I.C. UNIBOARDS

SIMPLE INTEGRATED CIRCUIT DESIGNS

ICE ALARM

No. 2

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At the time of writing, winter is upon us once more, and with it come the traditional problems of black ice and treacherous driving conditions for motorists.

This Ice Alarm warns the driver when possible conditions exist for the formation of black ice. It does this by monitoring the temperature outside the car. When this drops to about two or three degrees Celsius, slightly above freezing, the unit flashes a warning lamp on the dashboard, thereby alerting the driver.

Normally, however, this lamp is continuously alight to indicate that the unit is in operation. The device can be switched off when it is not required.

CIRCUIT DESCRIPTION

The unit employs a CMOS integrated circuit, and the full circuit is shown in Fig. 1.

The heart of the unit is IC1, a CMOS multivibrator which has been wired up as a gated astable. This means that the device oscillates only when pin 5 is high, otherwise it is inoperative.

There are three outputs, pins 10 and 11 are the Q and $\overline{Q}$ outputs, and pin 13 is the oscillator output. Of these, pins 10 and 13 are not used in this design. The Q and $\overline{Q}$ outputs simply go high and low alternately. At all outputs a square wave is generated, the period (or time for one cycle) of which is determined by values of C2 and R3.

At pins 10 and 11 the period is equivalent to roughly $4{\cdot}4 \times R3 \times C2$. Thus the period at pin 11, the only output used, is approximately 0·5 seconds, giving a frequency of 2Hz. The frequency of the square wave at pin 13 is always double this.

Ignoring TR1 for the moment, when pin 5 is grounded, the i.c. is disabled and does not oscillate. In fact pins 10 and 12 go low and pin 11 goes high. The outputs remain like this until pin 5 goes high again, when the i.c. will once more oscillate.

DETAILED OPERATION

The Ice Alarm operates in detail as follows. The sensor, RTH1, consists of a thermally sensitive resistor, or thermistor. Its resistance decreases as its temperature rises. It has a negative temperature coefficient. At 3°C it has a resistance of roughly 11 kilohms.

Along with R1 and VR1, the thermistor forms a potential divider, the output of which is connected to the base of TR1. This transistor is a *pnp* Darlington transistor. It is really two transistors in one, so connected as to form a very high gain unit.

If TR1 is on, pin 5 is high and so the i.c. oscillates freely. If the transistor is off, however, the reset pin is grounded through R2 and so the i.c. is disabled. In this case pin 11 goes high and remains like this until the transistor TR1 turns on again.

Under warm conditions TR1 is off. Pin 11 then delivers a constant drive signal to TR2, which switches on. This means that the indicator lamp LP1 is constantly alight.

As the temperature of RTH1 decreases towards 0°C, its resistance will increase and the voltage at TR1 base will be reduced. Eventually a point is reached where the base terminal is 1·2V less than the emitter and so TR1 must turn on. Pin 5 of IC1 goes high, permitting it to oscillate normally; pin 11 then presents a square wave signal to TR2 and this causes the indicator lamp to flash.

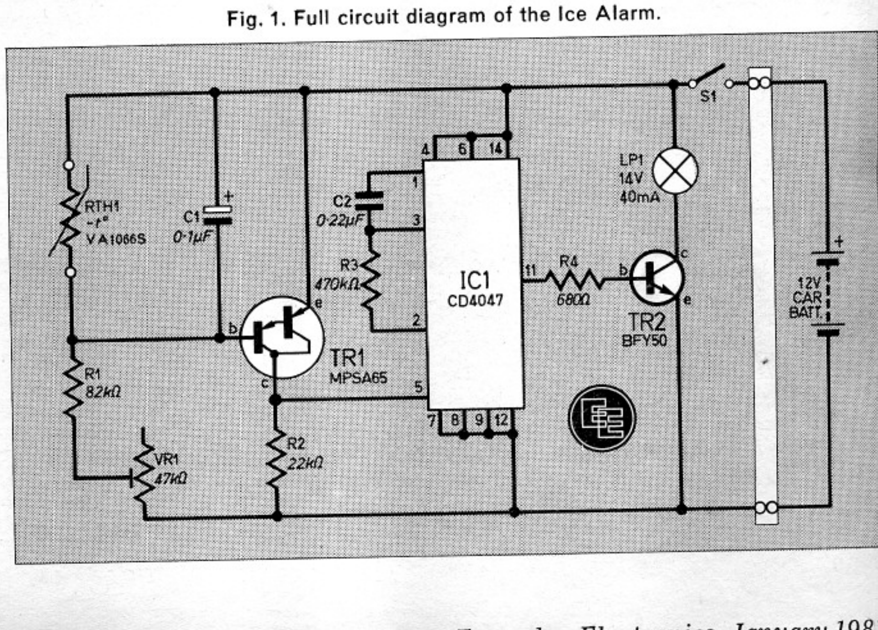
Note that the lamp is normally fully alight to show that the Ice Alarm is on, but it flashes when RTH1 detects a low temperature.

