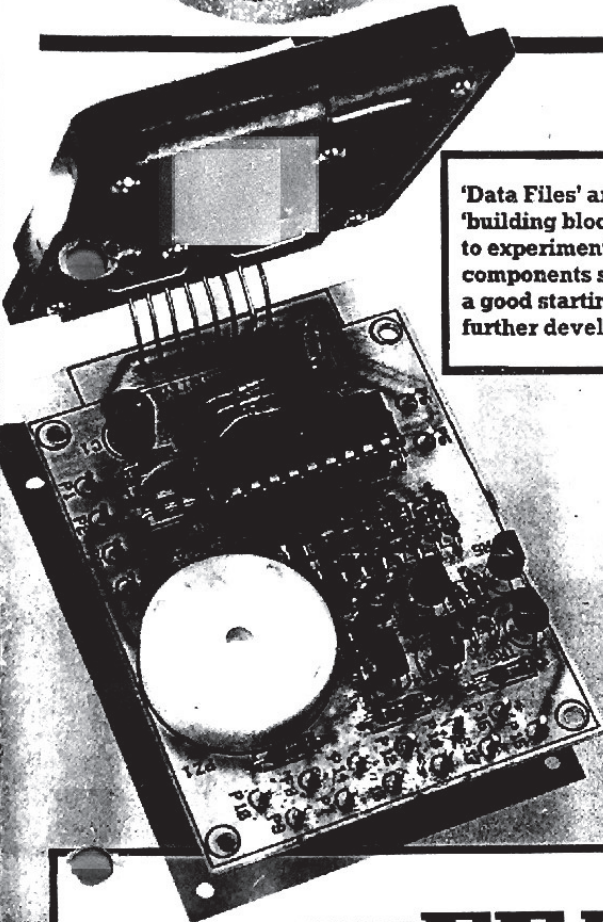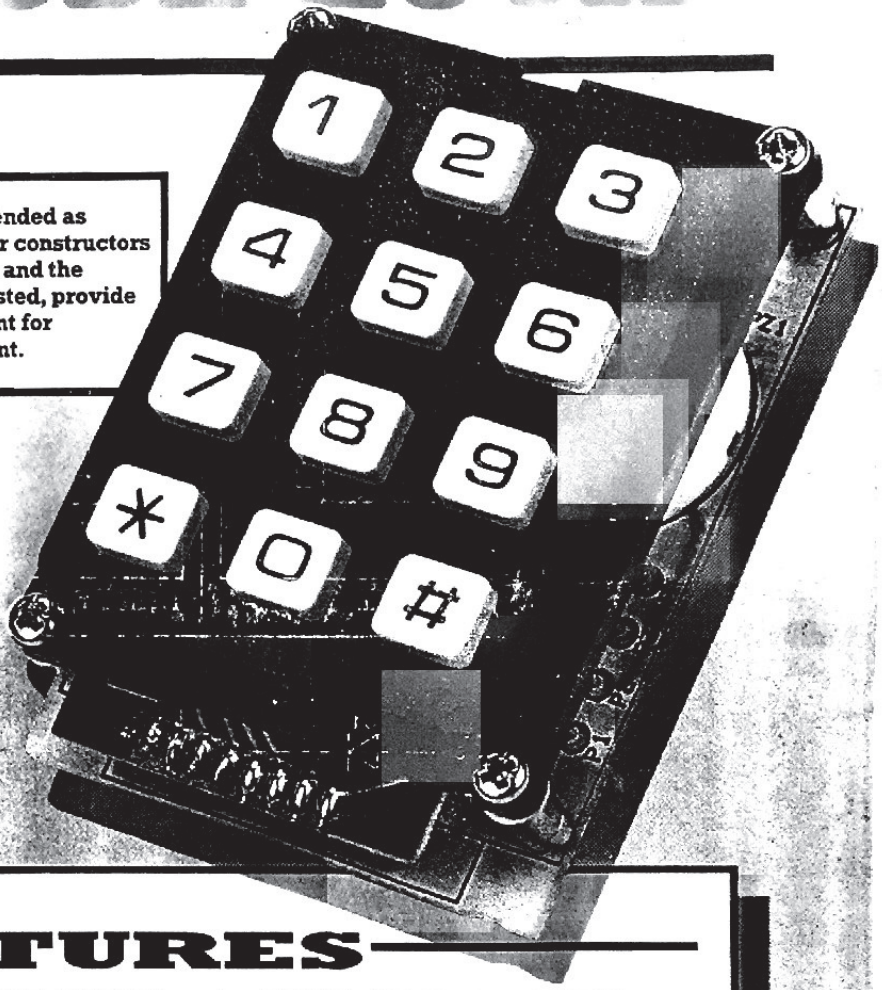# DATA FILE

UA3730 ELECTRONIC CODE-LOCK

'Data Files' are intended as 'building blocks' for constructors to experiment with and the components suggested, provide a good starting point for further development.

