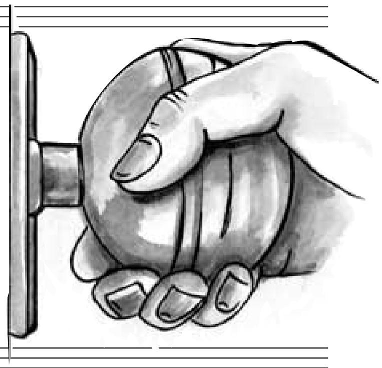
Top Tenners

DOOR PROTECTOR



OWEN BISHOP

Project 1

This short collection of projects, some useful, some instructive and some amusing, can be made for around the ten pounds mark. The estimated cost does not include an enclosure, for many of them work just as well as an open board.

All of the projects are built on stripboard, and have been designed to fit on to boards of standard dimensions. All of the projects are battery-powered, so are safe to build. In a few cases in which, by its nature, the project is to be run for long periods, power may be provided by an inexpensive mains adaptor. Again, the cost of such a unit is not included because most spares boxes contain a few of these, possibly pensioned off from powering now obsolete electronic gadgets.

EVEN if you already have an electronic security system installed in your home or workplace, there is likely to be a use for this Door Protector. With any security system, or even with none, it is important that all doors and windows should be protected by bolts, bars, grids or other physical means. It costs relatively little to fix strong bolts or locks to windows and doors, to make it virtually impossible for anyone to gain access without employing drastic measures.

Unfortunately, there is nearly always one weak point. This is the Exit Door, the door by which you normally leave the house when you are going out. This is also the door by which you enter the house when you come back home.

Other doors (and the windows) are bolted or locked from the *inside*. Once secured, they can only be opened by someone who is already inside the house. Only physical protection is needed.

On the other hand, the Exit/Entry Door has to be openable from *outside* the house as well. There is a limit to the number of locks that can be fitted, and usually it is not practicable to fit any bolts.

DOOR GUARD

This is where electronics, in the form of this month's project, can be of help. The Door Protector system described here can be set to one of two states:

- ***Disarmed:*** After pressing the Disarm button, you may open and close the Exit/Entry Door as often as you like and this has no effect on the siren.

- ***Armed:*** You arm the system by pressing the Arm button and then have 20 seconds to leave the house via the Exit Door without making the siren sound. On re-entering the house through the same door, nothing happens for the first 20 seconds but your entry has triggered the system and the siren will start to sound after 20 seconds unless you press the Disarm button.

The timings can be altered to suit individual locations. Of course, the function buttons are hidden away so that an intruder cannot quickly find them.

HOW IT WORKS

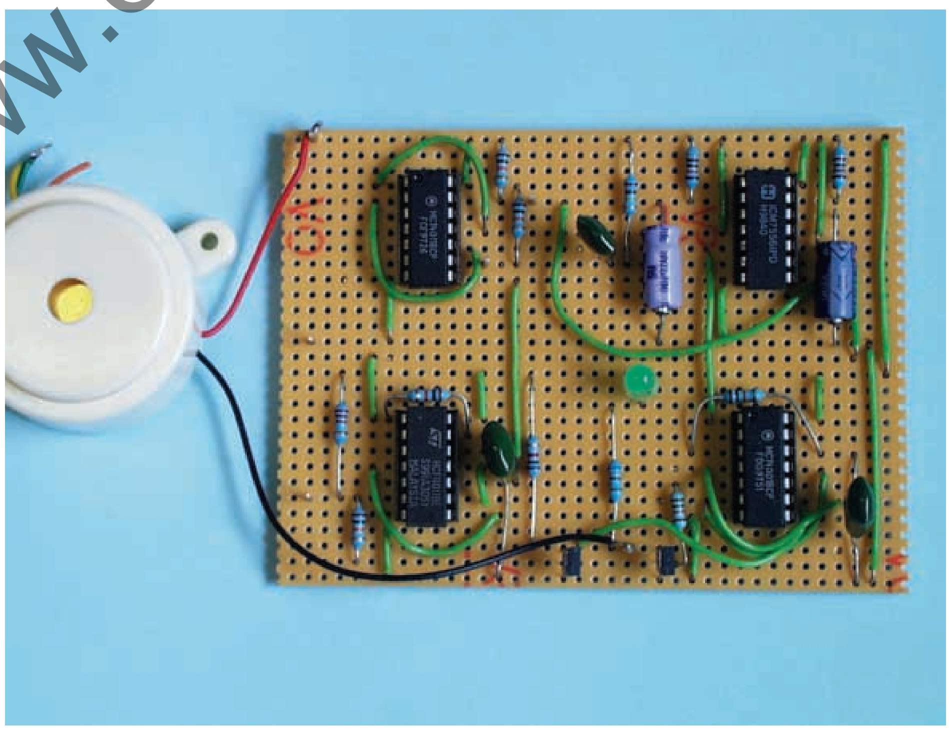
The circuit is triggered by a switch mounted on the door, and accessible only from the inside. This may be a microswitch or more conveniently a reed switch that closes when a permanent magnet is near it. Usually the switch is mounted on (or in) the frame of the door and the magnet is mounted on (or in) the door.