PRESET

The preset VR1 permits a certain amount of adjustment to be made to the "switching point" of TR1, that is the instance at which TR1 will start to conduct and cause IC1 to flash the lamp.

The two main factors affecting this switching point are the 20 per cent tolerance on the thermistor, and also the actual voltage of the supply rail. The tolerance on RTH1 may cause either premature or late operation of the flasher circuit.

Fig. 1. Full circuit diagram of the Ice Alarm.



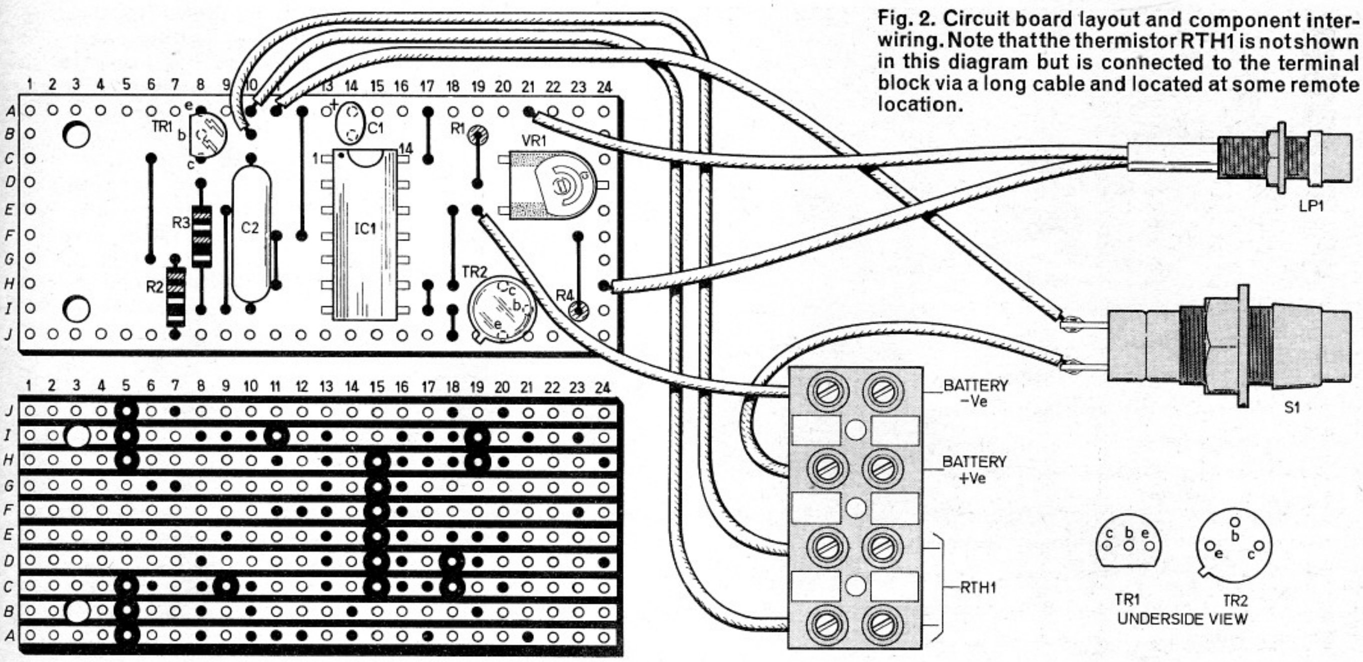


Fig. 2. Circuit board layout and component interwiring. Note that the thermistor RTH1 is not shown in this diagram but is connected to the terminal block via a long cable and located at some remote location.

CIRCUIT BOARD

The layout of the components is shown in Fig. 2. These are all mounted on 0·1 inch matrix stripboard which measures, of course, 10 strips×24 holes.

It is usually best to commence by drilling the two holes needed to take the mounting hardware and then make the breaks in the copper strips. There are eighteen of these.

