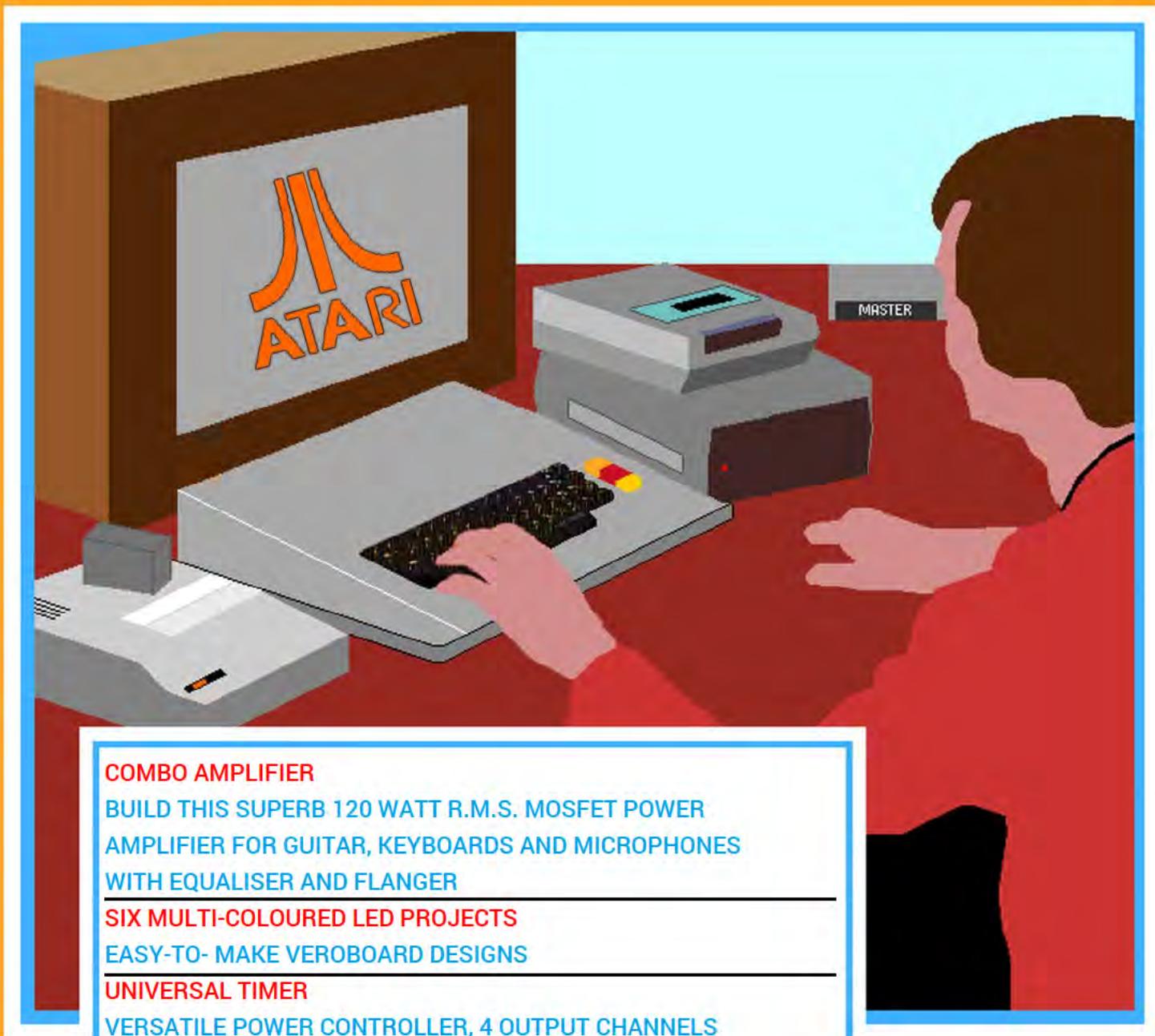


# Electronics

## THE MAPLIN MAGAZINE

DECEMBER 1981 - FEBRUARY 1982

PRICE 60p



### COMBO AMPLIFIER

BUILD THIS SUPERB 120 WATT R.M.S. MOSFET POWER AMPLIFIER FOR GUITAR, KEYBOARDS AND MICROPHONES WITH EQUALISER AND FLANGER

### SIX MULTI-COLOURED LED PROJECTS

EASY-TO-MAKE VEROBOARD DESIGNS

### UNIVERSAL TIMER

VERSATILE POWER CONTROLLER, 4 OUTPUT CHANNELS WITH NUMEROUS PROGRAMMES

### PASS THE BOMB!

AN ELECTRONIC VARIATION OF A WELL KNOWN PARTY GAME

### TEMPERATURE GAUGE

HAND-HELD UNIT WITH COLOURED LED DISPLAY

### PLUS

- \* ATARI SOFTWARE NEWS
- \* TELETEXT AND VIEWDATA EXPLAINED
- \* HOW TO SOLDER

**FIRST ISSUE**

# Electronics

## THE MAPLIN MAGAZINE

### ANOTHER ELECTRONICS MAGAZINE?

There are now nine other electronics magazines available at your newsagents so why should Maplin produce yet another one? It became very apparent to us last summer that the Maplin newsletter enjoyed considerable support and popularity. When we asked if you would pay a pound for our newsletter the response in favour was overwhelming, yet it contains very little even to justify that small amount.

A simple costing exercise quickly showed that for just a little more we could produce a newsletter with lots of projects and features in addition to all the usual material. Something that really would be worth the money. So here it is: issue one of the Maplin Magazine!

As with the newsletter, the price list is right in the middle for ease of use, but in addition, in this issue alone, there are ten complete projects to build including the universal timer that we've had literally hundreds of requests for and a superb quality combo-amp that we are certain will prove very popular.

For the future we have a large number of really new and exciting projects lined up. Take a look at the inside back cover to see what's coming in issue 2. Our multi-channel train controller project is being followed up with a whole series of novel projects for the model railway enthusiast. Our new high quality burglar alarm, too, will have other detection devices for use with it, described in later issues.

But most of all we'd like the Maplin Mag to become a club magazine for enthusiasts everywhere. Our letters pages are open to everyone and we'll even publish your advertisements completely free of charge, providing they're not too long.

So here's a warm welcome to you from the Maplin Magazine - a regular feast of good things for the electronics enthusiast!

December 1981 - February 1982 Vol. 1 No. 1

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Superb 120 watt MOSFET power amp with guitar and microphone inputs and flanger.

##### Universal Timer

Comprehensive programmable controller for use in the home.

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#### *Projects Special*

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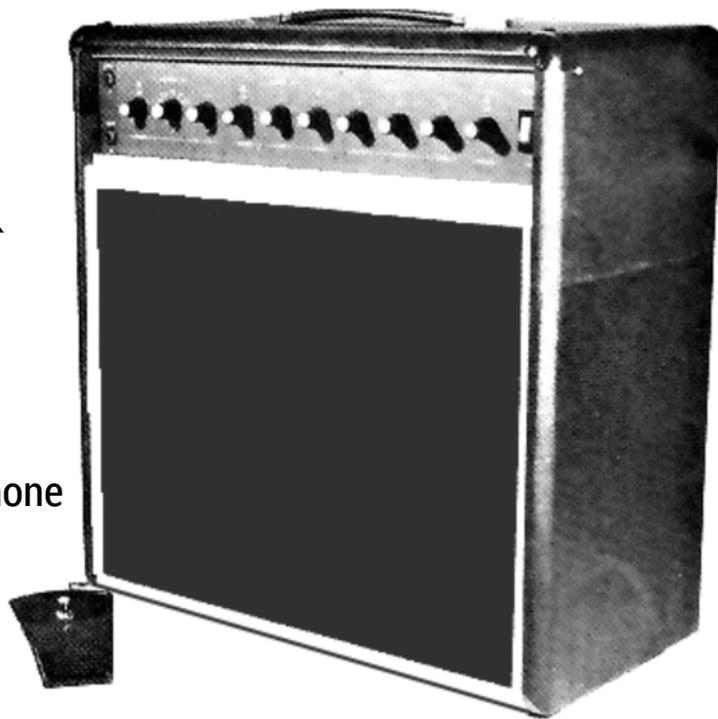
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# COMBO AMPLIFIER

by Dave Goodman

- 120 watts of reliable MOSFET power
- Built-in flanger effect
- Two inputs for guitars, keyboards or microphone
- Five step equaliser on channel A
- Bass and treble controls on channel B
- Low noise BIFET pre-amplifier



This is an easy to build portable amplifier for all stage musicians requiring high power, reliability and versatility. A choice of equalisation methods is given on the two input channels, allowing a wide range of sounds in conjunction with the built in flanger.

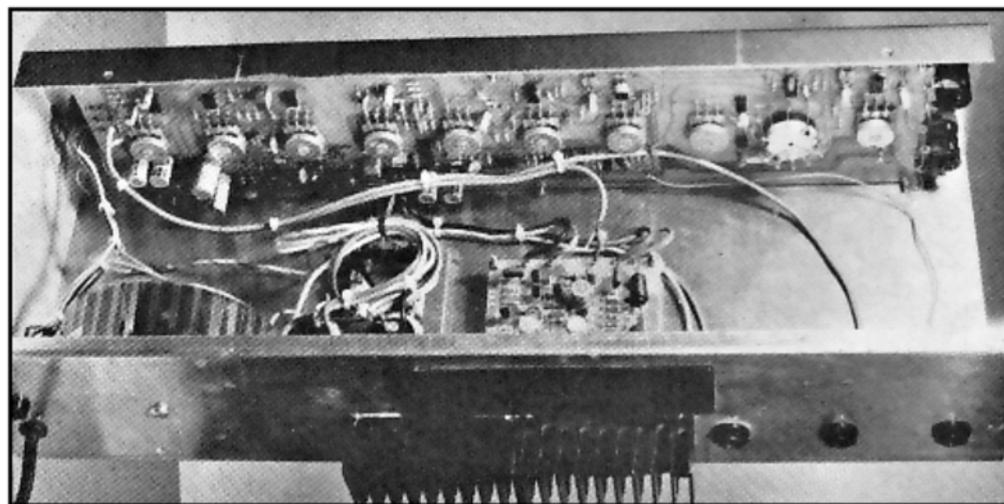
Sockets are provided for feeding a slave, PA amplifier or tape recorder, and for using alternative speakers. The amplifier gives 75 watts into an 8 ohm speaker, or 120 watts into a 4 ohm speaker or combination of speakers.

## Input Circuitry

IC1 forms the input stage of channel A. RV1, R2 and R3 adjust stage gain from below unity up to X20, and C2 removes any HF noise and unwanted RF signals. Input levels of 10 mV up to 10 volts can be accommodated into 47k input impedance. Amplified signals from the volume control RV2 are processed by the filtering stages of IC2a and b. Selective feedback paths, determined by SW1a and b and C6 to C15 produce up to 10 dB boost and cut at the centre frequencies 150 Hz, 250 Hz, 500 Hz, 1.5 kHz, 2.5 kHz under the control of RV3.

Processed signals from IC2b are routed through bi-lateral switch IC3 and R26 to output mixer IC6b. IC3 can be viewed as an electronic switch, being 'on' when the control gates (pins 5, 6, 12, 13) are high, and off when the control gates are low.

TR1 is normally biased off by R12, connecting IC3 pin 12 to the +7.5 volt supply through R11 and holding the switch 'on'. IC3 pin 13 will also be positive, connecting IC3 pins 5 and 6 to the -7.5 volt rail. The two switches comprising IC3 pins 3/4 and 8/9 will therefore be open circuit.



Inside view of the amplifier chassis.

Turning on TR1 by connecting pins 5 and 6 with the foot switch will reverse the quiescent condition of IC3. IC3 pins 10/11 will be open, pins 1/2 will be open, pins 3/4 and 8/9 will be closed. IC2b output will then be routed to the flanger effects circuitry and back to the output mixer IC6 via IC3 pin 8/9 and R27.

Channel B input IC4 is the same as channel A input stage. Signal processing, from volume control RV5 is achieved using a conventional Baxandall active tone control circuit. RV6 determines boost and cut of bass frequencies up to +12 dB at 100 Hz, and RV7 gives boost and cut of treble up to +12 dB at 10 kHz. C22 and C26 remove any instability at extreme boost settings and channel output is direct to the final mixer via R25.

RV8 is the master volume control supplying the power amp stage from IC6b output. IC6a is a unity gain buffer stage, supplying the slave output at a low impedance, and is not affected by the master volume control.

## Flanger Circuit

The flanging effect can be switched in or out of circuit silently with the use of an external foot switch, as previously described. Flanging is similar to phasing, and here, the heart of the system is a TCA 350Z 'bucket brigade' device. Signals are applied to a low pass filter, IC7a and IC7d. All frequencies are reduced in amplitude at -24 dB per octave above 4 kHz. This is necessary to ensure that mixing of input and clock signals does not produce a distortion effect known as "aliasing". The TCA 350Z (IC12) delays input signals; the delay period is not fixed, but sweeps up and down at a rate set by triangle waveform oscillator IC9 and IC10.

IC9 is a Schmitt trigger and IC10 is an integrator. RV10 determines the rate of oscillation which is variable from zero to 10 Hz. IC11 is a CMOS oscillator, current controlled from D4 and D5, and its range of oscillation is variable from 15 kHz up to 0.75 MHz.