FEATURES

★ **LOW POWER CONSUMPTION**   ★ **KEY-PAD ENTRY**
★ **3 DIFFERENT OUTPUTS**   ★ 10^{12} **UNIQUE CODES**
★ **PROGRAMMABLE UP TO 12 DIGITS**

APPLICATIONS ★ Security Systems ★ Electronic Locks

The UA3730 is a single chip electronic code-lock IC utilising CMOS technology. The IC can handle passcodes of up to 12 digits, allowing the use of up to 1 million million unique codes. If an incorrect code is entered three times or more, an output is activated allowing an alarm to be sounded. The code may be

required by the user providing additional security. Figure 1 shows the IC pin-out, and Table 1 lists typical electrical characteristics for the device. Also please note that the UA3730 may also be correctly supplied and marked as SH301.

Figure 2 shows a typical application circuit for the ... The IC requires a battery

Parameter	Conditions	Min.	Typ.	Max.
Power Supply Voltage:		3V	5V	6V
Operating Current:	Operating Freq. = 400kHz	1mA		4mA
Stand-by Current:			5µA	30µA
Operating Frequency:		260kHz	400kHz	645kHz
Output Current (OUT1-3):				15mA
Storage Temperature:		−55°C		125°C
Operating Temperature:		−30°C		70°C