It is strongly advised that a 14-pin dual-in-line (d.i.l.) socket be used to carry IC1, and the socket should next be soldered into position. Do not insert IC1 yet but keep it in its anti-static package for the moment.

Complete construction by soldering in the resistors, capacitors and then the transistors.

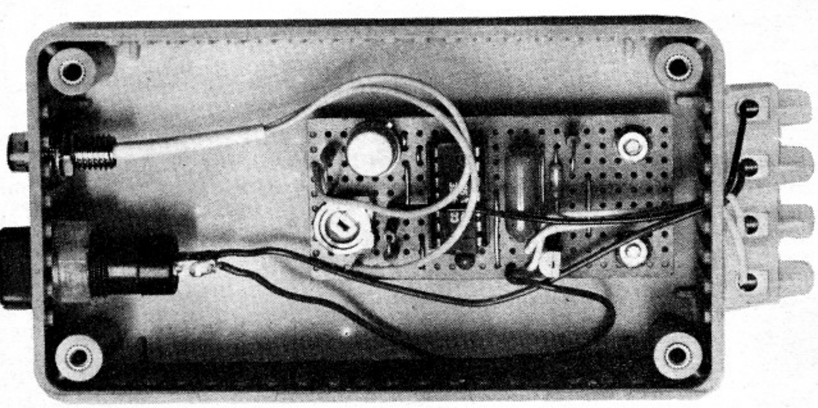
With the assembly of the component panel completed, the i.c. can now be inserted into its socket. Some precautions are necessary however because CMOS devices are sensitive to static electricity.

The circuit board is mounted with 6BA hardware within a plastic box roughly 110×60×30mm. Any case, either metal or plastic, of suitable dimensions can be used, although a Bimbox type BIM2003/13 was used in the prototype.

FINISHING OFF

The push switch, S1, and the indicator lamp were mounted on the box but there is no reason why these could not be extended to a suitable location on the dashboard. In its present form the Ice Alarm is fixed by brackets under the dash, with the lamp and switch facing forward.

Connections for the power feed and thermistor are taken by flying leads from the stripboard, through the case to a four-way screw terminal block mounted outside the case.



Inside view of the unit showing the position of the circuit board and interwiring to other off-board components.

COMPONENTS

Resistors

R1	82kΩ
R2	22kΩ
R3	470kΩ
R4	680Ω

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Capacitors

C1	0·1μF tantalum bead 35V
C2	0·22μF polyester C280

Semiconductors

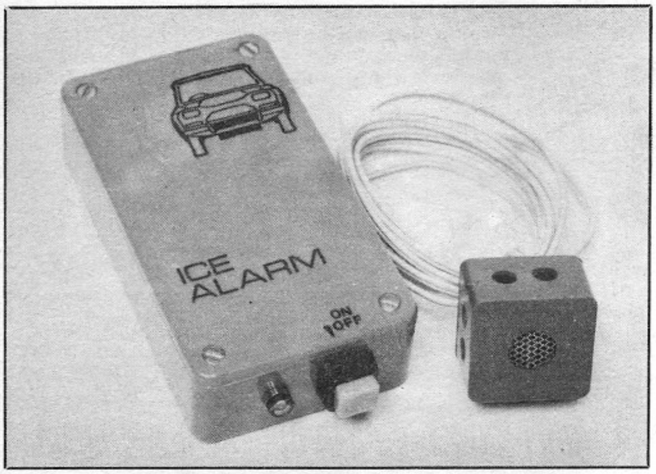
IC1	CD4047 CMOS mono/astable multivibrator
TR1	MPSA65 *pnp* silicon Darlington
TR2	BFY50 *npn* silicon

Miscellaneous

VR1	47kΩ miniature horizontal preset potentiometer
RTH1	VA1066S negative coefficient rod thermistor
LP1	14V 40mA integral type MA lamp (amber)
S1	push-on, push-off single pole switch

Case, 110 × 60 × 30mm, Bimbox type 2003/13 or similar; stripboard, 0·1 inch pitch, 10 strips × 24 holes; 14 pin d.i.l. socket for IC1; four-way screw terminal block; piece of tagstrip for mounting RTH1; twin core flex; mounting hardware for circuit board; lamp holder for LP1.

Guidance only Approx cost **£7·50** complete



Outside view of the completed unit. The thermistor is mounted in the small container shown on the right. It is important to keep RTH1 dry but at the same time it should not be unduly insulated from the outside environment. This means that the container should be adequately ventilated.

