ALARM SYSTEM FAULT FINDER

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A low-cost fault finder that will find a faulty sensor without the alarm system sounding-off incessantly.

When false alarms occur on domestic and on cheaper/older commercial intruder alarm systems it is often difficult to know which sensor has caused the alarm, and even if this is known, many panels do not have a soak test and log facility to test the would-be faulty sensor.

FINDING FAULT

The usual method of fault finding in this situation, after wiring checks, is either:

1) If more than one infra-red, or other sensor is on a single zone it is difficult to know which one is causing the false alarms. The usual method is to sequentially short the intruder contacts out in each sensor, one at a time, and carry on using the system and see when the fault disappears.

2) If a single sensor on a zone is causing false alarms, then the normal method is to short that sensor out in the sensor or at the alarm panel, then carry on using the system and see if the fault has disappeared, or just change the sensor for a new one.

Both methods are not very satisfactory for the following reasons:

(a) The false alarm, complete with bells, sirens, and internal sounders, will keep occurring until the faulty sensor is found and shorted out. This could take many attempts if there are a number of sensors on the faulty zone.

Constant repetitive false alarms, especially at night, are not good for your nerves or for your neighbours' tempers. Eventually any alarm will be ignored, as it will be put down to just another false alarm.

(b) If the sensor is just changed for a new one this could well cure the problem, but it may not, as the false alarms may be caused by vermin within the zone (infra-red etc.) or r.f. interference or mains transients occurring and being picked up by the sensor wiring and introduced into the sensor's electronics.

This simple, easy-to-build, low-cost fault finder project will let you find the faulty sensor without causing the complete alarm system to keep going off.

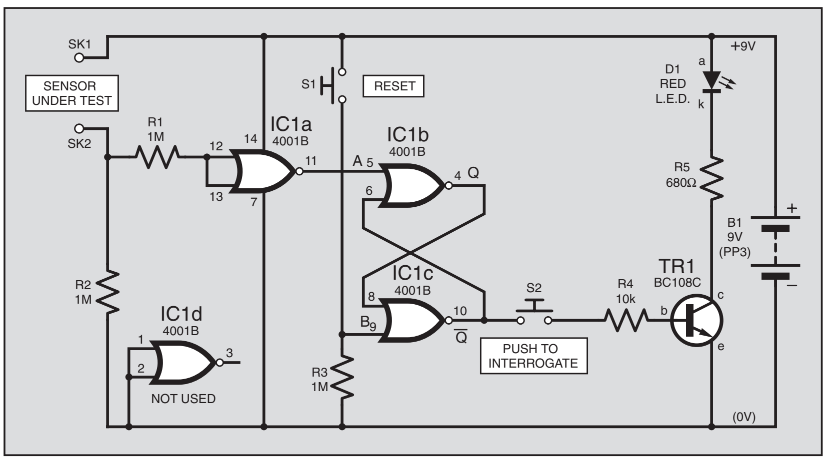


Fig.1. Complete circuit diagram for the Alarm System Fault Finder.

CIRCUIT DESCRIPTION

The full circuit diagram for the Alarm System Fault Finder is shown in Fig.1. The circuit is constructed around a CMOS 4001B quad NOR gate.

The first gate, IC1a, is used as an inverting buffer for the input signal from the detector/sensor on test. The second and third gates (IC1b and IC1c) are connected up to form an SR flip-flop. The fourth gate, IC1d, is not used.

It can be seen from Fig.1 that the inputs to IC1a (pins 12 and 13) on power up are at logic 0 (0V). Thus, the output from IC1a pin 11 is at logic 1 (Vcc or +V).

The output from IC1a pin 11 is applied to pin 5 (Set) of the first gate (IC1b) in the SR flip-flop configuration. From Table 1 it can be seen that any logic 1 applied to a gate input results in a logic 0 output. This logic 0 output from IC1b pin 4 is applied to pin 8 of IC1c, the second "half" of the flip-flop.

It can be seen that a logic 0 is also applied to IC1c pin 9, which results in a logic 1 output on pin 10, this being fed back to IC1a input pin 6. The flip-flop is now in the SET condition, and will remain so until it receives a logic 1 at the input of the buffer IC1a (pins 12 and 13).

The normally closed (n.c.) contacts of the alarm sensor "under test" are now connected to the test terminals SK1 and SK2, and Reset button S1 is pressed. From the truth table and circuit diagram it can now be seen that the input to IC1b is at logic 0, and the output of the second gate, IC1c pin 10, is at logic 0. Therefore, if the Interrogate button S2 was pressed transistor TR1 would be reversed biased and so turned off, thus the l.e.d. D1 would not illuminate.