When the door is open, the magnet no longer has an effect on the switch, which springs open. When the door is closed the magnet comes very close to the switch, causing it to close.

As shown in the full circuit diagram for the Door Protector in Fig.1, the door switch S1 is closed whenever the door (with magnet insert) is closed, so pin 9 of IC1a is held at logic low. If the door is opened, even by only a few centimetres and for only a fraction of a second, the input at pin 9 is pulled to logic high, via resistor R1, for long enough to trigger the circuit.

If the circuit is in the "disarmed" state the other input (pin 8 of IC1a) is at logic low, so the output of the gate at pin 10 remains at logic high, whatever the input to pin 9. Opening and closing the door has no effect on the system.

If the system is in the "armed state", the input at IC1a pin 8 is high. Then any high level at pin 9 caused by opening the door



causes the output at pin 10 to become low. This output goes to a set-reset flip-flop consisting of two NAND gates, IC1b and IC1c.

In the reset state, pin 11 of IC1c is high but this goes low (and stays low) when the flip-flop is triggered. The low-going level passes across capacitor C1 and produces a short low pulse that triggers the timer IC2a. The timer output at pin 5 is normally low but now goes high for 20 seconds.

The next stage is a pulse generator, formed by IC4a/IC4b which normally has a low output at IC4b pin 11, but produces a short high pulse when the input from the timer goes low, that is, after 20s. The output from the pulse generator goes to another flip-flop, formed this time from a pair of NOR gates IC4c/IC4d.

When this receives a high pulse its output at pin 10 goes high and stays high. It turns on transistor TR1, which in turn switches on the siren (WD1). The siren sounds until the system is disarmed or the power is switched off.

The remainder of the circuit is concerned with arming and disarming. Pressing the Arm button of switch S2 has two effects. It resets the flip-flop IC1b/IC1c, making its output at pin 11 go high. It is now ready to trigger the timer (IC2a) as already described.

The second effect is to trigger another timer, IC2b. The output of this goes high for 20s and, at the end of this period, another pulse generator (IC3a/IC3b) produces a short high pulse. This sets flip-flop IC3c/IC3d, making its output at pin 10 go high.

This output is fed back to pin 8 of the input gate IC1a that also received input from the door switch S1. With pin 8 high, pulses from the door switch are passed through to the flip-flop of IC1, so triggering IC2a. The system is now armed, but not until 20s *after* pressing the Arm button.

The Disarm button of pushswitch S3 also has two actions. One function is to produce a low pulse to reset the arm/disarm flip-flop at pin 6 of IC3. The low pulse is also inverted by transistor TR2 and then used to reset the siren flip-flop (IC4c/IC4d) and turn the siren off.

If you want to make one or both delay times longer, recalculate the values of the timing capacitor and resistor (R3, C2 or R5, C4), using the formula, $t = 1.1RC$. The delay time is t seconds, R is in ohms and C is in farads.