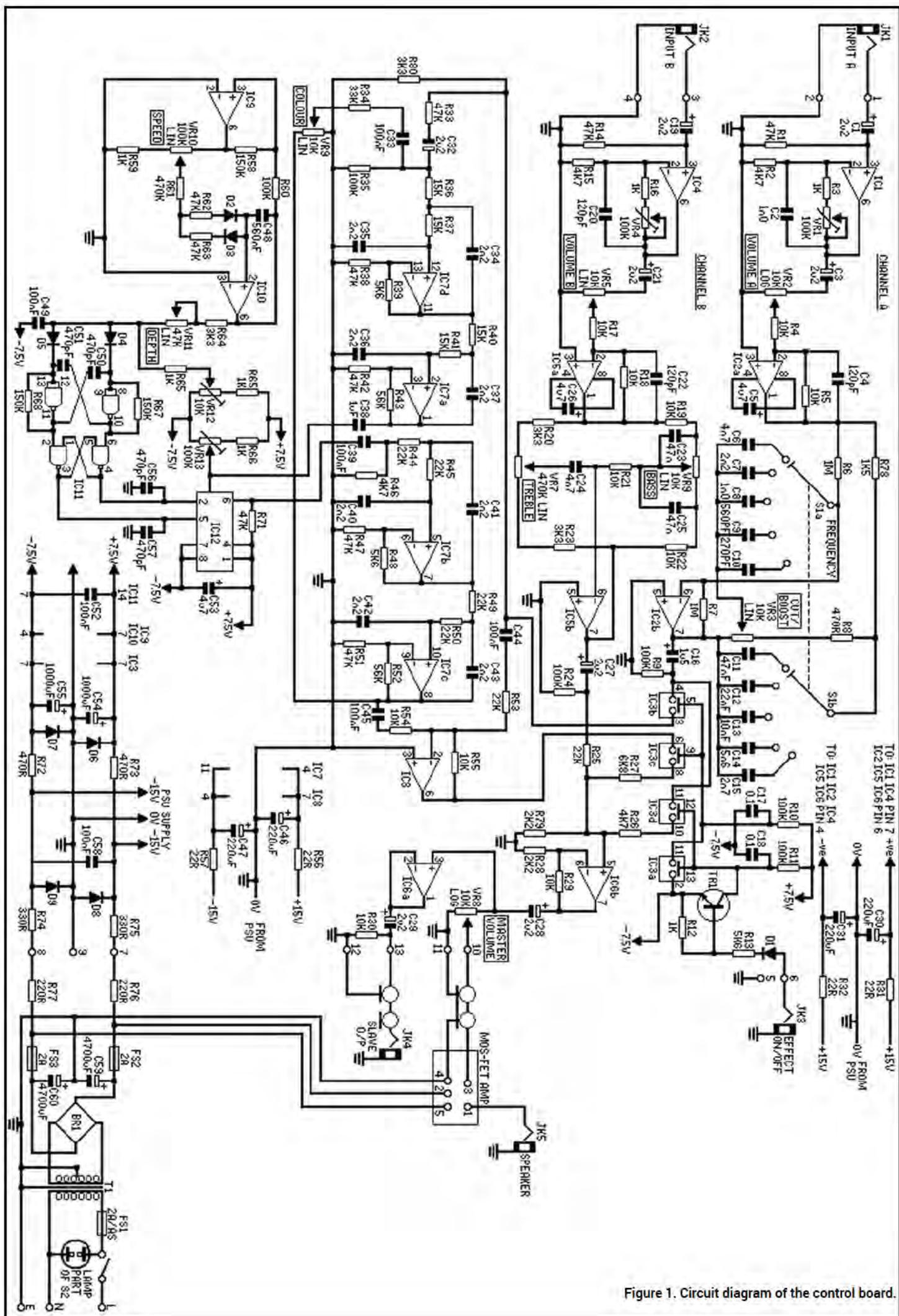


Figure 1. Circuit diagram of the control board.

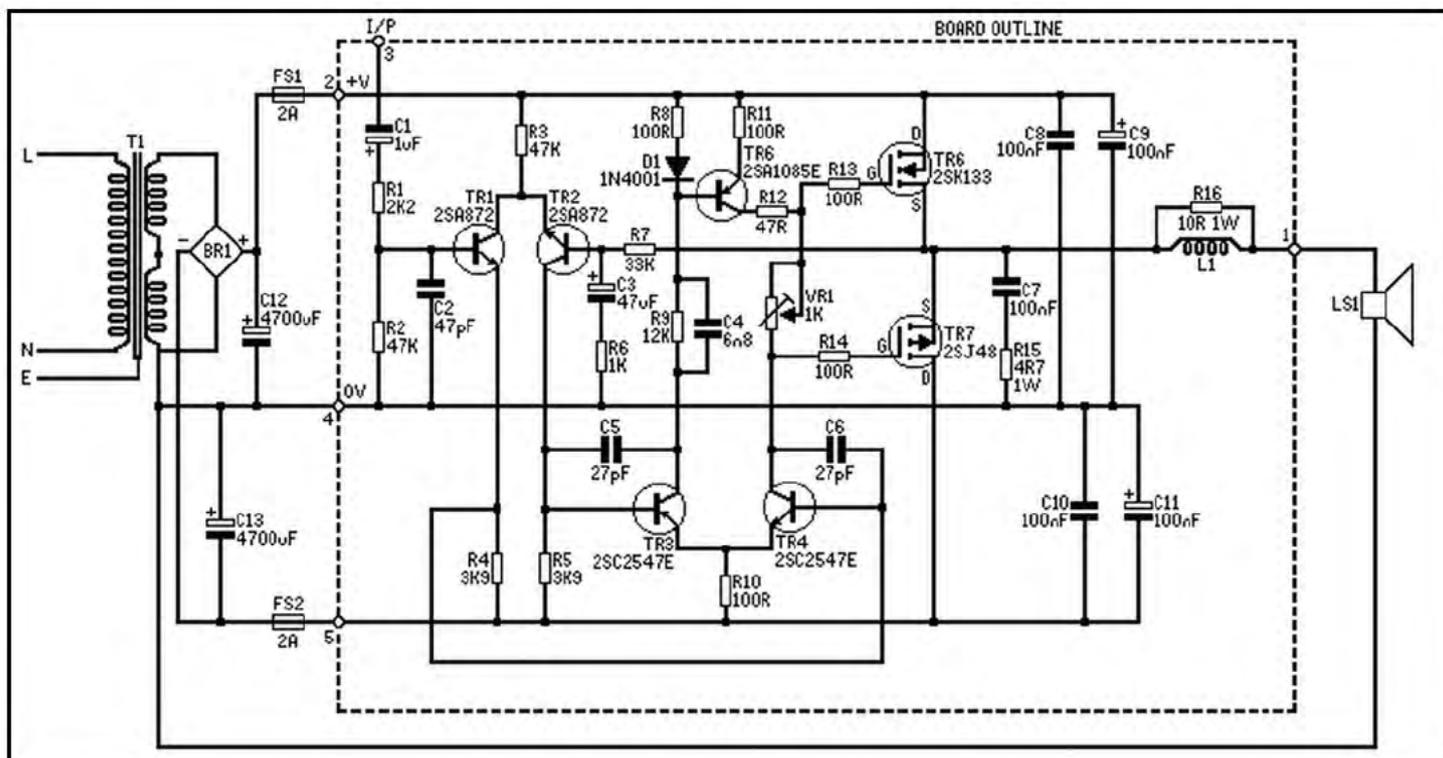


Figure 2. Circuit diagram of the MOSFET power amplifier.

The slow running triangle wave ramps the fast running square wave oscillator up and down depending on the depth control RV11. The minimum fast running oscillator frequency is preset by RV12. Antiphase square wave signals are applied to the two clock inputs, pins 2 and 5 of IC12.

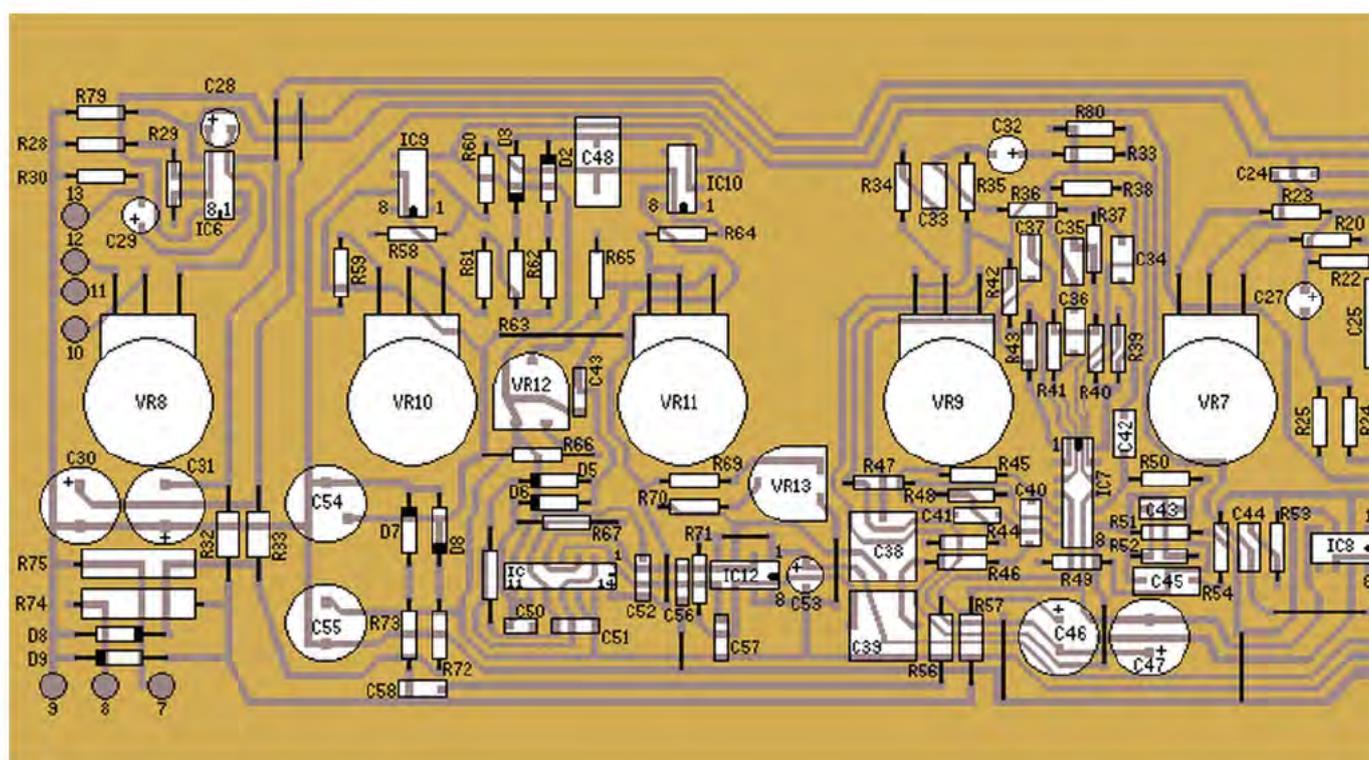
We now have our low pass filtered audio signal being delayed by IC12 for time periods between 300µs and 6 ms. The delay line output stages must be biased into class A operation, and preset RV13 should be adjusted for a symmetrical signal at pin 6 of IC12 - equivalent to 8 volts between pins 3

and 7 of IC12. Obviously, an asymmetrical output will give a distorted sound, so ensure accurate adjustment of RV13.

IC7b and c are, again, low pass filters and they serve to restore the 'stepped' waveform from IC12 by removing the clock signal and amplifying the delayed audio signal. The delayed signal is mixed at IC8 with a percentage of the original unaltered signal. The flanging effect is enhanced by introducing feedback from IC7c output via RV9, R34 and C33 back into the input filters. IC8 output is connected via IC3 pins 8/9 and R27 to the output mixer, IC6b.

R31, R32, C30 and C31 decouple the ±15 volt supply to IC7 and IC8. R72, R73, C54, R55, D6 and D7 connect ±7.5 volts to IC9, IC10, IC11 and IC12. C58 removes any RF present at the supply input, and R74, R75, D8, D9 regulate the +50 volts from the power amp supply. This degree of supply rail isolation and de-coupling is necessary to maintain a low noise level throughout the pre-amp circuitry.

The power amplifier stage is the MOSFET amplifier published in Electronics & Music Maker, June 1981. The details are reprinted here for convenience.



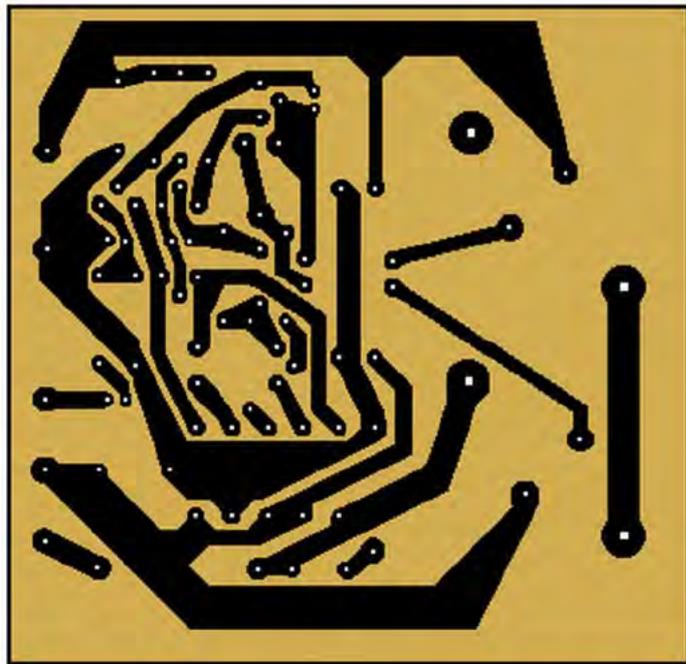
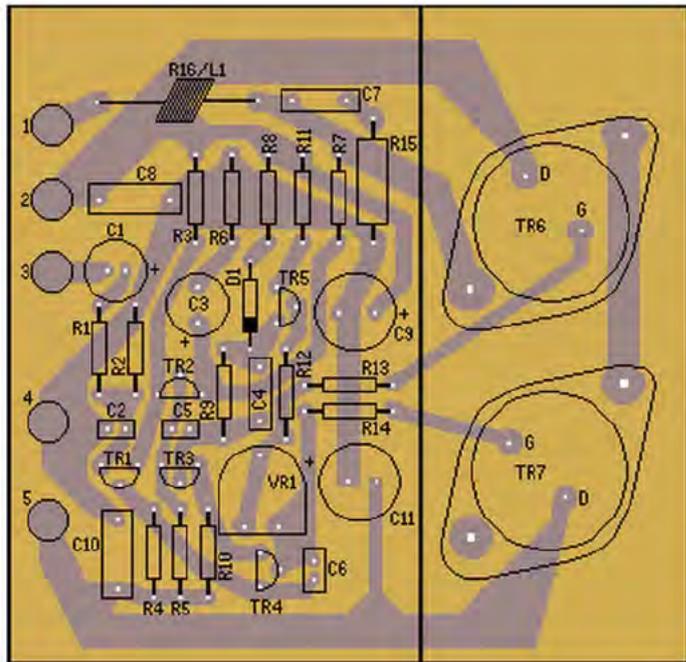


Figure 3. Power amplifier PCB.

