non-inverting

input slightly exceeding that at the inverting input causes this effect.

The output, being fed back to the non-inverting input, also holds this input high. Even if the pressure mat is now opened (weight being removed from the mat) pin 3 is still held at almost 9V, and pin 2 at only a couple of volts. The output therefore remains high. In other words, the circuit has latched.

Diode D1 will also illuminate. This high signal is directed by D2 into the base of TR1, a transistor connected as an emitter follower, with an audible warning device (WD1) as its load. The buzzer therefore sounds.

AUDIBLE WARNING

In this application a solid-state buzzer is used which draws roughly 15mA when sounding. Conventional electro-mechanical buzzers are not suitable in this circuit.

The lamp and buzzer continue operating until S1 is pressed. This normally closed push-button temporarily removes power from the circuit, so that when S1 is closed again, the two op-amps take up their quiescent state as described earlier.

The other channel built around IC1b functions in a similar fashion. Diode D3 is the indicator lamp for channel two, and the output signal is coupled via D4 to TR1, which operates the buzzer WD1 as before.

COMPONENTS

Resistors

R1 100k Ω	R8 100k Ω
R2 33k Ω	R7 33k Ω
R3 68k Ω	R6 68k Ω
R4 33k Ω	R9 33k Ω
R5 560 Ω	R10 560 Ω

All $\frac{1}{4}$ W carbon \pm 5%

Capacitors

C1, 2 10 μ F 10V elect. (2 off)

Semiconductors

IC1 TL082CP dual op-amp
TR1 7TX300 non silicon
D1 1N4220 red i.e.d.
D2 1N4148 small signal silicon diode
D3 1N4220 red i.e.d.
D4 1N4148 small signal silicon diode

Switches

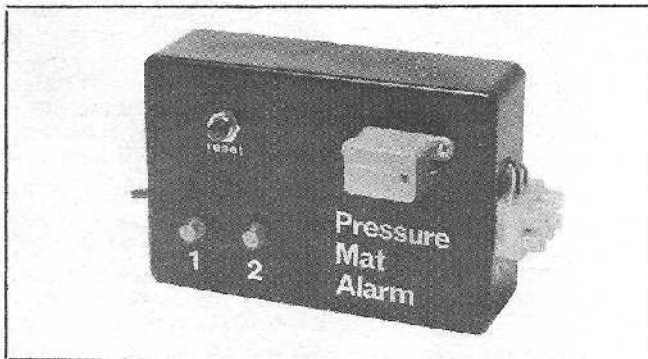
S1 push-to-break, release-to-make single pole
S2 s.p.s.t. toggle

Miscellaneous

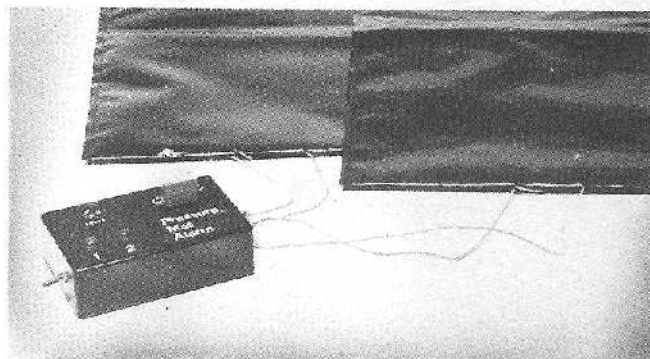
WD1 9V solid state audible warning device
TB1 three-way screw terminal block
B1 9V PP3 type
Plastics case, 116 x 77 x 35mm, type PB1 (Maplin), or similar; stripboard, 0-1 inch matrix, 10 strips by 24 holes; pressure mats with normally open contacts (2 off); 8 pin d.i.l. i.c. socket; battery clip to suit B1; connecting wire to link up trigger mats to alarm unit; 6BA nuts, bolts and spacers to mount circuit board (2 off each); hook up wire.

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COMPONENTS
approximate
cost **£8-50**
excluding mats



Outside view of the finished unit. The terminal block for the pressure mat connections is shown on the right.