The indicator lamp recommended for the design is a 14V 40mA "MA" integral type. This fits into a $\frac{1}{4}$ inch dia hole and has convenient flying lead connections which solder straight to the stripboard.

The thermistor, in the prototype, was soldered to a small piece of tagstrip with one mounting lug being used to secure this assembly inside a small plastic box measuring about 30×30×20mm.

This box must be well ventilated so that the thermistor within can measure the temperature of the air around it. Cheap twin core flex can be used to connect up the thermistor to the main unit.

INSTALLATION

It is of prime importance that the power supply is wired up the right way round; +12V and 0V are taken to the appropriate terminals of the connecting block on the case.

You should ascertain whether the car chassis is positive or negative earth and connect this to the positive of negative terminal on the terminal block. The other supply wire should come from an ignition-controlled circuit (possibly at the fusebox), so that the Ice Alarm is not inadvertently left switched on should the ignition be switched off.

The position of the thermistor module may be rather a trial and error affair The unit is obviously not waterproof and so it must not be exposed to spray or road filth. Furthermore it needs to be placed away from the car's exhaust system and cooling system—parts which get hot during normal operation.

Final positioning must vary from car to car. A suggestion is behind (i.e. inside) the front bumper.

Readers with component embedding resin available may like to try potting the thermistor inside a small box. This would weatherproof the module, and is a much better alternative than the assembly described in this article.

With installation completed there is little left to do except wait for a frosty night! Check for correct operation (the lamp flashes) when the thermistor has detected freezing temperatures.

Some adjustment of VR1 may prove necessary but initially start with the preset to mid-position. Once you have finalised the setting, the preset should be secured with a dab of glue or paint.

BOOK REVIEWS

A GUIDE TO ELECTRONIC MUSIC

Author	Paul Griffiths
Price	£2·95
Size	200 × 135mm 128 pages
Publisher	Thames and Hudson
ISBN	0 500 27203 4

IT IS OFTEN forgotten that electronic music is not much more than thirty years old and yet the electronic revolution has had a profound effect on composers, opening up a whole new range of creative possibilities.

At the same time this area of music is still a mystery to most people. How many can honestly say that they have heard of such composers as Pierre Schaeffer, Edgard Varèse and Herbert Eimert?

Using clear, non-technical language, Paul Griffiths gives us an introduction to some of the most exciting music of today. The main strength of the book is its readability, something not easy to achieve when there are a lot of different achievements to cram into a modest space.

Indeed the book is remarkably comprehensive, covering the early days in Paris and Cologne right up to the Punk Rock of the late seventies. However it must be said that the author has concentrated entirely on the aesthetic to the exclusion of any technical detail.

Surprisingly, the rock world is given comparatively little coverage, especially when it is given credit for a great deal of cross fertilisation to the so-called "art" music sector, but as the author says, "only the composer's background can be used to determine whether his music should be classed as rock or art." S.E.D.

TOWERS' INTERNATIONAL MICROPROCESSOR SELECTOR

Author	T. D. Towers
Price	£14·95
Size	250 × 175mm 244 pages
Publisher	Foulsham
ISBN	0 572 01037 0

AN ENORMOUS amount of work must have been carried out in the preparation of this book which lists with parameters, over 7,000 devices, consisting of microprocessors, memories, interface chips with other related l.s.i. circuits. The sheer volume probably accounts for the rather high price.

The specifications listed are: Function, Word length, Description of the device, Family, Manufacturer, Package, Technology, Temperature range, Supply voltages, Quiescent power consumption, Compatible I/O levels, and Substitutes where applicable.

These specifications occupy about 80 per cent of the content, the remainder being devoted to ten Appendices containing lists of names and addresses of the manufacturers, a glossary, codings and Microprocessor "Families" (the CPU and support chips) to mention a few.

For those interested in microprocessor "development systems", a section is devoted to this where the CPU is listed with makers name and address. One other Appendix to mention is a bibliography of books and magazines available on the microprocessor and programming. Over 200 titles are mentioned.

This book certainly gives you a lot of relevent information in one package, but it is questioned whether the tabulated data is of the best arrangement. The devices are listed in alphabetical order. This is fine for Diodes, Transistors and Op-amps—the subject of earlier books in the "Selector" series by the same author, but is it the best approach for micros and support chips? B.W.T.