### Circuit Description

TR1 and TR2 form a stable, differential input buffer amplifier, the bias current for each transistor being set to 0.5 mA. The 2SA872 transistor is used because it has a very low noise output but can handle high voltages. TR3 and TR4 form a 'current mirror' to give a high open-loop voltage gain. TR5 acts as a constant-current load and this low-noise, high-gain, class A amplifier stage is all that is required to drive the power MOSFETs TR6 and TR7. The transistors in the driver stage need to have a high voltage durability, high FT and low Cob. They also have to supply sufficient power to charge and discharge the gate-to-source capacitance of the power MOSFETs. In this case a bias current of around 50 mA is sufficient to ensure adequate power is available at all frequencies and power levels.

The input impedance of the amplifier is set by R2 to 47k, and C2 bypasses any RF signals present at the input. The amplifier has a gain of 33, and this is set by R7 and R6, via decoupling capacitor C3. R13 and R14 improve the stability at high frequencies by reducing the effective gate load capacitance. C7 and R15 are a Zobel network which, in conjunction with R16 and L1, ensures excellent stability into reactive loads at high frequencies.

### Construction

Fit the five Veropins, labelled 1 to 5, to the PCB and solder. Fit and solder diode D1 taking care that it is the right way round. Fit and solder all the resistors except R16, and all the capacitors, taking care with the polarity of the electrolytic ones, C1, C3, C9 and C11 (refer to Figure 3). Scrape or burn the enamel off one end of the piece of enamelled copper wire and solder it to one lead of R16, close to the body of the resistor. Now wind the wire tightly around the resistor ten times to form L1, as shown in Figure 4. Do not cut the wire, but hold it tightly and scrape off the enamel where it will touch the other lead-out wire of the resistor, then wrap it around the lead and

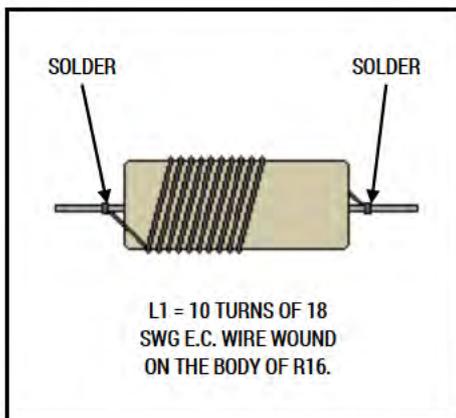


Figure 4. Power amplifier coil winding details.

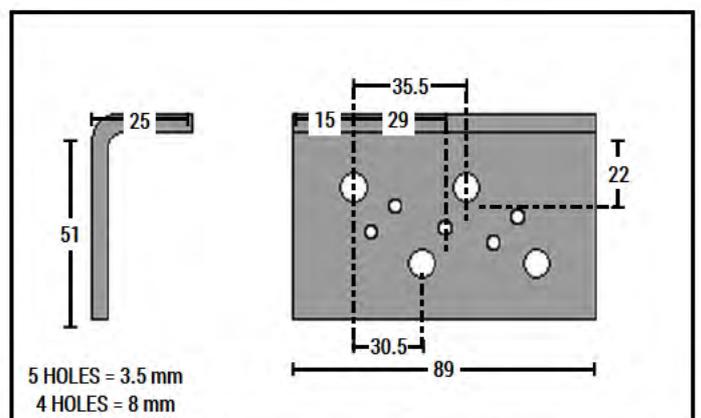


Figure 5. Power amplifier mounting bracket.

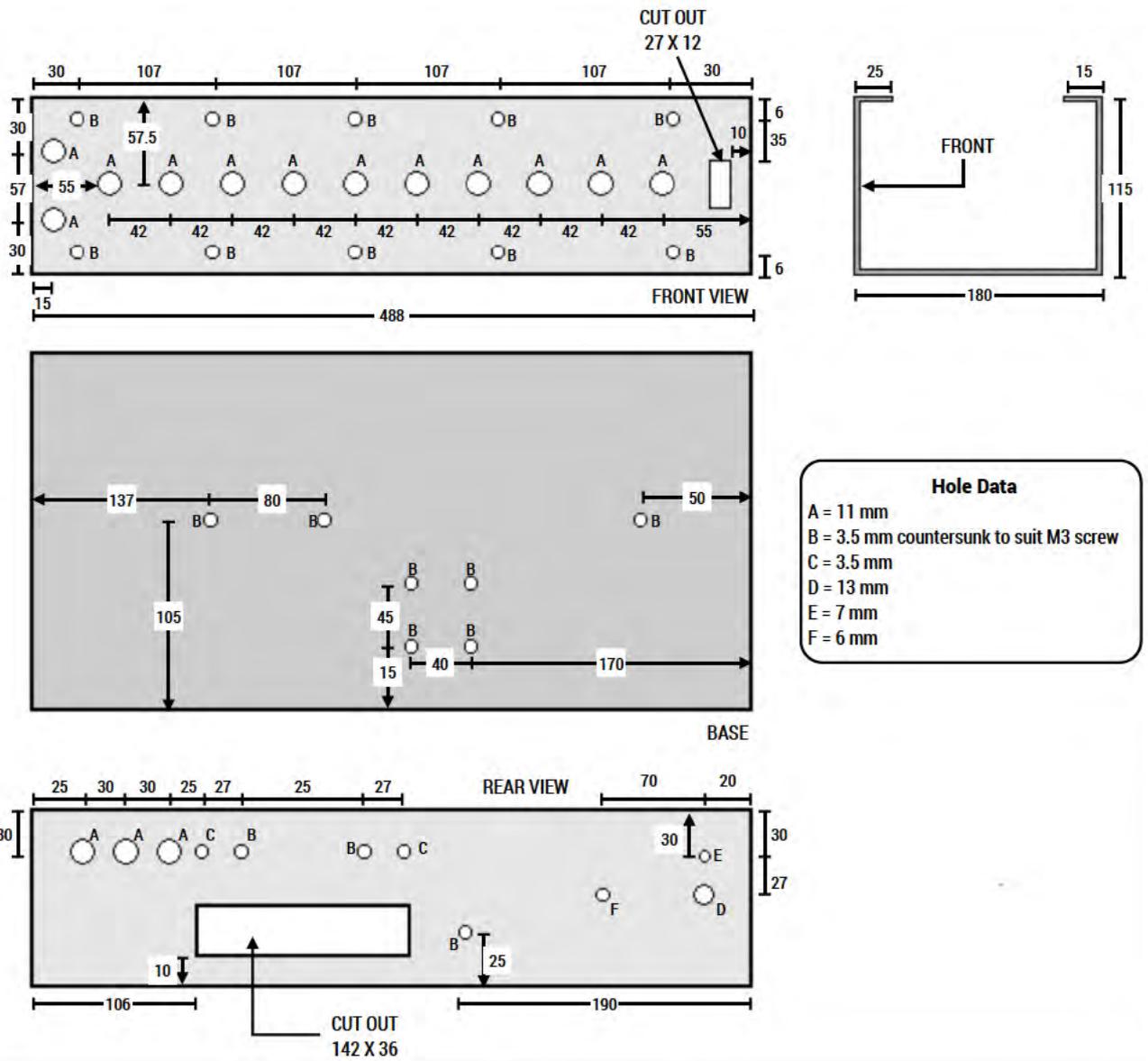
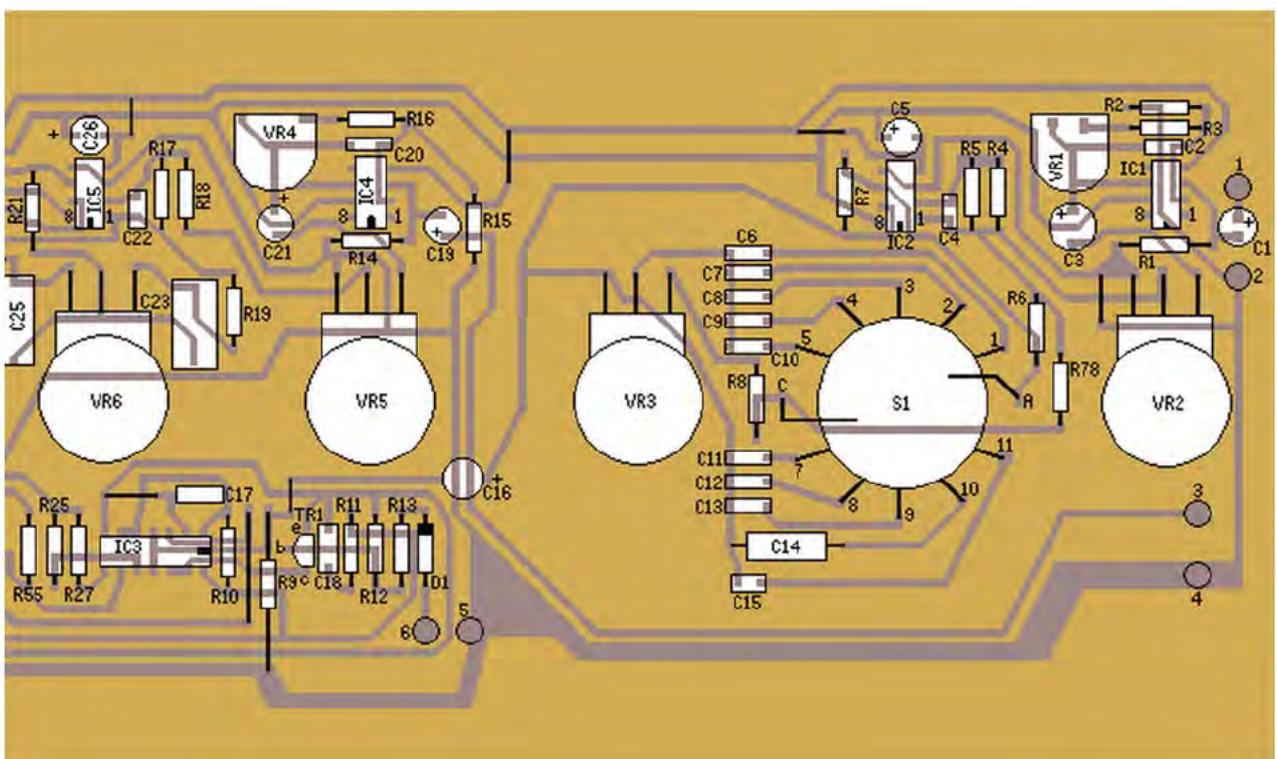


Figure 8. Metalwork details.



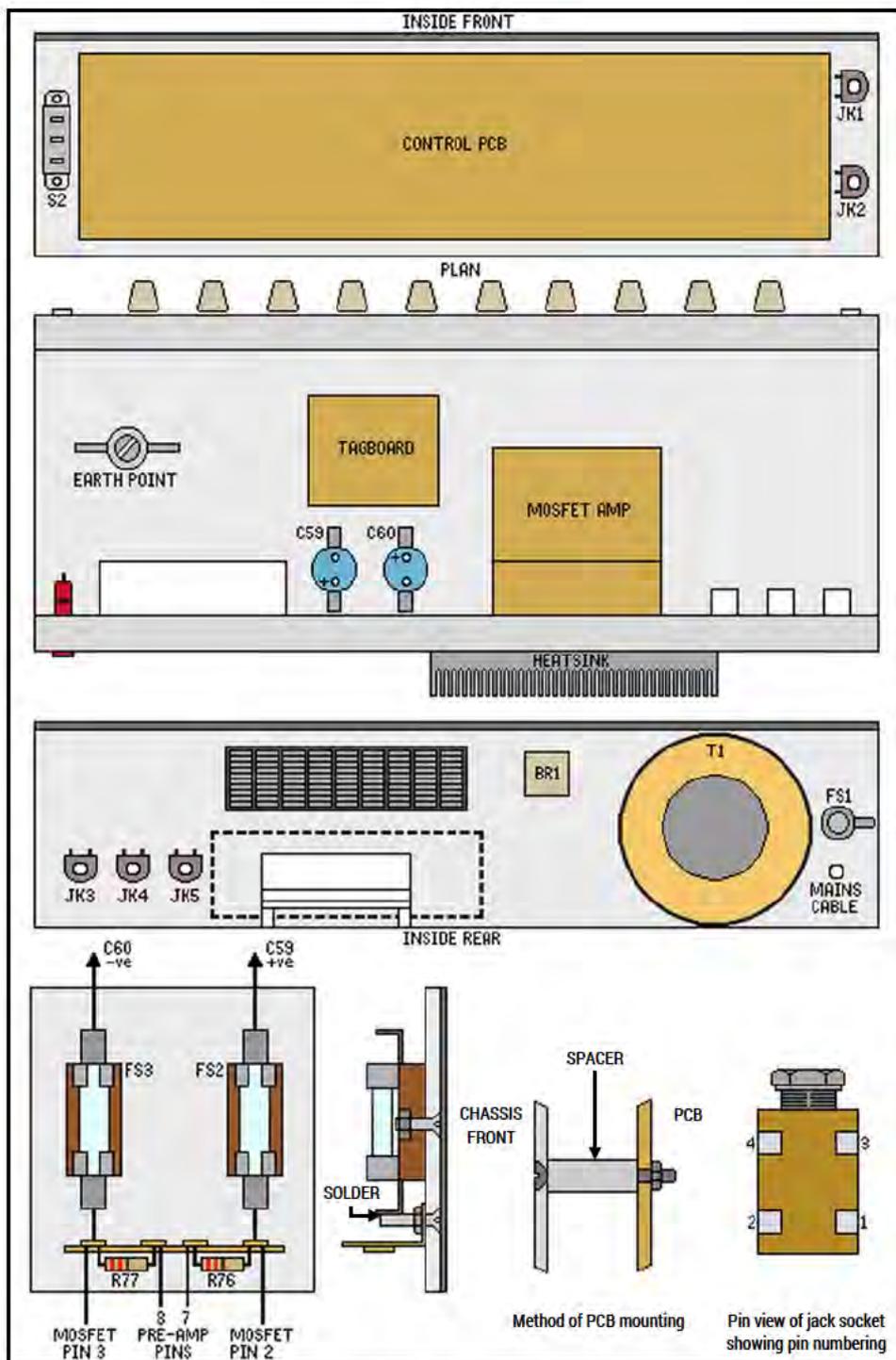


Figure 9. Chassis assembly layout.