POWER NEEDS

Although Fig.1 shows the circuit operating at 12V, it will operate at any voltage suitable for powering CMOS i.c.s and the siren. The minimum for a reasonably loud siren is 6V, and the maximum for CMOS is 15V. We chose 12V to suit the 3-tone piezo buzzer that we had decided on. It operates between 6V and 12V but is louder at 12V, with an output of 107dB.

Its power leads are red (positive) and black (0V) and there are two additional leads for determining the kind of sound it makes. With the yellow and green leads connected, it makes a 2-tone warble. Orange and green connected give a single-tone pulsed sound. If these leads are left unconnected, the tone is continuous.

The circuit requires only a small current when the siren is not sounding, so a power

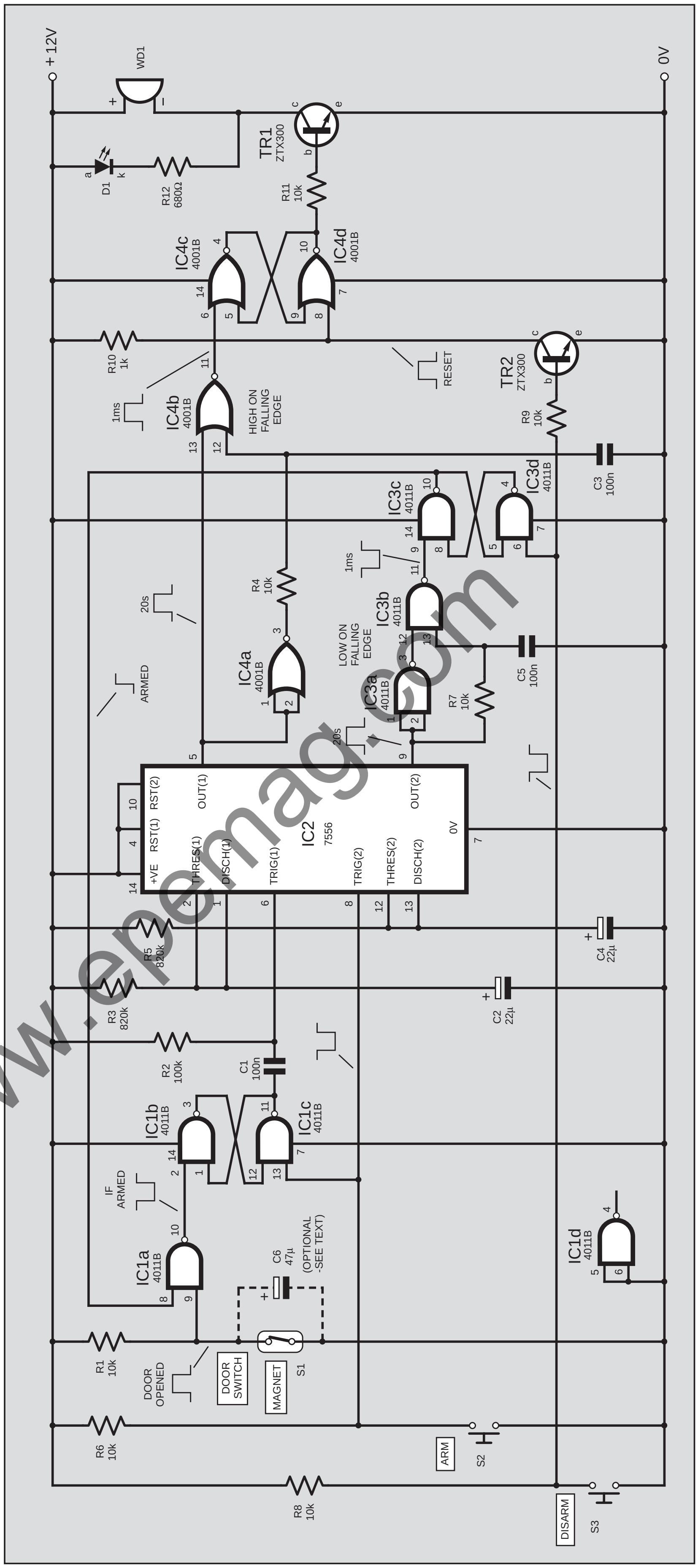
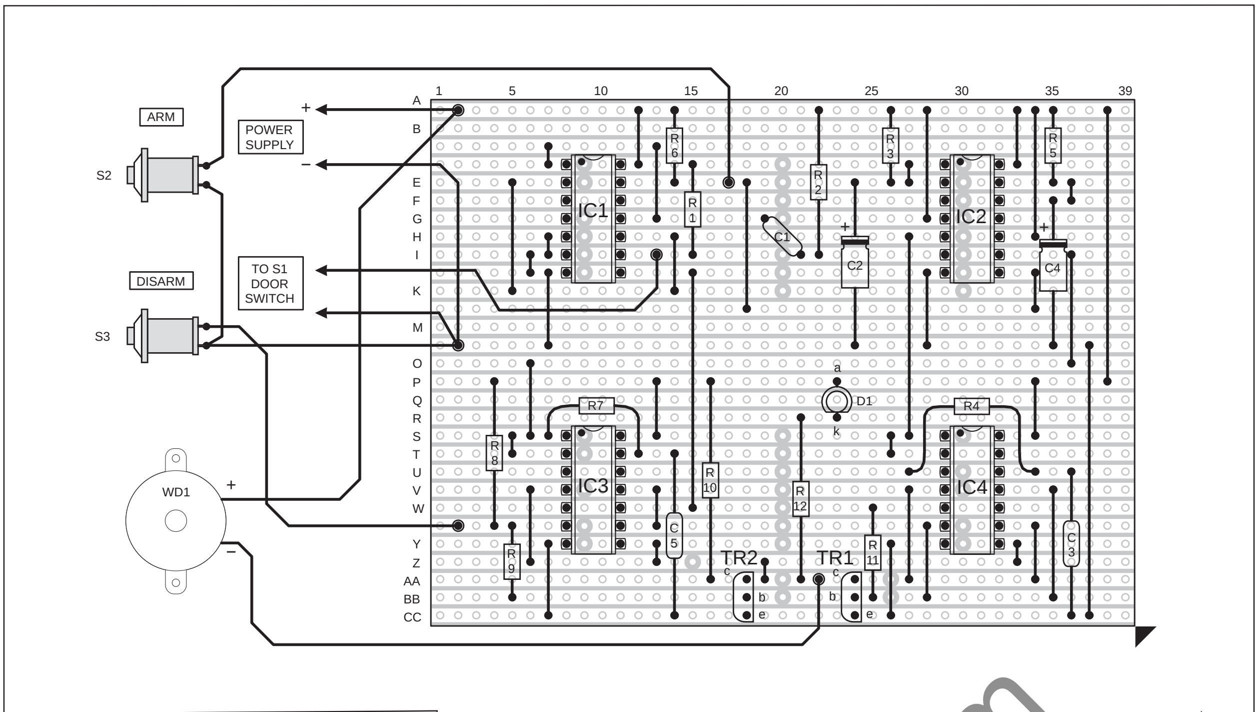