The control box wired into the pressure mats. The relative scale of the unit and pressure mats can easily be seen.

CONSTRUCTION starts here

CASE

A plastic case type PB1 can be used if an external power source or a PP3 battery is used. This case measures 116×77×35mm but any other type of case with suitable dimensions can be used. If larger batteries are employed then a larger box may be needed.

The drawing in Fig. 2 shows the arrangement of electronic components on the 0.1 inch matrix stripboard, which measures 10 strips × 24 holes (standard size). The assembly is fairly compact, and quarter watt resistors must be used.

During assembly take care to orientate the transistor and diode leads correctly, and do not subject them to excessive heat during soldering. It is best to use a heatshunt if you are in any doubt.

I.C. SOCKET

The i.c. is not particularly cheap and it would be wise to protect it from the rigours of soldering by using an 8-pin d.i.l. socket. Obviously it is important to plug the chip in the right way round.

The stripboard can be bolted to the lid of the box with 6BA hardware and two clearance holes exist in the stripboard for this purpose. There are quite a few flying leads coming off the board, and using several colours of insulated wire may help in identification. General purpose multi-stranded wire can be used throughout.

FINISHING OFF

Connections to the pressure mats are made by a three-way screw terminal block TB1, one terminal being common to both loops. Three wires from the terminal block pass through a hole in the case to the stripboard within.

Similarly, the buzzer is mounted on the front with 8BA hardware, and its two connecting leads pass through an