Table 1: Truth Table

Inputs		Outputs	
A	B	Q	$\overline{Q}$
0	0	1	1
0	1	0	0
1	0	0	0
1	1	0	0

If the sensor's contacts were to open momentarily then the output of IC1c would be latched at a logic 1, even if the sensor's contacts had closed again. Hence, if the Interrogate button is now pressed, transistor TR1 would be forward biased and l.e.d. D1 would illuminate with current limiting imposed by resistor R5.

Because the quiescent current drain of the circuit is so small no power supply On/Off switch has been incorporated.

CONSTRUCTION

The Alarm System Fault Finder circuit is built on a small single-sided printed circuit board (p.c.b.) and the component layout, together with a full-size copper foil master and interwiring details, are shown in Fig.2. This board is available from the *EPE PCB Service,* code 404.

Commence construction by soldering in position the 14-pin d.i.l. socket for IC1 followed by the five resistors and transistor TR1. Do not insert IC1 into its socket at this stage.

After this the small flexible lead-off wires can be soldered into place. These are to provide the connections to the battery, pushswitches, l.e.d. and test connectors SK1 and SK2.

ASSEMBLY AND WIRING-UP

The next job is to mount the pushswitches, l.e.d. and test connectors on the box lid. After this a battery compartment can be made from an old piece of stripboard or p.c.b. and slotted or glued into place in the box, as shown in the photographs.

The various board lead-off wires can now be soldered onto the front panel components, insulating solder joins with plastic sleeves where necessary (see Fig.2). After visually checking the completed tester for any wiring and connection errors, IC1 can now be plugged into its d.i.l. holder. Take the usual anti-static precautions when handling the i.c.

The completed Fault Finder is now ready for testing.

TESTING

Commence testing by connecting up the 9V battery and then press the Interrogate button (S2). This should cause the "memory" l.e.d. D1 to illuminate.

If all is well, apply a temporary shorting link between the test terminals SK1 and SK2 and press the Reset button (S1). Pressing the Interrogate button should not now cause the l.e.d. to illuminate.

Briefly break the short circuit between the test sockets/terminals. Now pressing the Interrogate button should cause the l.e.d. to illuminate.

If the tester does not operate correctly, immediately disconnect the battery and check all wiring and connections for errors. All p.c.b.-mounted components should also be checked for correct orientation.

If no faults have been found reconnect the battery and check the circuit through, preferably using a logic probe, but failing that use a digital multimeter with a high input impedance (10 megohms or above).

COMPONENTS

Resistors

R1, R2, R3	1M (3 off)
R4	10k
R5	680Ω

All 0·25W 5% carbon film

See SHOP TALK page

Semiconductors

D1	5mm red l.e.d.
TR1	BC108C *npn* transistor
IC1	4001B CMOS quad 2-input NOR gate

Miscellaneous

S1, S2	pushbutton switch, push-to-make (2 off)
SK1, SK2	4mm screw terminals (2 off)

Printed circuit board available from the *EPE PCB Service*, code 404; plastic case, type and size to choice; 14-pin d.i.l. socket; l.e.d. clip; 9V battery (PP3 type) and snap connector; multistrand connecting wire; sleeving; solder etc.

Approx. Cost Guidance Only **£8** ***excl. case & batts.***

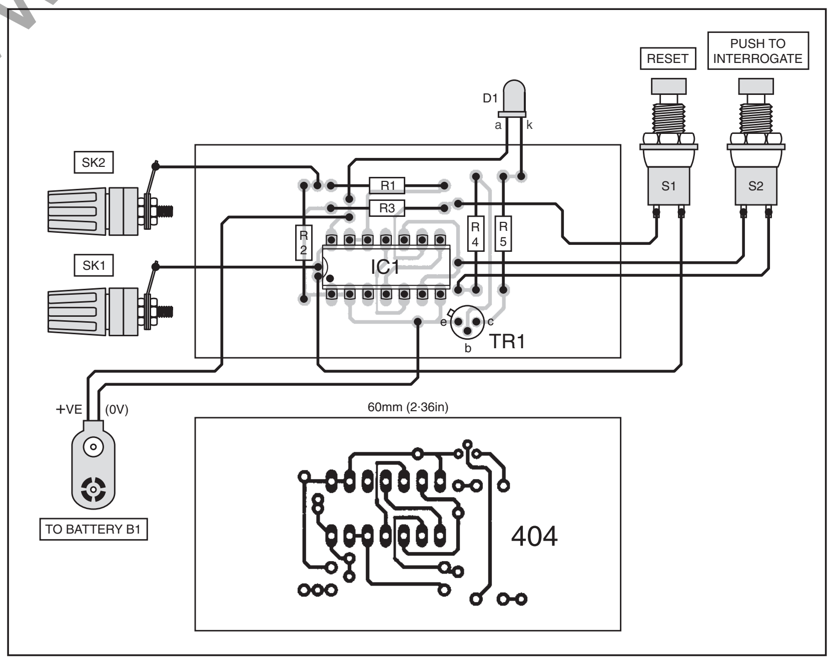
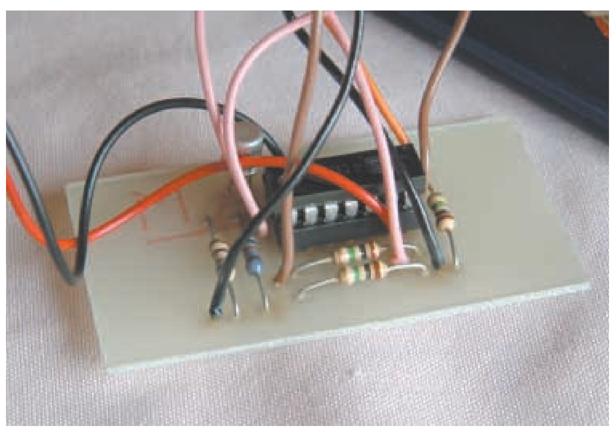