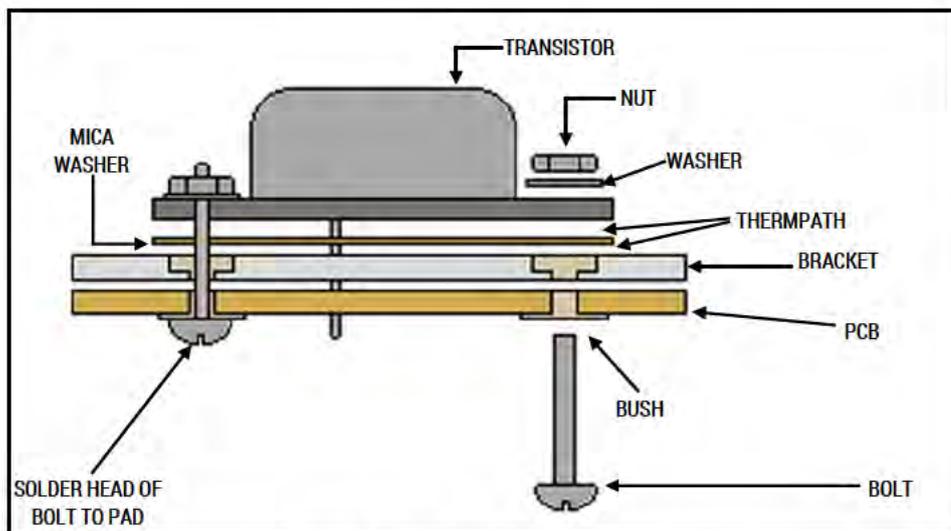
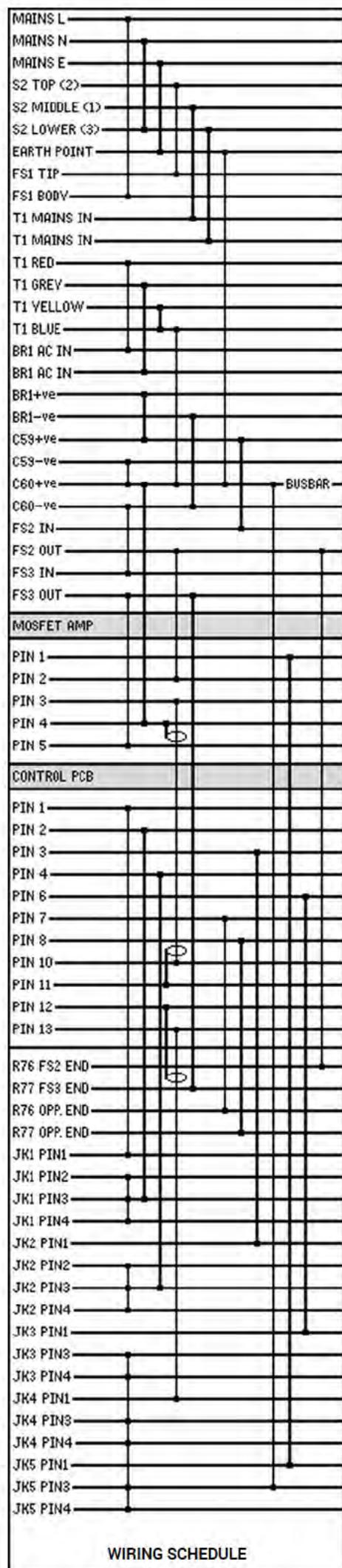


Figure 6. Power MOSFET mounting details.



WIRING SCHEDULE

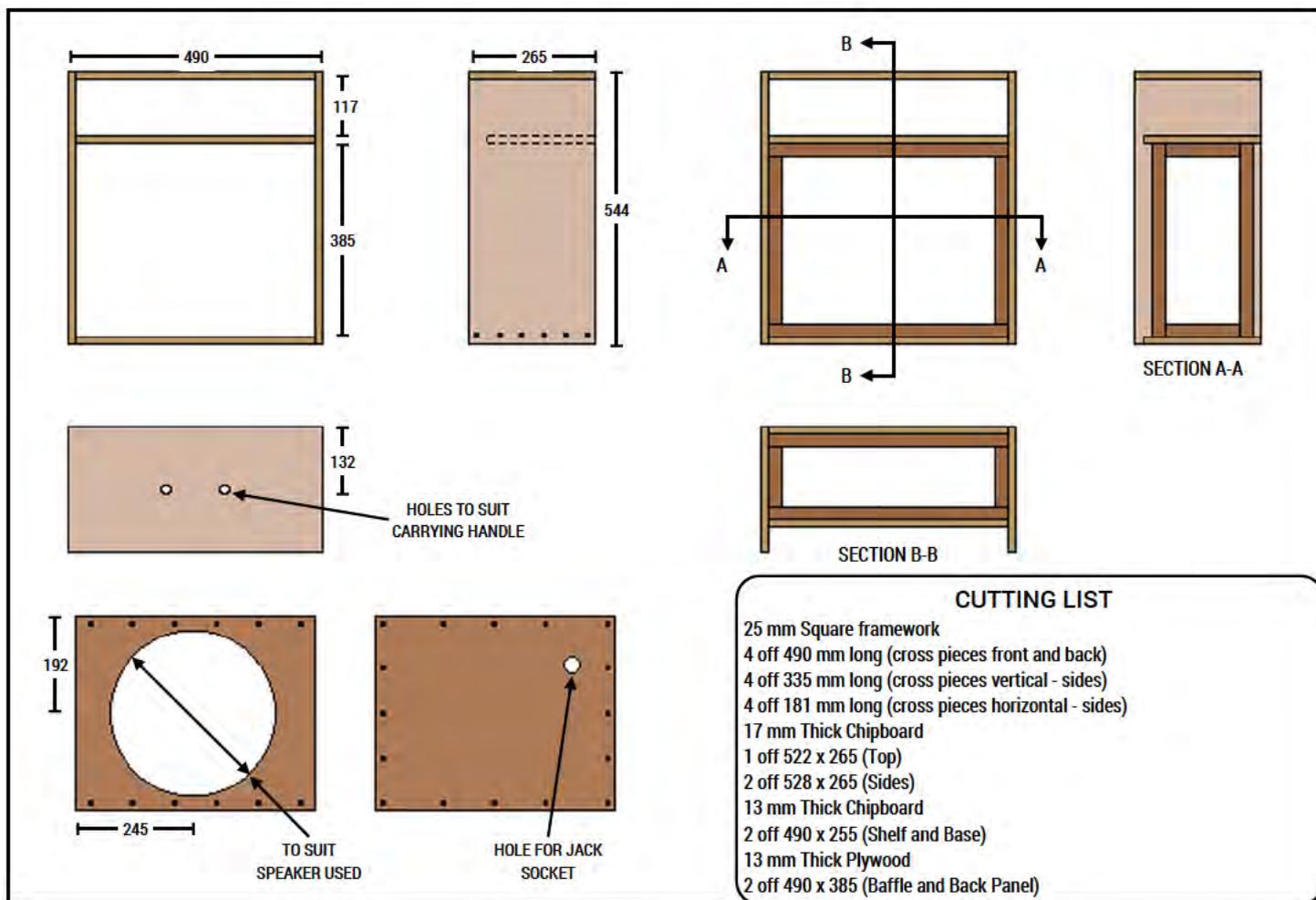


Figure 10. Cabinet construction details.

solder. Fit this composite component to the PCB and solder. Fit and solder the preset to the PCB, then the transistors (TR1-5).

Make the heatsink bracket shown in Figure 5. The mounting bracket fits to the component side of the PCB as shown in the photograph. Align it with the holes in the PCB and put one bolt through the centre hole from underneath using a 6BA nut, bolt and shakeproof washer. Referring to Figure 6, place a nylon bush in each of the four large holes in the bracket, smear both faces of both mica washers with Thermpath silicone grease and place these in position. Mount the two power MOSFETs, ensuring that TR6 (2SK133) is fitted closest to the coil L1. Put in the 6BA bolts to hold the transistors from underneath and secure them using nuts and shake-proof washers. Solder the bolt heads to the track on the

PCB. Finally solder the drain and gate pins to the PCB and recheck all component positions, polarisations and solder joints.

#### Setting Up

With no speaker connected and fuses not inserted, check that the voltage across C12 is approximately 48 volts (+5 volts) and that the voltage across C13 is the same. Switch off and short C12 and C13 in turn with a resistor (e.g. one of the test resistors). Now connect FS2 and FS3, via 100 ohm 5 watt resistors, to pins 2 and 5 respectively. Connect 0 volts to pin 4. Check with a multimeter set to the highest resistance range, that there is no connection between the MOSFET cases and the mounting bracket. Turn RV1 fully clockwise.

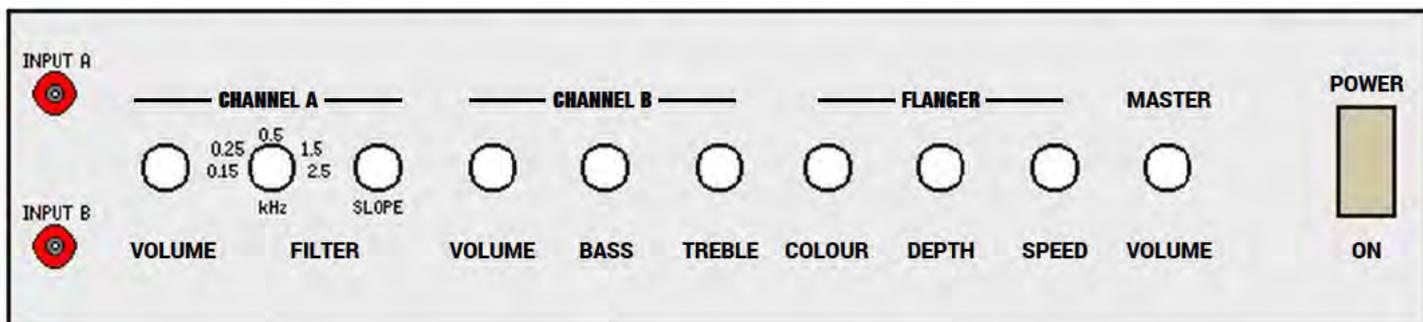
Insert 500 mA fuses for test purposes as FS2 and FS3 and switch on again. If either

fuse blows or any component gets excessively hot switch off immediately. If all is well, connect a DC voltmeter between pin 1 and pin 4. The meter should read about 0 volt (not more than  $\pm 100$  mV). Switch off and remove the two 100 ohm resistors. Connect FS3 directly to pin 5 and connect a multimeter switched to about 100 mA DC between FS2 and pin 2 (+ve lead to fuse and -ve lead to pin 2). Switch on again and rotate RV1 slowly until the meter reads 50 mA. Leave for 10 minutes and re-adjust.

Switch off, disconnect the meter and connect FS2 direct to pin 2. Replace FS2 and FS3 with 2 amp types.

#### Control PCB Assembly

Fit all links first, and then the resistors and capacitors. Electrolytic and tantalum capacitors are polarised, and attention



Front panel.

## COMBO AMPLIFIER PARTS LIST

**Resistors** - all ¼ watt 5% carbon unless specified

R1, R14, R33, R38, R42, R47, R51, R62, R63, R71	47K	10 off	Yellow Violet Orange
R2, R15, R26, R46	4K7	4 off	Yellow Violet Red
R3, R12, R16, R59, R65, R66, R69	1K	7 off	Brown Black Red
R4, R5, R17, R18, R19, R21			
R22, R29, R30, R54, R55	10K	11 off	Brown Black Orange
R6, R7	1M	2 off	Brown Black Green
R8, R72, R73	470R	3 off	Yellow Violet Brown
R9, R10, R11, R24, R35			
R60, R70	100K	7 off	Brown Black Yellow
R13, R39, R48	5K6	3 off	
R20, R23, R64, R80	3K3	4 off	Orange Orange Red
R25, R44, R45, R49, R50, R53	22K	6 off	Red Red Orange
R27	6K8		Blue Grey Red
R28, R79	2K2	2 off	Red Red Red
R31, R32, R56, R57	22R	4 off	Red Red Brown
R34	33K		Orange Orange Orange
R36, R37, R40, R41	15K	4 off	Brown Green Orange
R43, R52	56K	2 off	Blue Green Orange
R58, R67, R68	150K	3 off	Brown Green Yellow
R61	470K		Yellow Violet Yellow
R74, R75	330R	2 off	3W wirewound
R76, R77	220R	2 off	3W wirewound
R78	1K5		Brown Green Red

### Potentiometers

VR1, VR4, VR13	100K	3 off	Horizontal preset
VR2, VR5, VR8	10K	3 off	Log. potentiometer
VR3, VR9	10K	2 off	Lin. potentiometer
VR6, VR10	100K	2 off	Lin. potentiometer
VR7	470K		Lin. potentiometer
VR11	47K		Lin. potentiometer
VR12	10K		Horizontal preset

### Capacitors

C1, C3, C19, C21			
C27, C28, C29, C32	2µ2 63V PC electrolytic	8 off	
C2, C8	1n0 ceramic plate	2 off	
C4, C20, C22	120pF ceramic plate	3 off	
C5, C26, C53	4µ7 35V tantalum	3 off	
C6	4n7 monolithic ceramic		
C7	2n2 monolithic ceramic		
C9	560pF ceramic plate		
C10	270pF ceramic plate		
C11	47nF monolithic ceramic		
C12	22nF monolithic ceramic		
C13	10nF monolithic ceramic		
C14	5n6 polystyrene		
C15	2n7 ceramic plate		
C16	1µ5 35V tantalum		
C17, C18, C33, C34			
C45, C49, C52, C58	100nF disc ceramic	8 off	
C23, C25	47nF polycarbonate	2 off	
C24	4n7 polycarbonate		