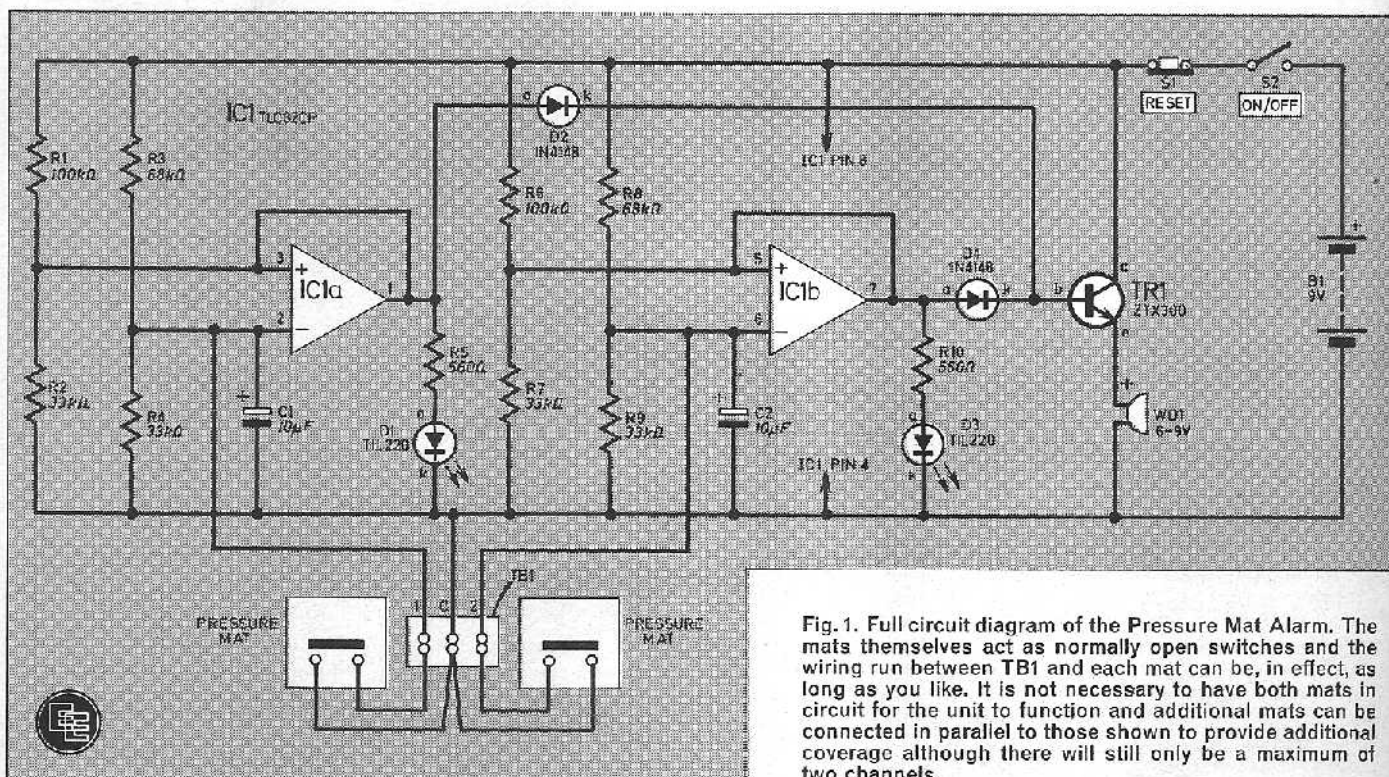
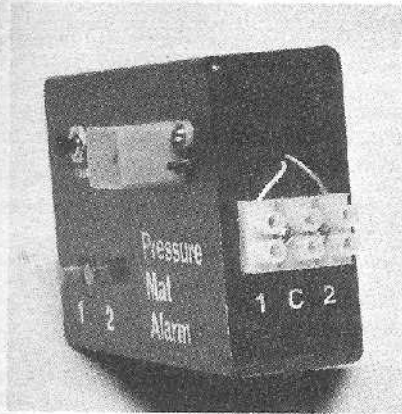
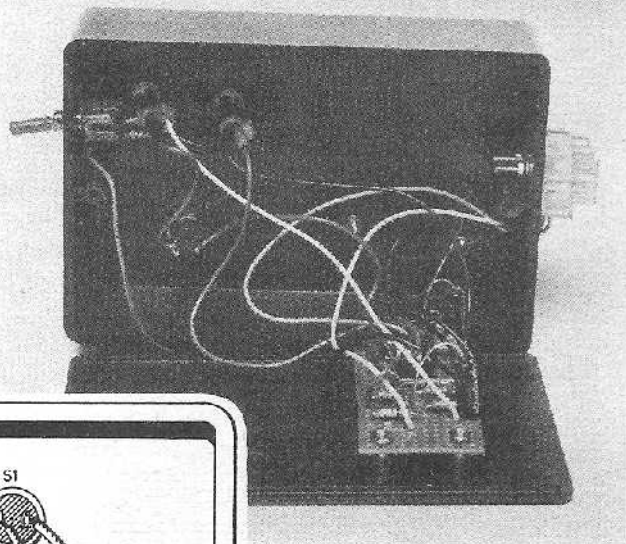