Fig.2. Printed circuit board component layout, off-board interwiring details and full-size copper foil master for the Alarm System Fault Finder. The extra board width is to allow the p.c.b. to slot into the author's plastic box internal "guide rails".



(Above) Completed circuit board removed from its case.

(Left) The finished prototype unit showing general component positioning and lettering on the case lid. Note the "access memory" legend has been amended to "Push To Interrogate" in the final version.

Prototype model showing the p.c.b. and battery compartment divider slotted into the case. The space between boards is to accommodate the lid-mounted components.

POSSIBLE FAULT CONDITIONS

DOOR CONTACT
- Magnet/reed switch out of alignment, and working "just on the edge".
- Old reedswitch whose resistance has increased dramatically.
- Cracked glass reed capsule.

INFRA-RED
- Sunlight falling directly onto the sensor.
- Heat sources within a zone.
- Strong air drafts onto the sensor.
- Animals in a zone.

DUAL-TECH
- Animals in a zone.
- Microwave range not correctly adjusted.

ULTRASONICS
- Animals in a zone.
- Draughts within a zone.
- Heat sources within zone.
- Two sensors "seeing" each other, and are not of the digital crystal controlled type.

USING THE TESTER

Even the most basic alarm panels will usually tell you which Zone has caused the false alarm. Once this is known, how you proceed depends upon how many sensors are connected to the faulty zone.

If one sensor only is fitted, it is necessary to extend the alarm contact wiring temporarily out to the Alarm System Fault Finder input terminals. If the sensor is an infra-red, dual-tech, or ultrasonic device then the tester will have to be located outside the "field of vision" of the detecting device.

After the temporary connections have been made it is also necessary to omit the faulty zone or to short out the zone circuit on the alarm system panel. Then when setting the alarm system also set the alarm system tester unit. This is set by first pressing S1 Reset button and then by pressing S2 Interrogate button. The "memory" l.e.d. D1 should stay extinguished, validating the alarm closed circuit through the would-be faulty sensor.

When returning home or getting up in the morning the intruder alarm system should be turned off first. The alarm "fault finder" unit can now be interrogated by pressing switch S2. If the l.e.d. illuminates this indicates a false alarm occurred during the alarm panel set period, and a false alarm would have normally occurred. If no false alarm occurred it is recommended that the test procedure is used for up to a week to validate the tests.

MULTI-SENSORS

If more than one sensor is fitted across the faulty zone then the zone will have to be broken down in a logical order to identify the faulty sensor. On modern systems it is usual to have one sensor per zone but on cheaper or older systems it is possible that each zone could have two, three, or even four sensors fitted to it.

Depending upon how many sensors are fitted to the faulty zone, two approaches can be taken. The first is to split the sensors into two groups and see which group is faulty, then split these down again and again until the faulty sensor is located.

The other method is to test each sensor, one at a time, perhaps using old knowledge or instinct as to where the fault lays. It can be seen that it will take time to locate the fault and the system's security coverage will be reduced during this time, but at least no false alarms will occur and you can sleep soundly at night, as can your neighbours.

Once the faulty sensor is located it can be replaced or relocated depending upon the fault. If the sensor is not faulty then the fault must be found, this could be due to any one of a number of causes, depending upon the type of sensor fitted.

A general guide to other possible "faults" can be found in the accompanying Possible Fault Conditions panel. Let's hope that "silence is golden" is the password for you and your neighbours! □

The Fault Finder connected to the author's Alarm System panel to monitor a suspect zone sensor.