back-up to prevent the code from being lost if the main power supply fails. When the device is initially powered up, the code is automatically set to 0. If IC pin 13 is connected to 0V, the IC is set to the program mode. A new code may then be set as follows: key in the new code (up to 12 digits) followed by 'M'(∗). The code has then been changed to that entered. After the new code has been set, pin 13 should
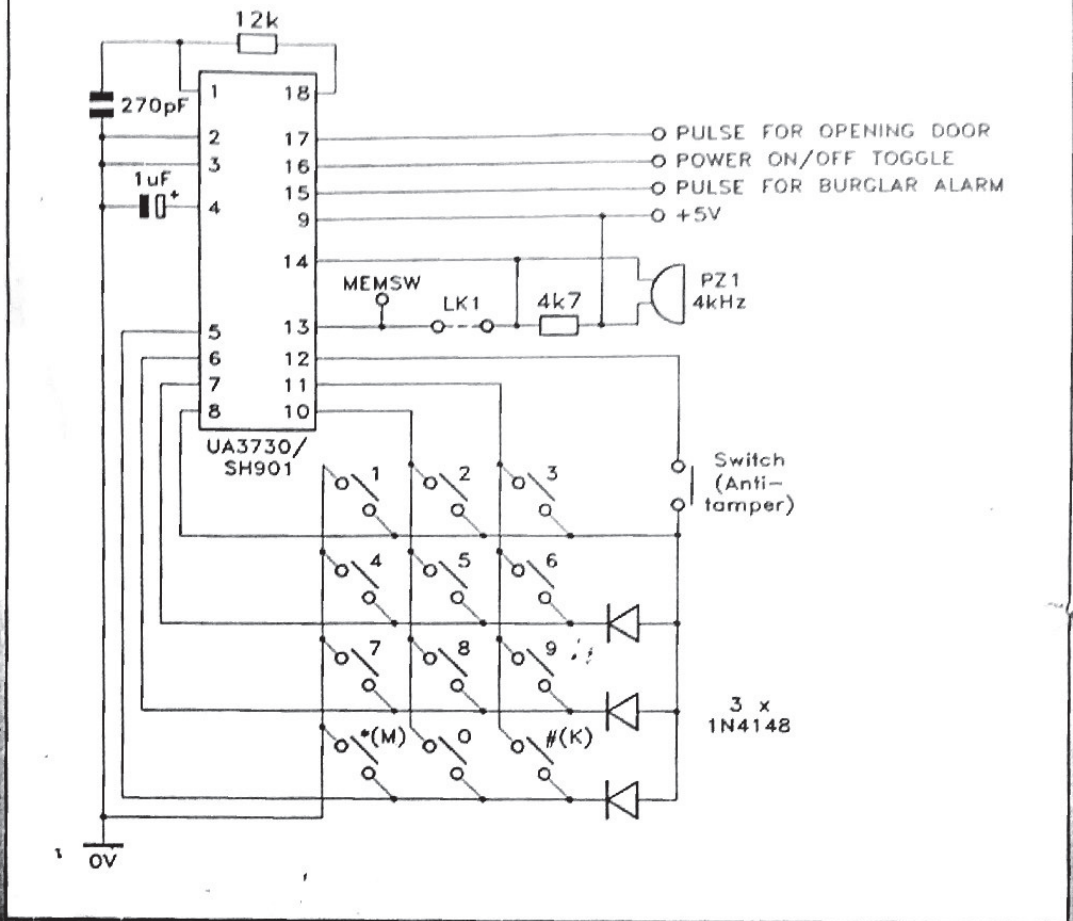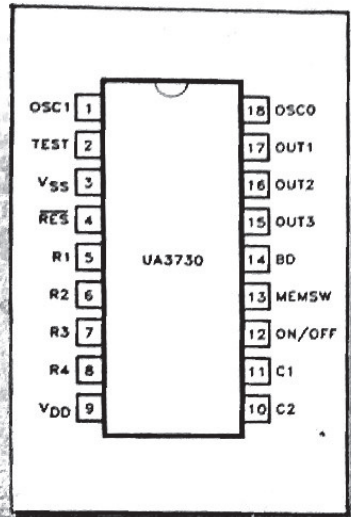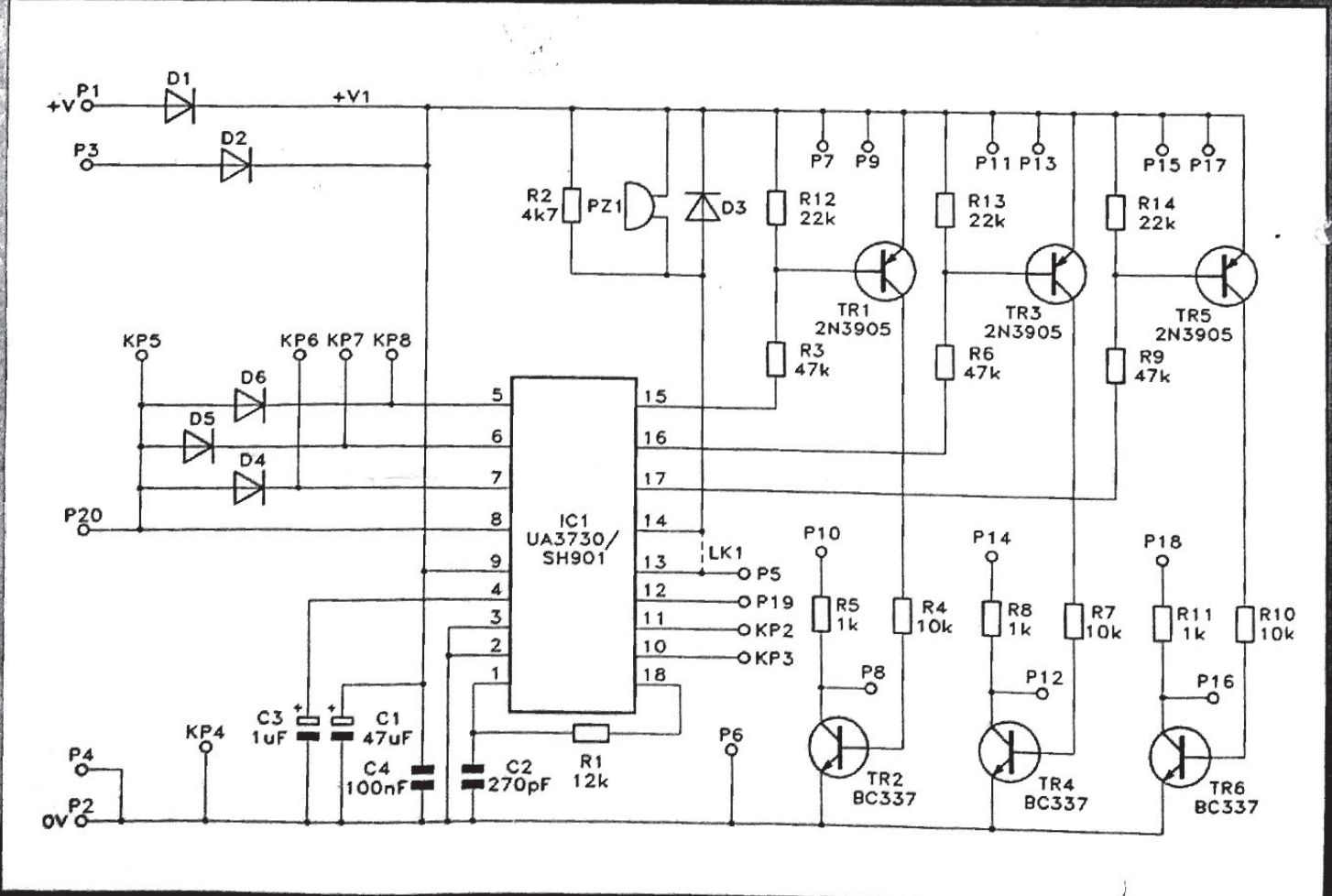