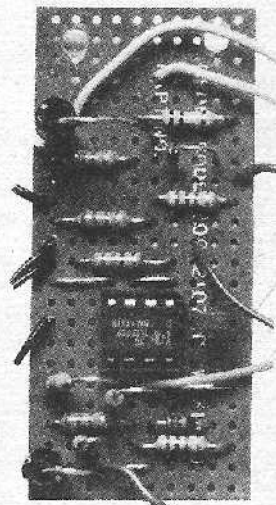
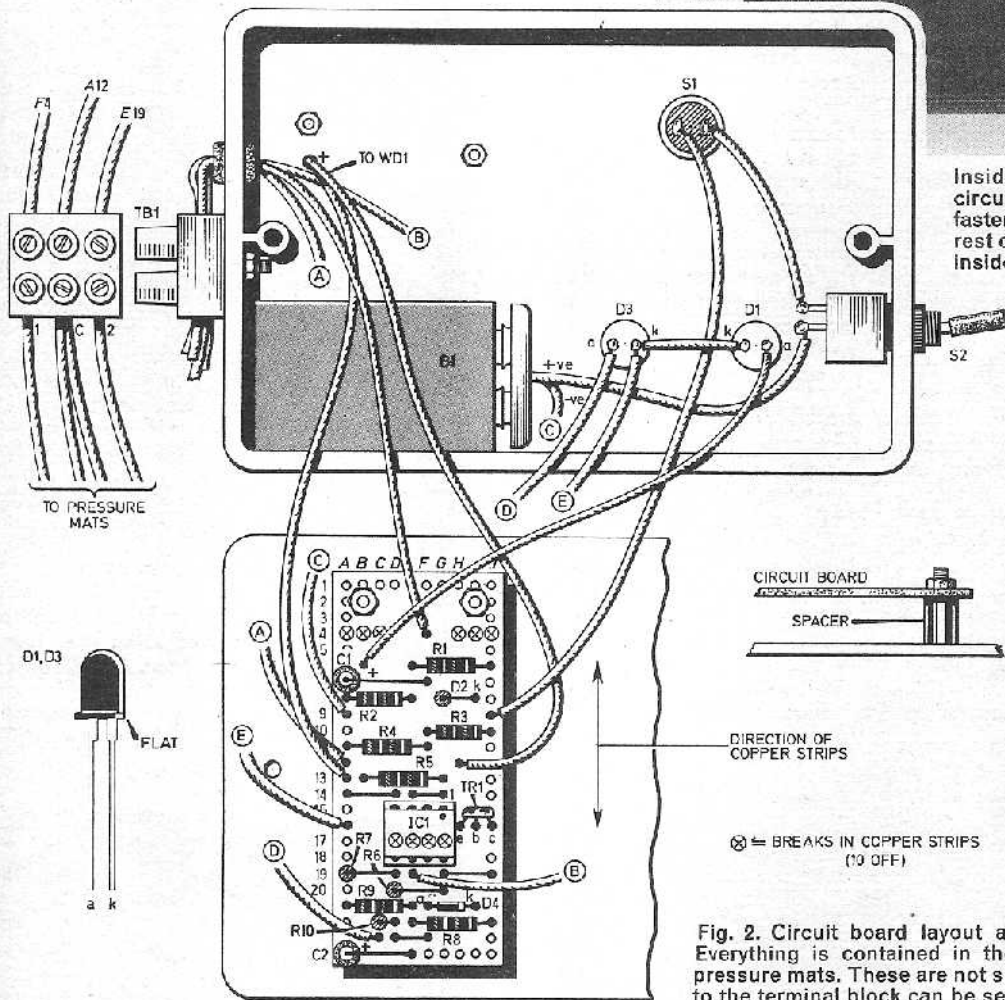
Fig. 1. Full circuit diagram of the Pressure Mat Alarm. The mats themselves act as normally open switches and the wiring run between TB1 and each mat can be, in effect, as long as you like. It is not necessary to have both mats in circuit for the unit to function and additional mats can be connected in parallel to those shown to provide additional coverage although there will still only be a maximum of two channels.



(left) End on view of the case showing the terminal block with each channel clearly marked and the buzzer with its connecting wires passing through a convenient hole in the case.



Inside view of the case. The circuit board can be seen fastened on the box lid with the rest of the components mounted inside the case.



The completed circuit board.

Fig. 2. Circuit board layout and component interwiring. Everything is contained in the one box apart from the pressure mats. These are not shown but their connections to the terminal block can be seen top left.

adjacent hole to the component panel within.

The two 0.2 inch light-emitting diodes D1 and D3 can be affixed to the front panel with the clips supplied with the l.e.d.s.

TESTING

With construction finished check out all the wiring thoroughly and then switch on. The buzzer may initially sound (and both l.e.d.s illu-

minate) but pressing S1 should reset the buzzer and extinguish the indicators. Shorting out the loop terminals should illuminate the appropriate l.e.d. and cause the buzzer to sound. Pressing S1 should reset the l.e.d. and buzzer once more.

You can hide the pressure mats in any suitable location but the mats must be on a flat surface. Several mats can be wired in parallel thus increasing the protection afforded by the system. However, the loop wires

are not tamperproof and must be hidden under the carpets, or otherwise shielded.

Loop lengths of about 10 metres have been tried on the prototype unit with great success and this distance could easily be exceeded with good results.

Transient protection appears to be good and there should be little danger, if any at all, of the alarm being triggered by transients on the loop wires or power rails. □