C30, C31, C46, C47	220µF 16V PC electrolytic	4 off
C34, C35, C36, C37		
C40, C41, C42, C43	2n2 polycarbonate	8 off
C38	1µ0 polycarbonate	
C39	100µF polyester	
C48	560nF polycarbonate	
C50, C51, C56, C57	470pF ceramic plate	4 off
C54, C55	1000µF 16V PC electrolytic	2 off
C59, C60	4700µF 63V can electrolytic	2 off

### Semiconductors

IC1, IC4, IC8	LF351	3 off
IC2, IC5, IC6	LF353	3 off
IC3	4016BE	
IC7	LF347	
IC9, IC10	µA741C	2 off
IC11	4011BE	
IC12	TCA350Z	
TR1	BC548	
D1, D2, D3, D4, D5	1N4148	5 off
D6, D7	BZY88C7V5	2 off
D8, D9	BZX61C15V	2 off
BR1	PW06	

### Miscellaneous

S1	MOSFET amplifier kit	
	2-pole 6-way rotary switch	
	make before break	
T1	35-0-35V 160VA toroidal transformer	
	Chassis fuseholders	2 off
	Panel fuseholder	
FS1	2A 20 mm antisurge fuse	
FS2, FS3	2A 20 mm fuse	2 off
S2	SPST rocker with neon	
JK1, JK2	Chrome bezel jack socket	2 off
JK3, JK4, JK5, JK6	¼ inch jack socket	4 off
	L knobs	10 off
	Red knob caps	3 off
	White knob caps	7 off
	2E heatsinks (see text)	2 off
	Jack plugs	3 off
	Footswitch	
LS1	Loudspeaker 12 inch	
	Handle	
	Ventilation grille	
	4-way tag strip	
	Grommet	
	6BA x 1 inch c/s bolts	10 off
	6BA ½ inch c/s bolts	11 off
	6BA nuts	27 off
	6BA washers	27 off
	6BA x ½ inch spacers	8 off
	Jack socket mounting plate	
	Cabinet cloth	1 m
	Speaker fabric	½ m
	Connecting wire	
	Screened cable	1 m
	Mains cable	
	Aluminium chassis (see Fig. 8)	

should be paid to their plus signs. Fit diodes, transistors and ICs using IC holders if preferred. Lastly, fit the rotary pots and SW1. The rotary switch fits into a locating hole which lines up the switch tags to their appropriate holes on the PCB. Connect pins 1 to 5 and pins 7 to 11 to the PCB; pins 6 and 12 are not used. The switch is a 6 way type and can be adjusted for 5 way with the lug washer on the spindle; the lug should go into the slot marked with a '5' moulded into the switch body. Wire pins A and C to the PCB. The 9 potentiometers are wired to the holes adjacent, either direct or by using Vero pins (1 mm type). After soldering and cutting all component wires, scrub the PCB with paint thinners and sponge, to clean off flux, and check for shorts etc. Double check

all components. A ±15 volt supply can be attached for testing the pre-amp circuitry before assembly in the chassis.

### Chassis Assembly

C1 and C2 come with their own mounting clips which are fixed with 4 x ½ inch 6BA countersunk bolts, nuts and washers. BR1 is also mounted with a ½ inch 6BA countersunk bolt, nut and washer. T1 is supplied with mounting pads, nuts and bolts. The 2 fuse holders FS2 and FS3 are fitted to a paxolin panel (for insulation) using ¼ inch 6BA bolts, and the 4 way tag strip is soldered to the holders.

Resistors R1 and R2 are mounted to the tag strip - see Figure 9 - and then wired to the Combo pre-amp PCB + and - inputs.

The MOSFET amplifier bracket is smeared with Thermpath and bolted to the back panel with 6BA bolts. The front of the PCB is supported using 1 inch countersunk bolts and ½ inch 6BA spacers.

If it is intended to use less than 8 ohm loads on the power amp, heatsinks are advisable. Two extra holes are shown for mounting 2 x 2E heatsinks.

Additional cooling is catered for by cutting a slot in the back panel, above the power amp. A Cool Grille can be accommodated in the dimensions shown in the chassis diagram.

### Control PCB Mounting

The chassis front panel has 6 countersunk holes. Fit 6 x 1 inch bolts and

## MOSFET AMPLIFIER PARTS LIST

### Resistors - all ¼ watt 1% metal film unless specified

R1	2K2	Red Red Red
R2	47K	Yellow Violet Orange
R3	47K	Yellow Violet Orange
R4	3K9	Orange White Red
R5	3K9	Orange White Red
R6	1K	Brown Black Red
R7	33K	Orange Orange Orange
R8	100R	Brown Black Brown
R9	12K 1W Carbon Film	
R10	100R	Brown Black Brown
R11	100R	Brown Black Brown
R12	47R	Yellow Violet Black
R13	100R	Brown Black Brown
R14	100R	Brown Black Brown
R15	4R7 3W Wirewound	

### Potentiometers

VR1	1K	Horizontal preset
-----	----	-------------------

### Capacitors

C1	10µF 35V axial electrolytic
C2	47pF Ceramic
C3	47µF 50V SMPS
C4	6n8F Polylayer

C5	27pF Ceramic
C6	27pF Ceramic
C7	100nF Polylayer
C8	100nF Polyester
C9	220µF 63V PC Electrolytic
C10	100nF Polyester
C11	220µF 63V PC Electrolytic

### Semiconductors

D1	1N4001
TR1	2SA872A
TR2	2SA872A
TR3	2SD765
TR4	2SD765
TR5	2SB716
TR6	2SK135
TR7	2SJ50

### Miscellaneous

	Insulator TO3	2
	MOSFET Amp Bracket	1
	Veropins type 2141	1 packet
	Bolt 6BA x ½ inch long	1 packet
	Nut 6BA	1 packet
	Washer (Shakeproof)	1 packet
L1	EC Wire 0.9 mm (see text)	

tighten with 6 x 6BA nuts. Place 6 x ½ inch 6BA spacers over the bolts and fit the Combo PCB over the bolts and spacers. Use 6 x 6BA nuts and washers to hold it down (note orientation of the PCB).

Fit the chrome bezel jack sockets to the front panel, and the mains neon switch.

Cut the rotary control spindles to size and fit the knobs; use red caps for the volume controls, white caps for the others.

The control PCB Output, pin 10, is connected to the power amp input using screened cable. Connect the cable screen to the power amp 0 volt pin and the control PCB 0 volt pin. The C1/C2 0 volt bus bar is wired to the power amp 0 volt and this also

supplies the control PCB 0 volt. Do not connect pin 9 to the 0 volt rail separately or earth loop hum will result.

The slave output pin should be wired with screened wire to the slave jack socket. Do not connect the screen at the jack socket end. Combo pin 6 (effect switch) is wired to the footswitch jack socket using hook-up wire. The bus bar supplies the 0 volt on all three jack sockets as in the chassis layout diagram.

The front panel input sockets are wired directly to the inputs and 0 volt pins on the control PCB. Screened wire is not necessary as the run is only about 1" long.

### Cabinet Construction

16 mm (5/8 inch) and 12 mm (½ inch) chipboard and 12 mm (½ inch) plywood is used in the construction of the cabinet. Material thicknesses vary and it is important to keep to the cabinet inside measurements when marking out.

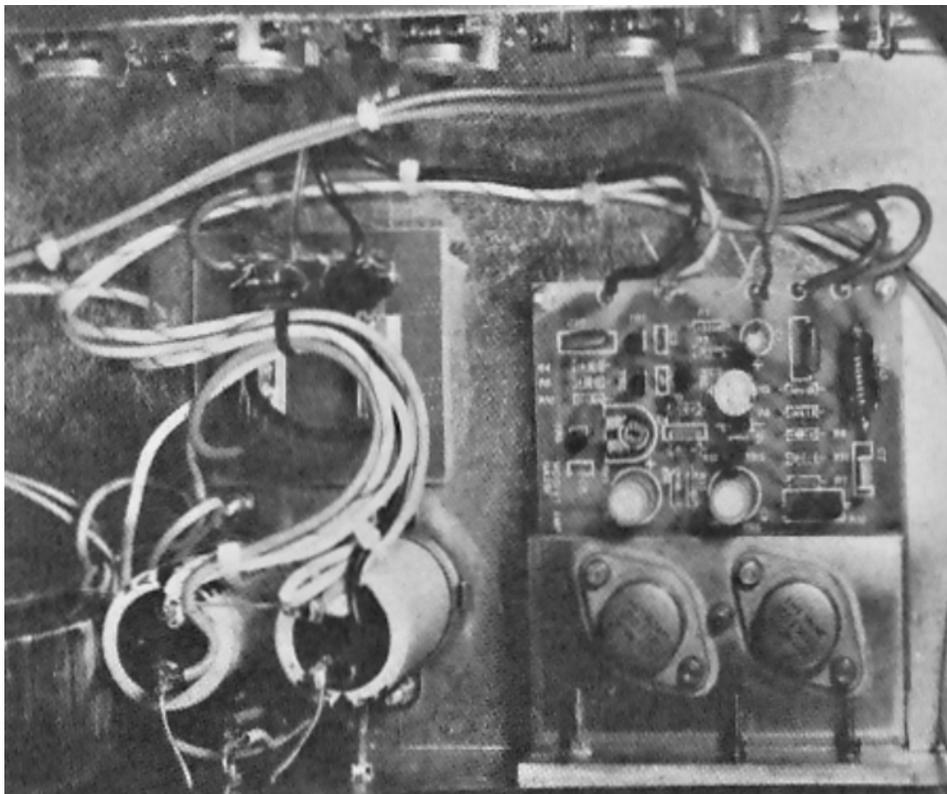
Cut out the five basic cabinet sections. Drill the top panel to accommodate a suitable carrying strap. The panel inside face will need the holes countersunk so that the nuts lie flush.

Use a good wood glue on the joints, and pin them (or use clamps) ready for drilling and screwing down. Use 1¼ inch No. 8 screws and countersink the outside of all holes. Note that the shelf and base panels fit flush with the back edges, while the front edges are set back by 10 mm.

Before fully tightening all screws, fit the front baffle board, after cutting a hole to suit the loudspeaker to be used. A 292 mm (11½ inch) hole is required for a 12 inch loudspeaker. Mark off the speaker mounting holes, drill and counter drill the holes to counter sink the mounting bolts. 1 inch x 2BA bolts usually suffice for this job.

Screw into the baffle board edges, through the cabinet sides. Ensure that the board is flush with the shelf front edge and base front edge. Tighten down all cabinet screws, and leave the assembly for the glue to dry.

Cut the 25 mm (1 inch) square wood to make a framework fitting inside the cabinet. Again, 1 inch prepared wood can vary considerably in thickness, so take this into account before cutting to size. Twelve pieces will be needed for the frame. Glue and screw the frame along the baffle edge (inside), but ensure the outer edge (back) framework is set back enough to accommodate the back panel 12 mm.



Power amplifier, capacitors and tag board mounted in chassis.



Completed MOSFET Amplifier.



Completed wiring in chassis.

Radius the front edges of the cabinet, and smooth all surfaces with a Surform and glass paper. The cabinet can then be covered using a suitable impact adhesive and cloth backed PVC material. About 2 metres of 0.5 metre wide material will be required. Cover the cabinet top with impact adhesive and lay the cloth centrally on to the glued surface. Smooth the cloth over the top completely. Remove the cloth and leave for two minutes - no more. Re-lay the cloth and stretch it gently, smoothing out any creases. Repeat this action for the sides; trim the corners and glue the cloth over the edges and into the cabinet about 25 mm.

The baffle can be covered with a suitable speaker material, glued (very conservatively) and laid over. Cut the edges with a sharp scalpel type blade.

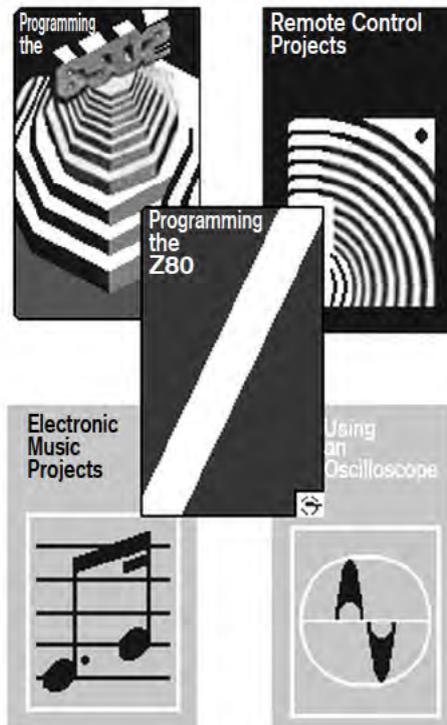
The shelf and base front edges can be covered with aluminium angle trim. The two sides of the baffle board can be fitted with our mixer trim channel.

Fit four plastic feet (or castors) to the base. Drill a hole in the back panel and cut out to accommodate a jack socket mounting plate. Wire the socket to the loudspeaker and screw the back panel into place. Fit the carrying strap to the top panel, and ensure the nuts are fully recessed.

If our chassis is to be used, slide it into the shelf area, up to the angle trim (if used) or to within 25 mm of the shelf front edge. Cut two pieces of channel trim to fit horizontally along the chassis front, top and bottom. This serves to cover the PCB mounting screw heads. Glue the channel to the cabinet top and shelf. Finally, screw in two small wood blocks behind the chassis to keep it in position.

### MAPLIN'S TOP TWENTY BOOKS

1. (2) Z80 IC's Data Sheets (RQ54J) (Cat. P35).
2. (1) How To Make Walkie-Talkies by F.G. Rayer (RF18U) (Cat. P30).
3. (10) How To Build Your Own Solid State Oscilloscope by F. G. Rayer (XW07H) (Cat. P29).
4. (5) Power Supply Projects by R. A. Penfold (XW52G) (Cat. P29).
5. (9) Remote Control Projects by Owen Bishop (XW39N) (Cat. P29).
6. (3) IC555 Projects by E. A. Parr (LY04E) (Cat. P27).
7. (4) Electronic Synthesiser Projects by M. K. Berry (XW68Y) (Cat. P33).
8. (12) The Oscilloscope In Use by Ian R. Sinclair (XW86T) (Cat. P30).
9. (7) Towers' International Transistor Selector Update 2 by T. D. Towers (RR39N) (Cat. P25).
10. (6) Adventures With Microelectronics by Tom Duncan (XW63T) (Cat. P24).
11. (29) Programming The Z80 by Rodney Zaks (XW72P) (Cat. P36).
12. (14) Z80 Assembly Language Programming by Lance A. Leventhal (XW71N) (Cat. P36).