UA3730 pinout:

Pin	Name	Pin	Name
1	OSC1	18	OSC0
2	TEST	17	OUT1
3	Vss	16	OUT2
4	RES	15	OUT3
5	R1	14	BD
6	R2	13	MEMSW
7	R3	12	ON/OFF
8	R4	11	C1
9	VDD	10	C2

Application circuit labels:

12k, 270pF, 1uF, UA3730/SH901, MEMSW, LK1, 4k7, PZ1 4kHz, PULSE FOR OPENING DOOR, POWER ON/OFF TOGGLE, PULSE FOR BURGLAR ALARM, +5V, Switch (Anti-tamper), 3 x 1N4148, OV

Keypad: 1 2 3 / 4 5 6 / 7 8 9 / ∗(M) 0 #(K)

Lower schematic labels:

+V P1, D1, +V1, P3, D2, R2 4k7, PZ1, D3, P7 P9, R12 22k, P11 P13, R13 22k, P15 P17, R14 22k, TR1 2N3905, TR3 2N3905, TR5 2N3905, R3 47k, R6 47k, R9 47k, KP5, D6, D5, D4, KP6 KP7 KP8, IC1 UA3730/SH901, P20, LK1, P5, P19, KP2, KP3, P10, R5 1k, R4 10k, P14, R8 1k, R7 10k, P18, R11 1k, R10 10k, P8, P12, P16, TR2 BC337, TR4 BC337, TR6 BC337, C3 1uF, C1 47uF, C4 100nF, C2 270pF, R1 12k, P6, KP4, P4, P2, OV

be disconnected from 0V and returned to the 'floating' state, preventing unauthorised users keying in further new codes.

The circuit may also be set to the programming mode using the keypad, if pin 13 and pin 14 of the IC are linked together. In this case the code may be changed as follows: key in the current code (which is set to '0' when the unit is powered up) followed by 'M'. The circuit is now set to the programming mode. Then key in the new code followed by 'M'. The new code is then set and the circuit returns to the previous state.

There are three outputs which are activated from the keypad. OUT1 activates for 2 seconds when the correct code followed by 'K' (#) is entered. OUT2 changes state when the correct code followed by 'K' is entered providing a toggle action. OUT3 activates for 1 minute if an incorrect code is entered three times or more, and this output may be used to trigger an alarm. All outputs are open drain types and require a pull-
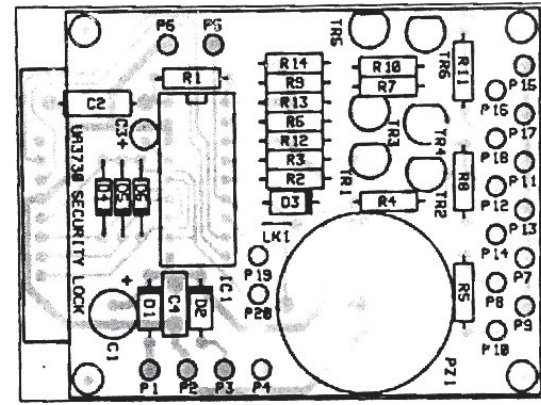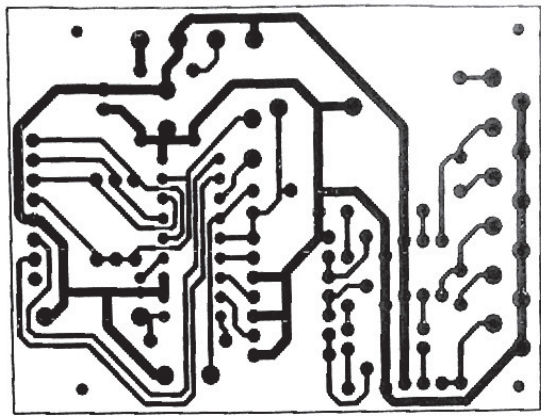

Figure 4. PCB legend.

up resistor. IC pins 12 and 8 may also be used to trigger an alarm condition, and may be connected to a mechanical microswitch to provide additional anti-tamper protection.