Fig.1. Complete circuit diagram for the Door Protector.



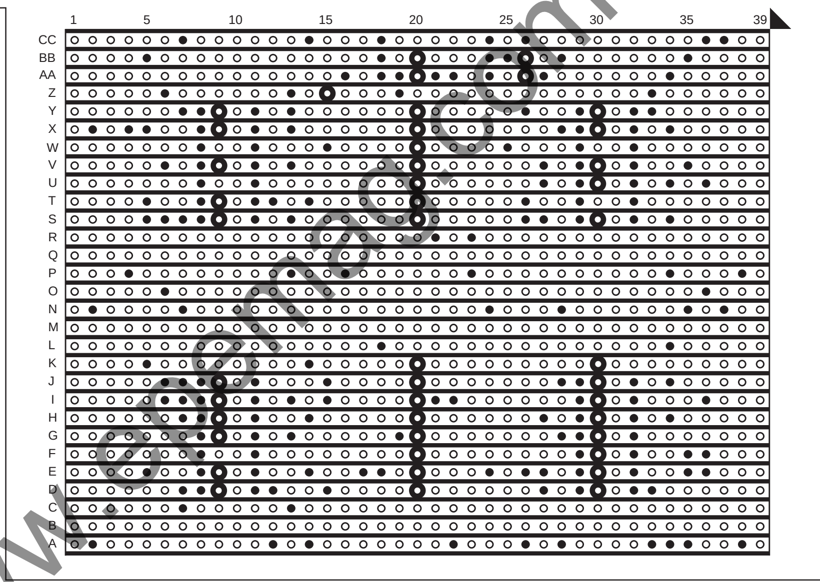


Fig.2. Stripboard topside component layout, interwiring to off-board components and details of breaks required in the underside copper tracks.

COMPONENTS

Resistors

R1, R4, R6 to R9, R11	10k (7 off)
R2	100k
R3, R5	820k (2 off)
R10	1k
R12	680Ω

All 0·25W 5% carbon film

See SHOP TALK page

Capacitors

C1, C3, C5	100n polyester (3 off)
C2, C4	22µ radial elect. 16V
C6	47µ radial elect. 16V (optional)

Semiconductors

D1	3mm or 5mm light-emitting diode (l.e.d.), red
TR1, TR2	ZTX300 *npn* low-power transistor or similar (2N3704) (2 off)
IC1, IC3	4011 CMOS quad 2-input NAND gate (2 off)
IC2	7556 dual timer
IC4	4001 CMOS quad 2-input NOR gate

Miscellaneous

S1	magnetic reed switch, with magnet
S2, S3	pushbutton switch, push-to-make (2 off)
WD1	audible warning device (triple tone piezo buzzer)

Stripboard 0·1 inch matrix, size 29 copper strips by 39 holes; 14-pin i.c. socket (4 off); D-type alkaline cells or unregulated mains adaptor – see text; 1mm solder terminal pins (6 off); solder, etc.

***Approx. Cost Guidance Only* $16**
excluding batts or mains adpt.

supply from four (or eight) D-type alkaline cells could be used. Using a battery makes the system immune to power cuts. However, in the long run it is more economical to use a 6V, 9V or 12V unregulated mains adaptor rated at 300mA or more.

CONSTRUCTION

The Door Protector circuit is built up on a piece of 0·1in. matrix stripboard, containing 29 copper strips by 39 holes. The board topside component layout and details of breaks required in the underside copper tracks are shown in Fig.2. It is recommended that d.i.l. sockets are used for all the i.c.s.

As there is plenty of room on the circuit board, there should be no problems in making the connections. Note that the copper strips are cut at certain places but that some of the strips beneath the i.c.s are NOT cut.

If you are intending to construct several of the projects in this series, it may be worthwhile investing an extra "fiver" in purchasing a special spot-face cutter for cutting the copper tracks neatly. Alternatively, a handheld twist drill bit of around 5mm dia. will do the job just as well. Whichever method you use to make the breaks you should always double-check for any slivers of copper bridging any surrounding tracks or cuts before moving on to the next break.

You can assemble the whole circuit before testing it, working from the smallest (link wires) up to the largest components, but you may prefer to check each stage as you go. If so, begin with the main triggering circuit, starting at switch S1 and working stage by stage through IC1, IC2a and IC4 to the siren.

You will need to enable the circuit by temporarily wiring pin 8 of IC1 to the positive rail. Also, temporarily connect pin 8 of IC4 to 0V through a 10 kilohm resistor. Provide a flying lead for briefly bringing pin 8 to logic high when you need to reset the flip-flop to silence the siren.