13. (8) BASIC Computer Games by D. H. Ahl (RQ21X) (Cat. P37).
14. (15) Electronic Circuits For Model Railways by M. H. Babani (RH45Y) (Cat. P29).
15. (11) Basic Electronics Set (XX10L) (Cat. P24).
16. (61) Programming The 6502 by Rodney Zaks (XW80B) (Cat. P35).
17. (18) Radio And Electronics Colour Code And Data Chart (RH05F) (Cat. P24).
18. (13) Beginners' Guide To Building Projects by R. A. Penfold (RF09K) (Cat. P26).
19. (31) Z80 Instruction Handbook by Nat Wadsworth (RL39N) (Cat. P36).
20. (24) Electronic Music Projects by R. A. Penfold (XW40T) (Cat. P33).

These are our top twenty best-selling books based on mail-order and shop sales during August, September and October 1981 and do not include our own publications or magazines. We stock over 325 different books relating to electronics and the full range is shown in this magazine and on pages 23 to 37 of our 1981/1982 catalogue.

# STARTING POINT

by Robert Penfold

Introducing the fundamentals of electronics for the constructor.

## Amplifying Modes

A transistor can be used in three modes of amplification, and these are the **common emitter**, **common collector** (popularly known as the **emitter follower**), and the **common base** modes. Results obtained in each case are quite different, and each mode of operation has applications where it is ideal, and others where it would be totally useless. We will consider each type of amplifier in turn, concentrating on the characteristics and uses of each type.

### Common Emitter

The common emitter mode is certainly the most common mode of amplification, and the reason for this is simply that this type of amplifier has the most useful set of performance characteristics. Figure 1(a) shows the basic common emitter configuration and Figure 1(b) shows a simple common emitter configuration for use with AC signals. Incidentally, the name of this mode of amplification is derived from the fact that the emitter terminal of the transistor is common to both the input and output of the stage, whereas the other two terminals handle only one signal or the other. In other words, one side of the input and one side of the output connect to a common point (which is usually one of the supply rails), and the emitter of the transistor either connects direct to this rail, or is coupled to it in some way. The other two types of amplifier obtained their names in a similar way, but of course have different 'common' terminals.

If we consider the simple configuration of Figure 1(a), with no input applied to TR1 the device is cut off and virtually the full supply voltage is present at its collector. The collector will not be at the full positive supply voltage because a small leakage current will flow between the collector and emitter terminals of TR1, but using a modern silicon device this leakage current will be too low to be of significance in practice (usually only a fraction of a microamp).

If a steadily increasing voltage is applied to the input of the amplifier, TR1 will not start to conduct significantly between its collector and emitter terminals until the base-emitter voltage reaches about 0.6 volts. Raising the input voltage above this threshold level results in TR1 rapidly conducting more heavily and reaching saturation with a base-emitter voltage of only about 0.8 volts. The collector voltage at saturation depends on a number of factors, such as the collector current and particular type of transistor in use, but it is likely to be between about 20 millivolts and 1 volt, and increasing the base-emitter voltage further has no significant effect on this voltage once saturation has been reached.

This type of amplifier obviously gives good voltage gain since a change in input voltage of perhaps only a couple of hundred millivolts or less can give a change in output voltage of several volts or more (a voltage change

practically equal to the supply voltage in fact). There is also current gain, of course, since bipolar transistors are current operated devices and providing current gain is their basic function.

A simple DC amplifier of this type is often used to drive loads such as a relay, indicator light, or loudspeaker, but in a practical design it is necessary to have either a resistor in series with the base of the transistor, or a drive circuit having only a limited current drive capability. Otherwise even quite a modest input voltage of (say) about one volt could drive a very high base current into TR1 and destroy the device.

### AC Amplifier

In order to amplify an AC signal it is necessary to bias the transistor, and the simplest practical way of doing this is shown in the configuration of Figure 1(b). Applying an AC

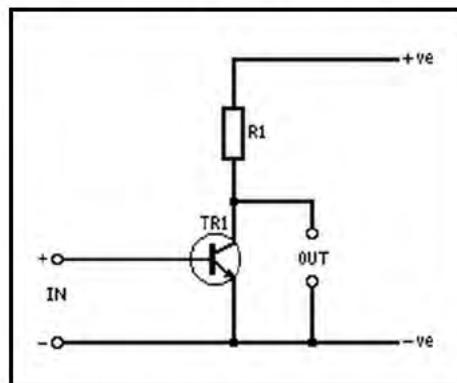


Figure 1(a). A simple DC common emitter stage.

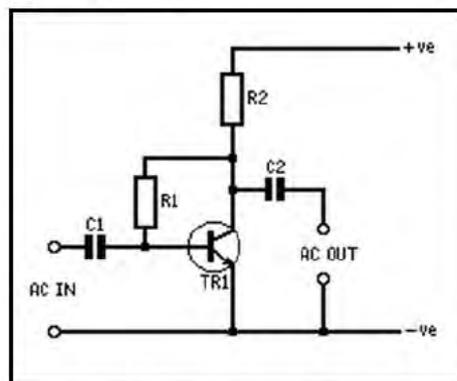


Figure 1(b). A simple AC common emitter stage.

input to the circuit of Figure 1(a) would not give satisfactory results as TR1 would only conduct during part of positive input half cycles, and not at all during negative input half cycles! This would obviously give an output signal that only vaguely resembled the input signal. In the circuit of Figure 1(b), R1 is used to bias TR1 into conduction under quiescent conditions, and ideally it should bring TR1 into a state of conduction that gives a collector voltage of half the supply voltage. C1 and C2 block steady DC signals from entering and leaving the circuit respectively, but varying input and output voltages are allowed to pass.

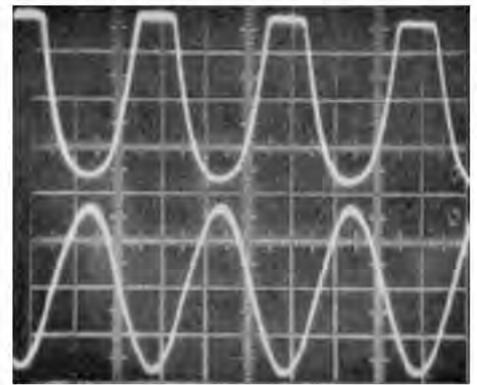


Figure 2(a). Half cycles being clipped.

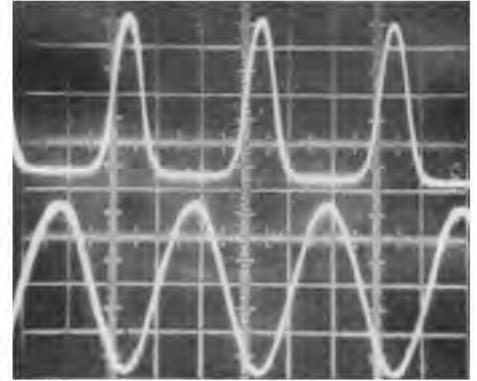


Figure 2(b). Half cycles being clipped.

An AC input signal takes the base of TR1 more positive and causes TR1 to conduct more heavily, with a consequent reduction in collector voltage. Negative input half cycles have the opposite effect with a consequent rise in the collector voltage of TR1. This gives an AC output from C2 that closely resembles the input signal, but the output is much higher in amplitude, and the current taken from the output can be much higher than that consumed at the input. Like the DC version, the circuit therefore gives good voltage, current, and power gain.

There is, of course, a limit to the maximum output voltage that can be provided by the circuit. The peak-to-peak output voltage can at best be marginally less than the supply voltage.

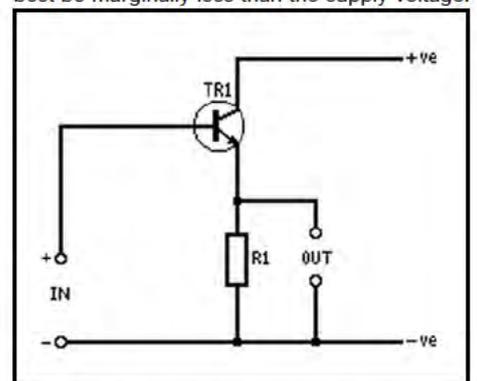


Figure 3(a). A simple DC emitter follower stage.

It can never equal the supply voltage because no practical transistor can achieve a collector voltage of zero when biased into saturation, and if an output current is drawn from the circuit (which would be the case in any practical situation) there must be a voltage drop through R2.

The point of biasing the collector of TR1 to about half the supply voltage is that this enables an output voltage swing which is virtually equal to the supply voltage to be achieved before the voltage at TR1's collector reaches its peak or minimum level. If TR1 was to be biased so that its quiescent collector voltage was only a small

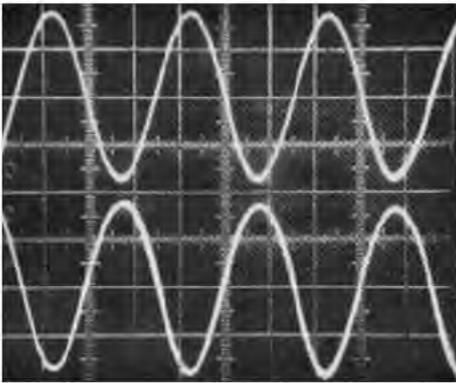


Figure 2(c). Unclipped output.

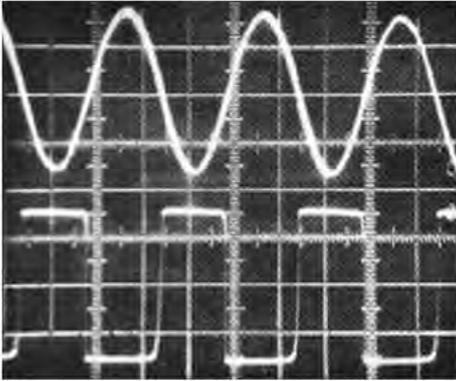


Figure 2(d). Symmetrical clipping

fraction of the supply voltage, then a negative output voltage swing of only very limited proportions would be achievable. Similarly, with TR1's collector biased to almost the positive supply potential only a small positive voltage swing would be possible before the maximum output voltage was reached.

If only a small output voltage swing is likely to occur this is not of great importance, but if the maximum peak-to-peak output level that is needed is a substantial fraction of the supply voltage it becomes essential to have good

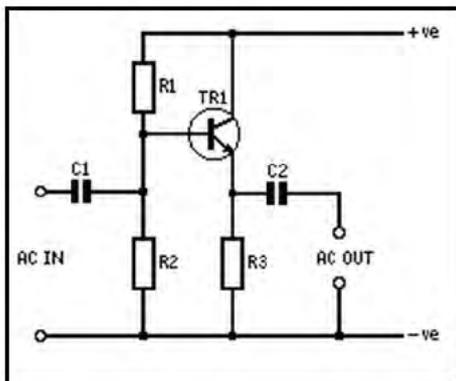


Figure 3(b). A simple AC emitter follower stage.

biasing or the transistor will become switched off or saturated during signal peaks of one polarity. This would result in one set of half cycles being clipped, as shown in Figure 2(a) and 2(b). Correct biasing gives an unclipped output, as shown in Figure 2(c).

Of course, even with ideal biasing it is still possible to overload the amplifier, and this gives symmetrical clipping, as shown in Figure 2(d). Even with the output below the clipping level the output signal is distorted to a certain extent, and no amplifiers are perfectly linear. The main cause of this distortion is the variations in the current gain of a transistor that occur as the collector current varies. A normal bipolar transistor has a level of current gain that increases as collector

current increases, although the gain may well reduce somewhat at very high collector currents. These variations in gain are not usually sufficient to cause severe distortion, and are only really of significance in critical applications such as Hi-Fi equipment.

A point that is often of no practical importance, but can in some applications be crucial, is that the signal undergoes an inversion or 180 degree phase shift when it is processed by a common emitter amplifier. Thus a positive going input produces a negative going output, and vice versa.

#### COMMON EMITTER AMPLIFIER CHARACTERISTICS

High voltage current, and power gain.  
Medium input and output impedance (typically several kilohms in each case).  
Phase inversion through the circuit.

#### Common Collector Mode

Figure 3(a) shows the basic common collector (emitter follower) configuration, and Figure 3(b) shows an AC version. Although on the face of it neither of these configurations lives up to its name, with the collector terminal of the transistor being common to neither the input nor the output, this is not in fact the case. Any change in voltage relative to one supply rail will be an identical change in relation to the other supply rail since the two are a fixed potential apart. Thus, although the collector terminal of the transistor does not connect to the negative supply rail direct, it is effectively coupled to it via the supply source.

If we consider the DC version first, with a gradually increasing input voltage to the circuit the voltage across R1 will remain practically zero until the input reaches about 0.6 volts because TR1 will not turn on until this point. Taking the input voltage above this point causes the voltage across R1 to increase, and remain about 0.6 volts below the input voltage. In fact, the difference between the input and output potentials will increase somewhat as the input voltage is raised,

due to the increase in the current flow through the collector-emitter terminals of TR1, and the increased base-emitter voltage that this demands.

This configuration obviously gives a voltage gain of less than unity, but it does give the full current gain of the transistor which could be quite high in practice. The input current needed to fully drive a common emitter amplifier and a comparable emitter follower stage are much the same since the output current required and the gain of the transistor will be identical. However, the input voltage needed to fully drive an emitter follower is much higher than that required by a common emitter stage, and the input impedance of an emitter follower is obviously comparatively high. This ability to match a high impedance signal source to a low impedance load makes the emitter follower a very useful electronic circuit which is frequently employed in practical designs.

In the AC version of the circuit R1 and R2 are used to bias the input of the amplifier to slightly more than half the supply potential so that quiescent output voltage is half the supply voltage. C1 and C2 are the input and output DC blocking capacitors.