Kit Available

A kit of parts is available, including a fibreglass PCB with a screen printed legend, for a basic application circuit using the UA3730. A simple numeric keypad is also supplied in the kit. Figure 3 shows the circuit diagram of the module, and Figure 4 shows the PCB legend. The PCB is designed to mount onto the rear of the keypad and be wired directly to the terminals. Figure 5 shows how to mount the PCB onto the keypad using M3 spacers and washers and M2·5 nuts and bolts. The keypad is connected to the PCB using 24 SWG tinned copper wire as shown in Figure 6. Other input and output connections to the module are made via double sided PCB pins, and may be taken from either side of the PCB. The pins are fitted such that the thin end of the pin is inserted into the PCB from the track side. A different keypad may be wired onto the PCB in place of the keypad supplied as long as the matrix is correct. The required matrix is shown in Figure 7. A piezo sounder is included in the design as an aid to the user. The length of the output from the sounder indicates whether or not the input has been accepted, as shown in Table 2. LEDs may also be connected to indicate output status.

The module requires a regulated 4V to 6·5V power supply that is capable of supplying at least 20mA. The power supply should be well decoupled to prevent the introduction of noise onto the supply rail, as this could produce unpredictable results. If the power supply is also used to drive an output load connected to the module, then the total current consumption of the load must also be added to the power supply capacity, for example, if the total load current is 30mA, then the power supply must be capable of supplying at least 50mA (20mA for the module and LEDs + 30mA total load current). Figure 8 shows a simple 5V regulator
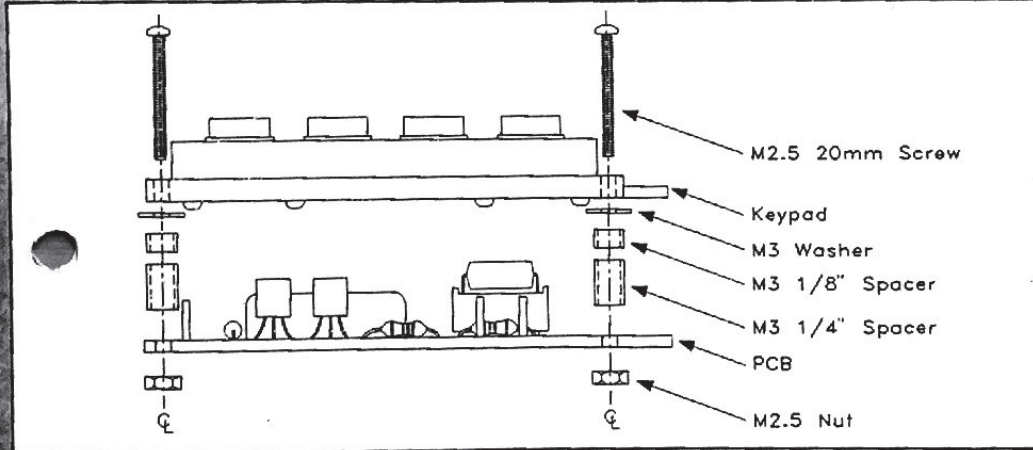

M2.5 20mm Screw
Keypad
M3 Washer
M3 1/8" Spacer
M3 1/4" Spacer
PCB
M2.5 Nut

Figure 5. Mounting the PCB onto the keypad.
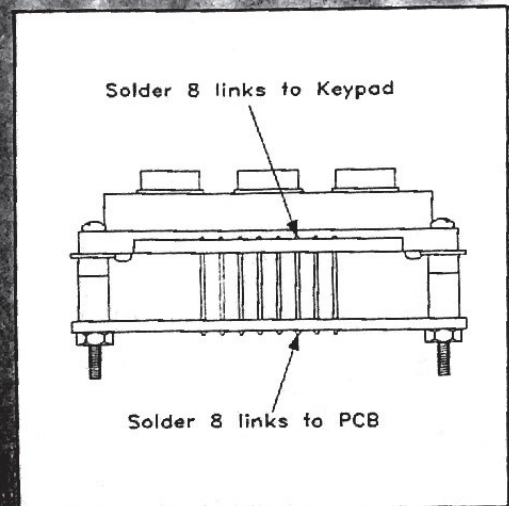