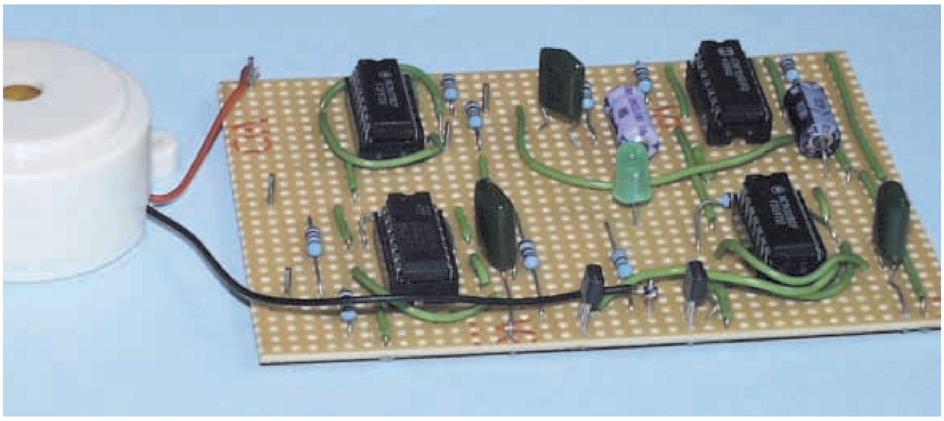
After this, assemble and test the arming and disarming sections of the circuit, based on the second half of timer IC2 and IC3.

INSTALLING THE SYSTEM

The entire Door Protector system, including the siren, can be located at a convenient point and housed in a single enclosure. However, it makes more sense to mount the siren in a remote and relatively inaccessible place where it can easily be heard and cannot be interfered with.

Wiring between the board and siren must be concealed as far as possible. Power leads should likewise be hidden as much as possible.

Similarly, you should hide the pushbutton switches, particularly the Disarm one, in a place where they are difficult for an intruder to find but are quick and easy for you to reach. It is not so important to hide the leads to the door switch because, if the intruder finds and cuts these leads, it has the same effect as opening the door; the siren sounds 20 seconds later!



Component layout on the prototype Door Protector circuit board. No case details are given as it is left to individual choice – you may wish to hide the switches remote from the main unit.

In some situations there may be false triggering due to electromagnetic interference picked up in the leads joining the circuit board to the door switch. If this occurs, it can usually be cured by wiring a capacitor between IC1 pin 9 and the 0V rail (C6 in Fig.1). □

SHOP TALK
with David Barrington

EPE Moodloop

No real trouble should be encountered when searching for components for the *EPE Moodloop* project. The OP279 rail-to-rail, high current, dual op.amp is an Analog Devices chip and was originally ordered from **Maplin**, code NP18U. The BD135 and BD136 power transistors should be widely stocked, try **Cricklewood** (☎ ***(020) 8452 0161***, Fax ***(020) 8208 1441***).

The 15-way D-type chassis socket and 15-way IDC plug connectors should now be widely available, check out **ESR Components** (☎ ***0191 2514363*** or ***www.esr.co.uk***) and **Magenta** (☎ ***01283 565435*** or ***www.magenta2000.co.uk***).

The Frequency 12-way rotary switch used in the model is a Lorlin type, with a limit end-stop behind its mounting bolt to set the required number of "ways". This was removed completely when mounting the switch in the unit. Most of our component advertisers should be able to offer a suitable 12-way single-pole switch as well as the 4-way d.i.l. switch (if required).

If you intend to invest in the same case, this is from the Vero Patina range which succeeds the popular 200 series. The top and bottom sections clip together, without screws, and we understand that the Vero part number is 75-265742E (series 215 box code 75-3008J). The Maplin code for the Patina case is: NC91Y.

Turning now to the software. For those readers unable to program their own PICs, the author is able to supply ready-programmed PIC16F84 microcontrollers for the sum of £6 each, inclusive of postage (overseas add £1 per order). Orders should be sent to: **Andy Flind, 22 Holway Hill, Taunton, Somerset, TA1 2HB**. Payments should be made out to *A. Flind*. For those who wish to program their own PICs, the software is available from the Editorial offices on a 3·5in. PC-compatible disk, see *PCB Service* page 637. It is also available *free* via the *EPE* web site: **ftp://epemag.wimborne.co.uk/pubs/PICS/moodloop**.

Finally, the printed circuit board is available from the *EPE PCB Service*, code 271 (see page 637).

Door Protector

For the first of our "Top Tenner" projects, the author has chosen a simple *Door Protector* alarm circuit. The components for this project seem to be fairly straightforward and should not cause any sourcing problems as most of our component advertisers should be able to provide suitable items.