#### EMITTER FOLLOWER AMPLIFIER CHARACTERISTICS

Less than unity voltage gain, but good current and power gain.  
High input impedance and low output impedance.  
No phase change through the circuit.

#### Common Base Mode

Common base amplifiers are not used a great deal, and do not have very useful characteristics. Figure 4(a) and Figure 4(b) show the basic DC and AC common base modes respectively.

In order to switch on TR1 in Figure 4(a), it is necessary to take the emitter about 0.6 volts negative, and then only a marginal increase in this signal is necessary in order to cause TR1 to saturate. Although this configuration seems in many ways similar to the common emitter mode, an important difference is that the output current flows through the input path of a common base emitter circuit. This gives a common base stage a current gain of only about unity and a low input impedance. Provided load resistor R1 has a fairly high value, the circuit has a reasonably high voltage gain, but this gives the circuit a high output impedance.

In the AC version R3 and R4 supply a positive bias to the base of TR1, which is more convenient in practice than negative biasing the emitter, and has the same effect of biasing TR1 into conduction. The bias circuit is arranged to give a quiescent voltage of about half the supply voltage at the collector of TR1. C2 couples the base of TR1 to the negative supply rail at AC but does not affect the DC bias conditions. The biasing can only operate properly if there is a DC path from the emitter of TR1 to the negative supply, and this is provided by R2. C1 and C3 are the input and output coupling capacitors.

#### COMMON BASE AMPLIFIER CHARACTERISTICS

Good voltage gain, about unity current gain, and moderate power gain.  
Low input impedance and high output impedance.  
No phase change through the circuit.

The circuits shown in this article all use NPN transistors, but the configurations are the same using PNP devices with the only exception that all polarities are reversed.

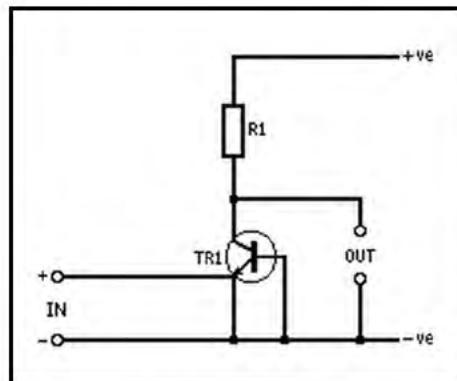


Figure 4(a). The basic common base configuration.

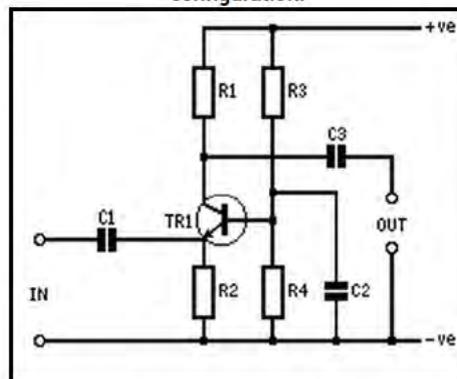


Figure 4(b). A simple AC common base amplifier.

# PASS THE BOMB!

by Alan Davies

- \* Make your party go with a BANG!
- \* Explosive fun for young and old
- \* Low cost novel construction



Are you bored with some of the traditional party games - 'musical chairs', 'pin the tail on the donkey', 'blind man's buff etc? Well, here's The Bomb which, while perhaps not quite as exciting as 'postman's knock', gives an electronic 'facelift' to that old party favourite 'pass the parcel'.

For those unfamiliar with this game, one version of it is as follows: those playing sit in a circle just far enough away from one another to be able to pass an object round the ring. This usually takes the form of a 'parcel'. The package is only passed round while some music is playing. When the music stops, the person holding the parcel has to drop out of the game or 'lose a life' (it may be agreed that when a small number of people are playing that each has say three 'lives'). As each person

drops out, the circle of people closes in and the process of passing the parcel continues. The winner of the game is of course the person left in at the end of the game when everyone else has had to drop out.

This works well but does have some disadvantages: a piano or record player is required in the room to be able to play at all and of course someone must play the piano or switch the music on and off. This can also create problems if the provider of the music is accused of cheating by stopping the music when the parcel is with a particular person - strictly not in the party spirit!

But all of this is in the past! No more music needed, no more gamesmanship - enter The Bomb!



This is an entirely self-contained unit which consists of a loud alarm and a circuit for varying the time period between soundings. When The Bomb is primed by pressing the priming button the alarm ceases to sound and the game begins. The Bomb is passed around from player to player until it 'goes off' (the alarm sounds)

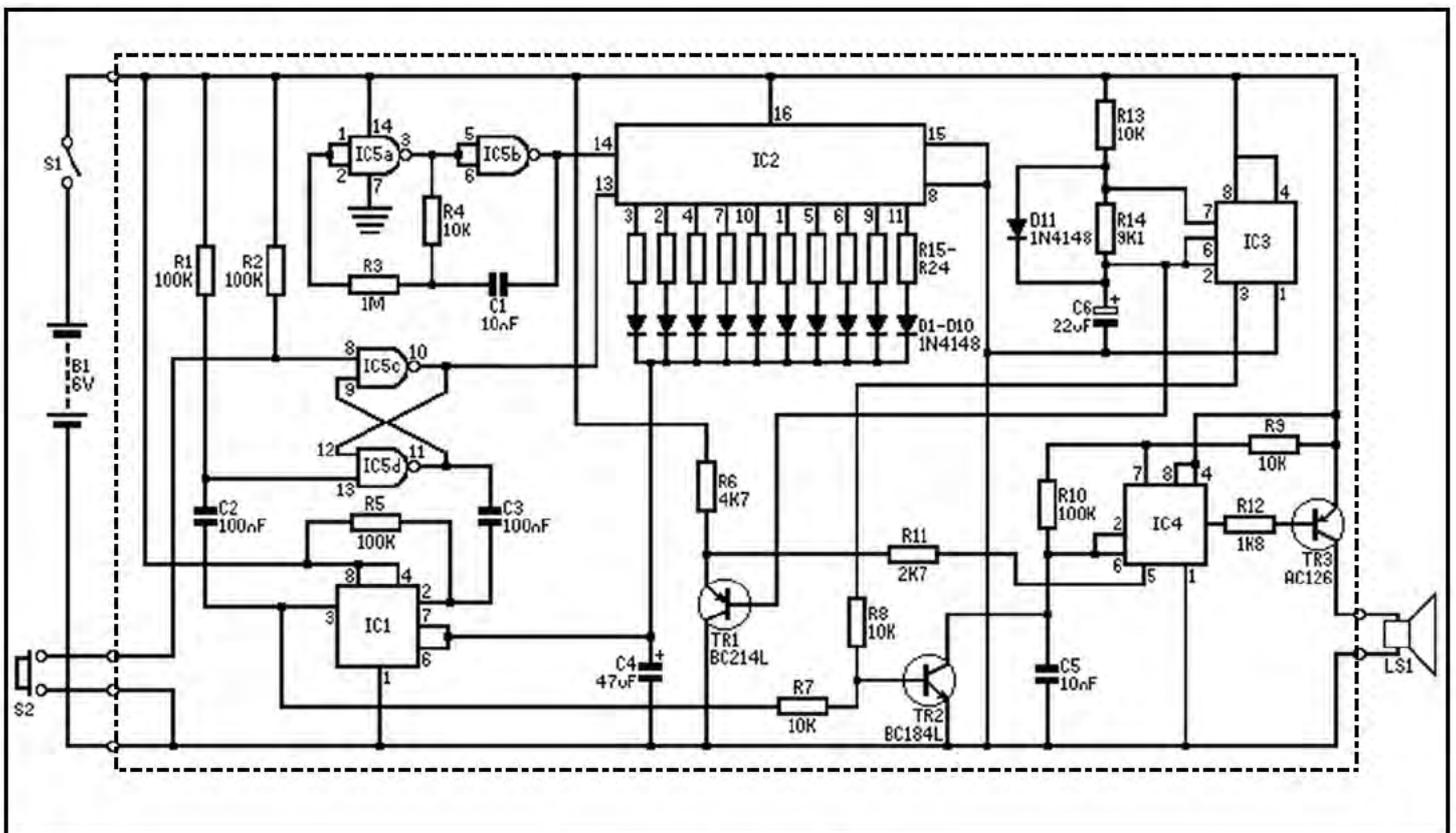


Figure 1. Circuit diagram of The Bomb.

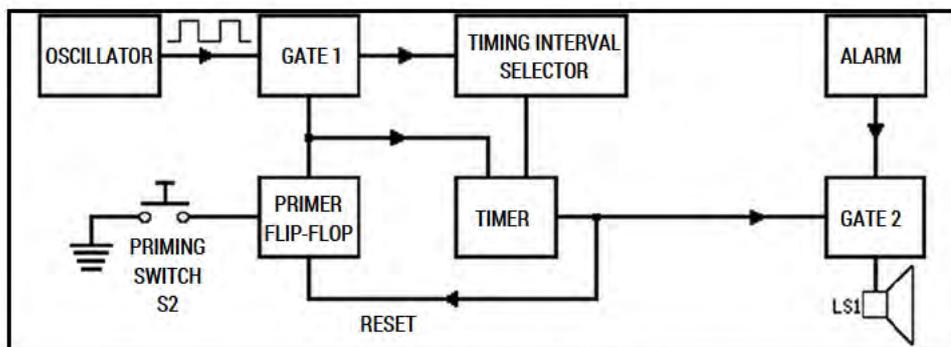


Figure 2. Block diagram of The Bomb.

in someone's hand. This person then has to drop out and the game continues until one player remains - the winner!

#### Principle of Operation

With reference to the block diagram, Figure 2, it will be seen that The Bomb consists of two main sections: timing and alarm.

During a timing period (when the alarm is off) the output from the timer switches gate two off preventing the alarm signal reaching the loudspeaker. As soon as the timing period is over, gate two is switched on and the alarm sounds. Whilst the alarm is sounding a clock waveform produced by the oscillator is allowed through to the timing interval selector via gate one. The timing interval selector consists of a ten-stage counter one of whose outputs is 'high' at any one time. As the priming button is pressed to initiate a new timing cycle, gate one is switched off and the timer itself is triggered and produces a timing period dependent upon which output of the timing interval counter was 'high' at the moment the priming button was depressed.

The oscillator clock rate is sufficiently fast (kHz) that it is impossible to predict where the counter in the timing interval selector will stop and hence which one often timing periods will have been selected when the priming button is pressed. The timing periods range from 3-25 seconds approximately.

#### Circuit

The Bomb circuit diagram is shown in Figure 1. The clock oscillator is formed using two of the NAND gates in IC5, a and b. These are wired as inverters and form an RC oscillator with R3, R4 and C1. Since R3 is much larger than R4 the approximate frequency of the oscillator is given by:

$$\frac{0.455}{R4 \times C1} \text{ i.e. } 10 \text{ kHz}$$

The square wave output from this oscillator is fed into the clock input (pin 14) of IC2 which is the ubiquitous 4017 - a 5-stage Johnson counter with ten decoded active 'high' outputs.

The remaining two NAND gates of IC5, c and d, are configured into an RS flip-flop (see Figure 5). When the priming button S2 is pressed a 'low' is produced on pin 8 of the IC. This causes pin 10 to go 'high'

and pin 11 to go 'low'. (Further depressions of S2 will have no further effect - this means that once The Bomb is primed no one can cheat by resetting it to the start of its timing cycle by pressing S2 as it is passed around). The 'high' produced on pin 10 stops the 4017 from counting as it is connected to the clock inhibit input of the IC (pin 13). In this way one of the 4017 outputs is selected to charge up C4 (a low leakage tantalum lead capacitor) via one of the resistors R15-R24. Diodes D1-D10 ensure that all the charging current goes into C4 and that some is not taken to ground via a parallel combination of the remaining nine unselected resistors. (Remember all but the selected output of the 4017 IC are at logic '0' which equals ground potential.)

This resistor-diode-capacitor network is connected to the timing pins of IC1 - another popular chip the 555 timer.

This IC is triggered by a falling edge waveform on pin 2 which is generated by the RS flip flop, R5 and C3. The resistor capacitor network ensures that a 'low-going' pulse is produced which resets 'high' (due to R5) despite the output of the flip flop remaining 'low'. If pin 2 of IC1 were continually 'low' then it would not function as desired.

The sequence of events thus far then is: IC2 counting and alarm sounding - S2 pressed - flip-flop activated - timer triggered - timing period selected (counter stops) - alarm stops.

Whilst IC1 is timing its output, pin 3 is 'high'. This is used to switch off the alarm circuit which comprises IC3 and IC4 (both 555 timers) with their associated components. The timing capacitor of IC4 (C5) is shorted to ground using TR2 as a switch (a 'high' on the base input = switch ON, low resistance; a 'low' on the base input = switch OFF, very high resistance).

When IC1 comes to the end of its period, pin 3 goes 'low' which resets the 'priming' flip-flop via C2 and R1, which generates a low going pulse on pin 13 of IC2.

The 'low' on IC1 pin 3 also switches TR2 off allowing the alarm to sound once more. Thus a complete cycle has been generated and The Bomb awaits re-priming via S2.

The alarm circuit itself comprises timer IC4 configured as an astable oscillator with a basic frequency:

$$1.46 f = (R9 + 2 R10) C5 700 \text{ Hz}$$

This frequency is modulated via TR1 at pin 5 by a ramp waveform generated at pins 2 and 6 of IC3. The sound is further enhanced by switching it on and off using the square wave produced at pin 3 of IC3 to turn TR2 on and off. TR2 thus serves a dual purpose - that of totally switching the alarm off and that of modulating the sound the alarm produces.

#### Construction

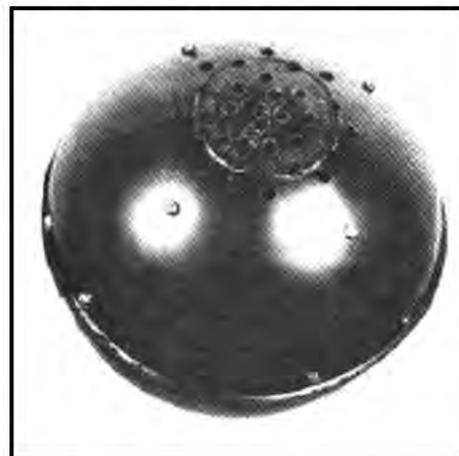
The printed circuit board with component overlay is shown in Figure 3. It is recommended that IC sockets be used at least for the CMOS chips IC2 and IC5 and if desired for the 555 timers.