Solder 8 links to Keypad

Solder 8 links to PCB

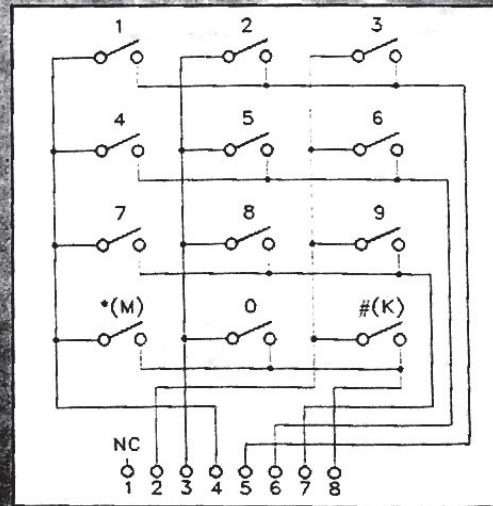Figure 6. Linking the keypad to the PCB

Figure 7. Keypad matrix

circuit suitable to power just the module and LEDs (any output loads should be connected to a separate supply).

Setting the User Code

There are two methods of setting a user code as detailed above. Link LK1 may either be fitted or omitted depending on the chosen method of setting the code. The options are as follows:

1. LK1 NOT Fitted

To set the new code, link P5 to P6 and enter the new code (up to 12 digits) followed by the '✻' symbol on the keypad. The new code is then set and the circuit will no longer respond to any previous codes. After the new code is set, the link between P5 and P6 should then be removed.

2. LK1 Fitted

To set the new code, key in the current code ('0' when the circuit is initially powered up) followed by the '✻' symbol; the circuit is now in the program mode. Enter the new code (up to 12 digits) followed by '✻'. The new code is then set and the circuit will no longer respond to any previous codes. This procedure must be followed each time a new code is set. If LK1 is fitted P5 and P6 must NOT be linked at any time.

The '✻' button on the keypad is only used when

Condition	Number of Pulses from Sounder	P16 OUT1	P12 OUT2	P8 OUT3
Input Correct Code:	1	Active for 2s	Toggle	–
1st and 2nd Wrong Inputs:	2	–	–	–
3rd Wrong Input; Tamper (on/off) Input:	Groups of 3 Pulses for 1 Minute	–	–	–
P19 connected to P20:	Active for 1 Minute	–	–	–

Table 2. Output conditions.
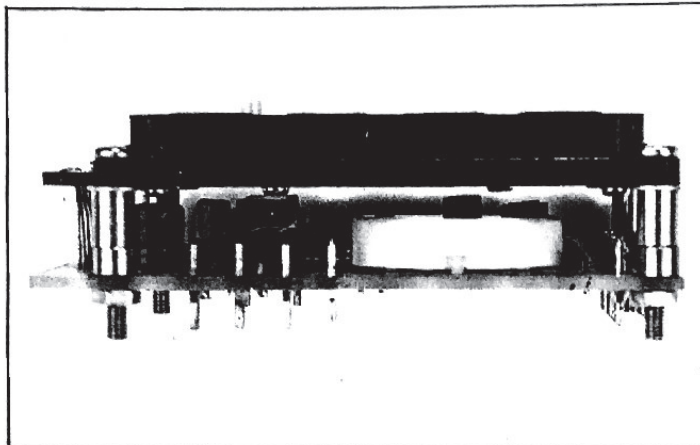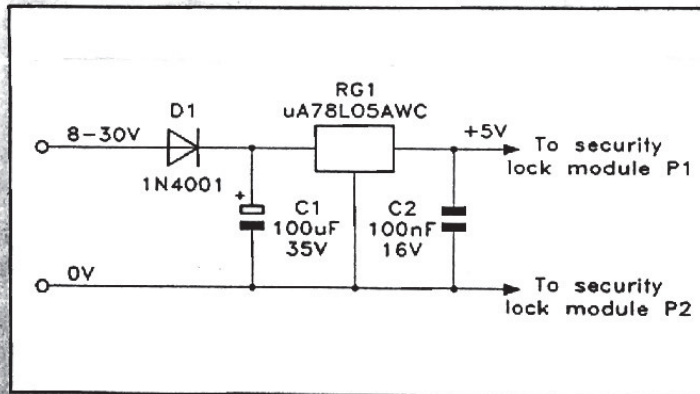

Side view of the keypad/PCB.

Figure 8. Simple regulator circuit.

a new code is being set. For normal use, the code is entered to activate and deactivate the outputs to open and close doors, switch lights on and off, etc. To operate the outputs, key in the code (which you have previously set using the procedure above) followed by the '#' symbol on the keypad.