Several of our current advertisers such as **Suma Design**, **Quasar Electronics**, **Bull Electrical** and **Maplin** may be able to offer a suitable reed switch and magnet combination. Maplin list a surface mounting type (YW47B) and a self-adhesive UPVC type (MM11M). The triple-tone buzzer, used in the prototype, also came from the last mentioned company, code KU60Q.

One last point, we understand that some overseas readers may have difficulty in obtaining the ZTX300 transistor. We suggest that they try a general purpose, low power, type such as the 2N3704.

Quiz Game Indicator

Although the formats may differ slightly, most of the components required for the *Quiz Game Indicator*, this month's Starter Project, should be "off-the-shelf" items. However, some readers may prefer to use the identical parts as listed and shown in the article.

This may apply particularly to the neat-looking contestant boxes and the accompanying pushbutton switches. These were both purchased from **Rapid Electronics** (☎ ***01206 751166*** or E-mail ***sales@rapidelec.co.uk***). The snap-together ABS mini-box carries the code 30-1905, and the miniature push-button switch is coded 78-1520.

The transistor used in this circuit is the BC184**L**, and the suffix **L** after its type number indicates a different pinout line-up to other BC184s. In practice, virtually any low power, small signal, *npn* general purpose transistor can be used here, but take care to check the leadouts and place them in the correct order on the p.c.b.

The small printed circuit board is available from the *EPE PCB Service,* code 272 (see page 637).

Handy Amp

The most likely component to cause concern when ordering parts for the *Handy Amp* project is the Analog Devices SSM2211 power amplifier i.c. For those readers who do have trouble finding this chip, the one in the model came from **Maplin** (***www.maplin.co.uk***), code OA20W. The 5534 low-noise op.amp should be generally available and is an improved version of the standard 741 type.

When ordering the headphone 6·35mm stereo jack socket you **must** specify that you need a plastic bodied (***insulated***) chassis mounting type; this should have all its connections, including the mounting bezel, isolated from the metal case. Most headphones now seem to terminate with a 3·5mm jack plug, so you will probably need a 6·35mm to 3·5mm adaptor. Both these forms of socket/plug should be available from your usual component supplier or one of our component advertisers.

Selecting an internal 8 ohm loudspeaker is left to the constructor, you do not have to use an elliptical type, just make sure it will fit inside the metal case. However, do not use one having a rating *less* than 2W.

The choice of a "vinyl-effect" aluminium case for this project is one that has proved popular in past constructionals and many of our component stockists now carry them. This is sometimes referenced as a WB3 type. Do not use a plastic box, as this will not provide any screening and hum pick-up could be a problem.

The printed circuit board is available from the *EPE PCB Service*, code 273 (see page 637).

Cave Electronics

Some readers may be intrigued to experiment with the L.E.D.-based Caving Lamp circuit (Fig.1) contained in the *Cave Electronics* feature. We can offer the following assistance with components for this circuit.

We are informed that the 10μH inductors L1 and L2 are made up from Philips 432202097180 toroid formers (**Farnell** – (☎ ***0113 263 6311*** or ***www.farnell.com***) – code 180-008) wound with four twisted strands (two parallel pairs) for the primary and secondary windings. The cores are wound with the four strands of 0·315mm wire until a single layer is completed. This gives approximately 28 turns. The ends are sorted out and soldered to the terminal pins.

Also, checkout the Linear Technology web site (***www.linear-tech.com***) where a circuit using their LT1513 switching regulator (IC1/IC3) shows the use of a twin-winding Coiltronics CTX10-1 10μH common core inductor. All we can tell you about IC2 and IC4 is that they are Motorola devices. It seems that the Schottky diodes also came from Farnell (see above).

We are told that the main "lighting" l.e.d.s are of Hewlett Packard manufacture and made up as follows: green (8 off) HLMP-BM01; blue (4 off) HLMP-BB01; red (2 off) HLMP-BD06 and yellow (amber) (2 off) HLMP-BL06. Once again, the above mentioned component supplier is a possible source.