Battery Back-up

If the user wishes to retain the code when the power supply is removed, then a back-up battery supply must be provided. Facility for the connection of a back-up battery is provided by P3 (battery +) and P4 (0V). The voltage of the main supply should be kept at least 0·5V above the back-up battery voltage to prevent the battery being drained in normal use. The battery voltage should be between 3·7 and 6V. Typically, with a main supply voltage of between 5V and 6V, a back-up 4 to 4·5V battery pack could be used. The quiescent current of the circuit in stand-by mode is typically in the order of a few hundred nA and so the drain on even a low capacity back-up battery is very little when the circuit is in the quiescent state.

Alarm Condition

If an incorrect code is entered more than twice then the circuit latches into an alarm condition and the sounder pulses for 1 minute or until the correct code is entered.
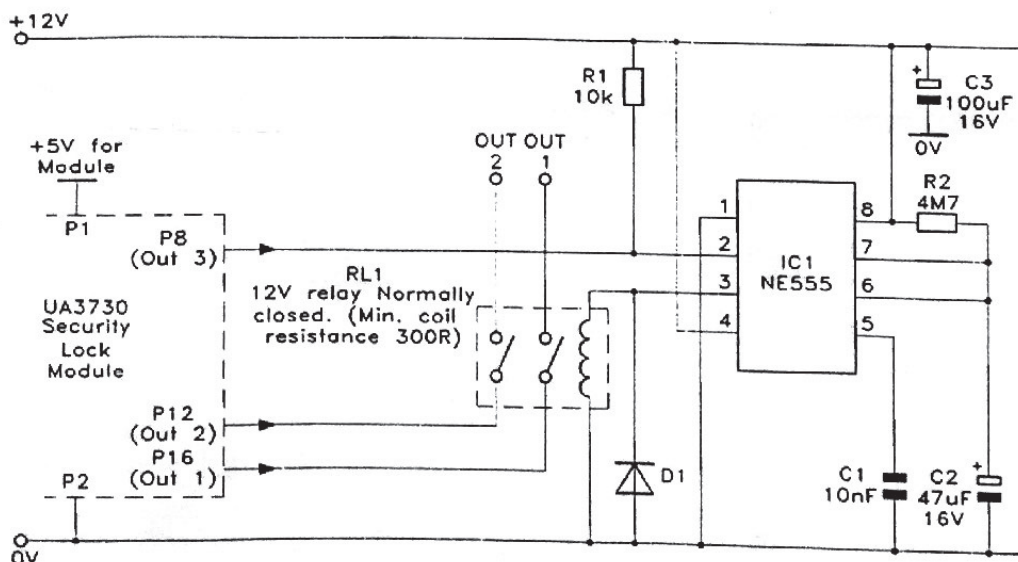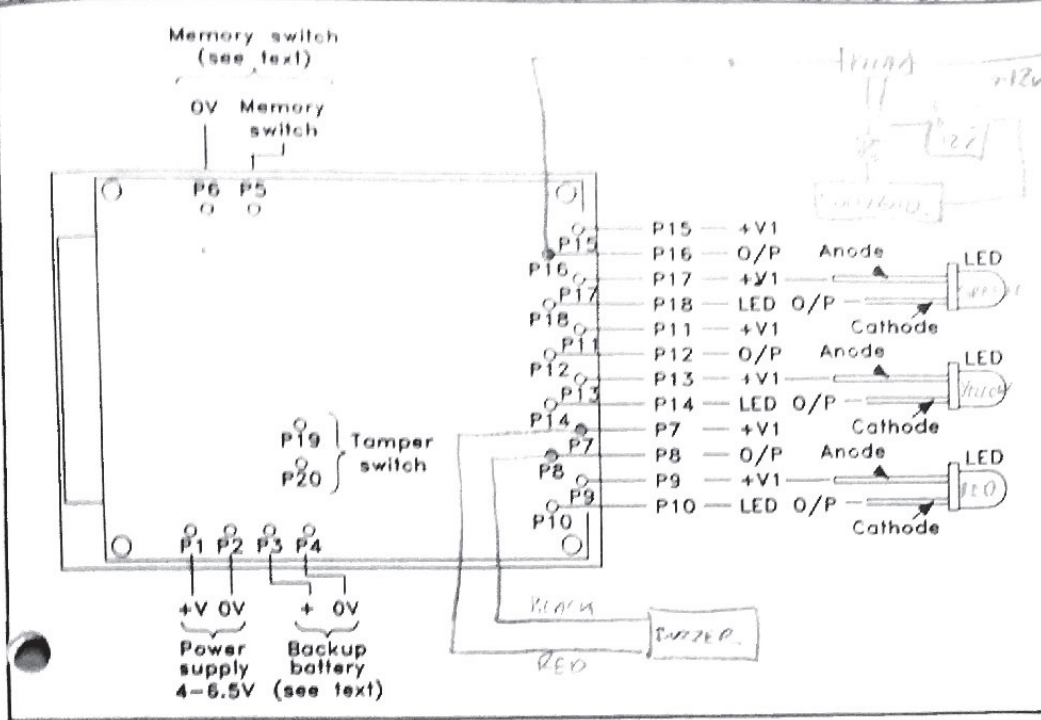
Figure 10. Wiring diagram.

trigger additional circuitry, providing a 'lockout' function. This means access is denied for a set period after the alarm output has been triggered, even if the correct code is subsequently entered and the keypad disabled. Figure 9 shows an idea for a simple 'lockout' circuit, featuring a lockout time of around 5 minutes.

Outputs are provided for 3 LED indicators to show the state of the outputs OUT1 to OUT3. In some cases, the user may not wish to fit the LEDs as they do add to the current drain. If a visual indication is not required, then it is quite acceptable to omit the LEDs.

The three outputs from the module are of the open collector type and the load is connected between the appropriate output pin (P8, P12 or P16) and either a +V1 pin on the PCB (P7, P11 or P15) or another suitable +V supply (15V maximum). The load current should not be allowed to exceed 40mA at any time, as irreparable damage could occur. Finally, Table 3 shows the specification of the prototype UA3730 Security Lock module.

Figure 10 shows the wiring diagram for the module, showing how to connect the LEDs, back-up battery, etc.

An alarm condition can also be created by connecting P19 to P20 using a mechanical switch; a microswitch may be connected to this input to provide a degree of anti-tamper protection. It should be noted that this input may be used to activate the alarm output (OUT3) independently of the previous state of the circuit. In addition to triggering an alarm, the alarm output may also be used to

Parameter	Condition	Typical
Power Supply Voltage:		4V to 6·5V
Back-up Battery Voltage:	< Supply Voltage − 0·5V	3·7V to 6V
Power Supply Current:	Stand-by	220nA at 5V
	Operating (Without LEDs)	310μA at 5V
	Operating (LEDs Active)	17mA at 5V
PCB Size:		61mm × 71mm
Outputs:	Open Collector Type	
Output Sink Current:	Absolute Maximum	40mA

Table 3. Specification of Prototype.

ELECTRONIC CODE-LOCK
PARTS LIST

RESISTORS: All 0·6W 1% Metal Film

R1	12k	1	(M12K)
R2	4k7	1	(M4K7)
R3,6,9	47k	3	(M47K)
R4,7,10	10k	3	(M10K)
R5,8,11	1k	3	(M1K)
R12,13,14	22k	3	(M22K)

CAPACITORS

C1	47μF 16V Minelect	1	(YY37S)
C2	270pF 1% Polystyrene	1	(BX60E)
C3	1μF 63V Minelect	1	(YY31J)
C4	100nF 16V Minidisc	1	(YR75S)

SEMICONDUCTORS

IC1	UA3730	1	(UM98G)
D1-3	1N4001	3	(QL73Q)
D4-6	1N4148	3	(QL80B)
TR1,3,5	2N3906	3	(QR41U)
TR2,4,6	BC337	3	(QB68Y)

MISCELLANEOUS

DIL Socket 18-pin	1		(HQ76H)
Numeric Keypad	1		(JM09K)
PCB Piezo Sounder	1		(JH24B)
Pin 2144	20		(FL23A)★
Steel Screw M2·5 × 20mm	1 Pkt		(JY32K)★

Steel Nut M2·5	1 Pkt	(JD62S)★
Spacer M3 × ⅛ in.	1 Pkt	(FG32K)★
Spacer M3 × ¼ in.	1 Pkt	(FG33L)★
Steel Washer M3	1 Pkt	(JD76H)★
TC Wire 24swg 0·56mm	1 Reel	(BL15R)★
PCB	1	(GH18U)
Instruction Leaflet	1	(XT75S)
Constructors' Guide	1	(XH79L)

OPTIONAL (Not in Kit)

LED Red 5mm 2mA	1	(UK48C)
LED Green 5mm 2mA	1	(UK49D)
LED Yellow 5mm 2mA	1	(UK50E)