Begin assembly by soldering the two wire links as shown and then insert the resistors followed by the capacitors. The diodes should be fitted next taking care to assemble them the correct way round as per the band on the casing. Now solder the transistors in place also taking care with their correct orientation. Next solder the battery connections ensuring that the polarity is correct. The two off board switches S1 and S2 and the loudspeaker may then be soldered allowing approximately 6 inch lengths of wire.

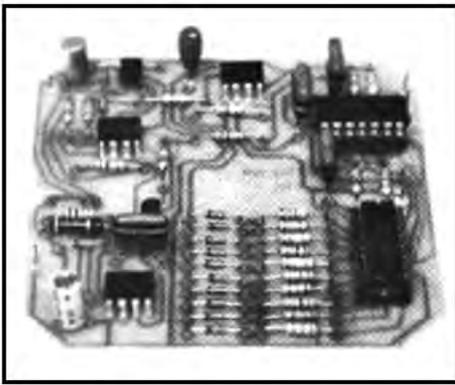
Before inserting the ICs into their holders connect the batteries up to the board and check that the correct power supply voltage is reaching the appropriate pins on each socket. Finally, disconnect the batteries and check for any solder bridges on the track side of the PCB. The ICs may now be inserted and the circuit tested.

Switch on and wait for the alarm to sound. Reset the circuit by depressing S2 and wait for the alarm to sound again. Do this a few times checking against your watch that a varying period of time elapses between S2 being pressed and the alarm sounding. If all is well you may then proceed to fit the unit into a case.

As may be noticed from the photographs the prototype was fitted into



Base view showing loudspeaker holes.



Assembled PCB of The Bomb.

a plastic lavatory cistern float which may be obtained from most ironmongers. A black one is ideal although another colour could be painted but is liable to scratching due to the excessive handling which the final device undergoes. Two basic types are available, the main difference being the position of the threaded section. This is either internal or external as shown in Figure 4, which also gives the internal layout of The Bomb. The construction is the same for both types except where stated.

If a float is used first cut the float in half along the 'equator' as shown in Figure 4 keeping the screw thread entry point as the 'North Pole'. This cutting operation can be difficult. The best method is to drill a few small diameter holes e.g. 1 mm close together along the seam and then enlarge these laterally into a slit into which a pad saw (keyhole saw) fitted with a fine toothed blade may be inserted. Proceed to saw carefully around the float.

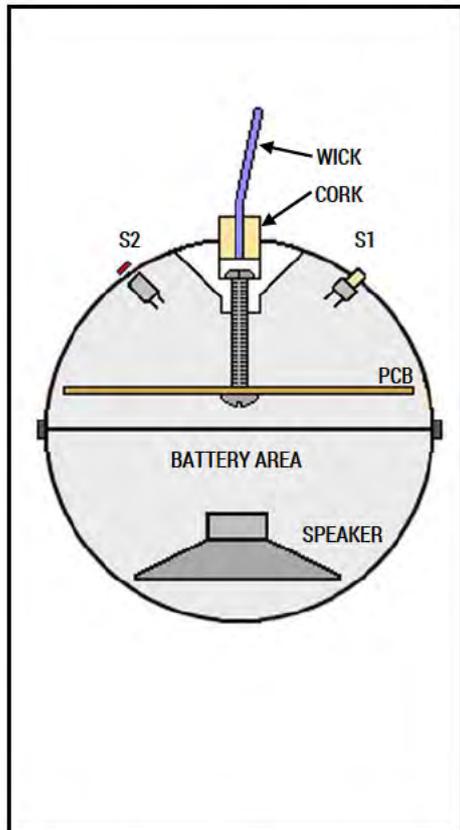


Figure 4. Internal layout of The Bomb.

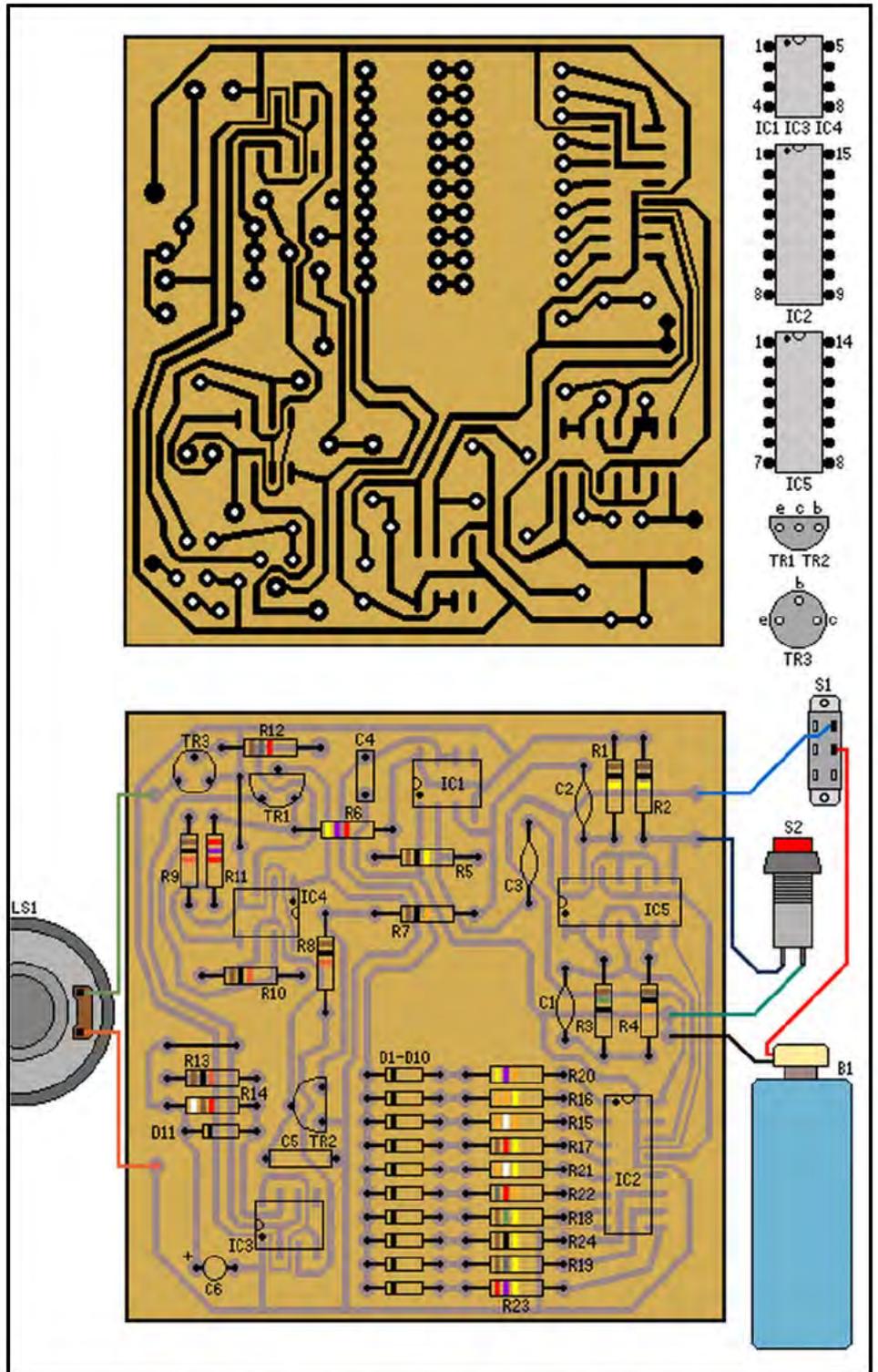


Figure 3. PCB track layout, component overlay and wiring.

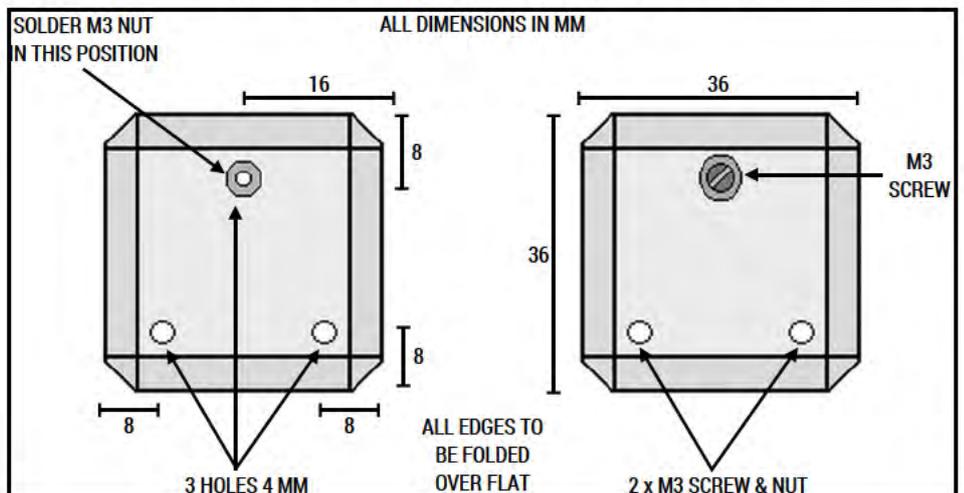
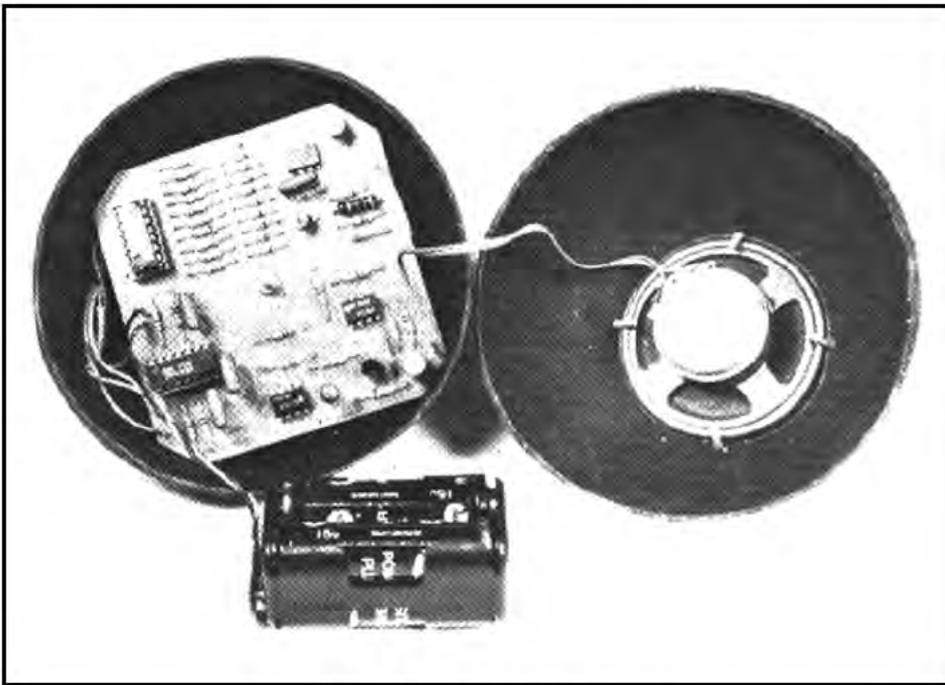


Figure 5. Mounting bracket template.



Internal view of upper and lower hemispheres.

## PARTS LIST FOR THE BOMB

### Resistors - all ¼ watt 5% carbon unless specified

R1, R2, R5, R24	100K	Brown Black Yellow (4 off)
R3	1M 10%	Brown Black Green
R4, R7, R8, R9		
R10, R13	10K	Brown Black Orange (6 off)
R6	4K7	Yellow Violet Red
R11	2K7	Red Violet Red
R12	1K8	Brown Grey Red
R14	9K1 ½ watt	White Brown Red
R15	39K	Orange White Orange
R16	330K	Orange Orange Yellow
R17	120K	Brown Red Yellow
R18	150K	Brown Green Yellow
R19	180K	Brown Grey Yellow
R20	47K	Yellow Violet Orange
R21	390K	Orange White Yellow
R22	82K	Grey Red Orange
R23	270K	Red Violet Yellow

### Capacitors

C1, C5	10nF Polyester (2 Off)
C2, C3	100nF Polyester (2 off)
C4	47µF 10V Tantalum Bead
C6	22µF 16V PC Electrolytic

### Semiconductors

D1 - D11	1N4148 (11 off)
TR1	BC214L
TR2	BC184L
TR3	AC126
IC1, IC3, IC4	NE555 (3 off)
IC2	4017BE
IC5	4011BE

### Miscellaneous

LS1	8 ohm 0.2 watt miniature loudspeaker
S1	Single pole sub-miniature slide switch
S2	Push switch
	14-pin DIL Socket
	16-pin DIL Socket
	Bolts 6BA ½ inch (9 off)
	Nuts 6BA (9 off)
	Bolts 8BA ½ inch (6 off)
	Nuts 6BA (2 off)
	Case
	6 volt Battery

Having obtained the two halves, take the one with the screw thread and drill a 1/8 inch diameter hole through the screw thread entry point as shown. The 2 inch M3 bolt is inserted into the hemisphere which is used to secure the PCB. In order to get the PCB to fit into the hemisphere it will be necessary to pare off the corners along the lines shown on the component overlay Figure 3.

Now take the other hemisphere and drill the 8BA mounting holes for the loudspeaker and also a pattern of holes which allow the sound out.

In order to join the two hemispheres together whilst still retaining access to change the batteries, occasionally it will be necessary to cut out three pieces of thin tin-plate according to the template in Figure 5 from, for example, a can of beans - washed first unless you want a stink Bomb! This is a delicate operation if injury is to be avoided and if some young constructors are contemplating building The Bomb it is advisable here to ask an adult to do this stage for you. Having cut these out each one should be drilled with three 4 mm diameter holes and a M3 nut should be soldered on to the reverse side of hole A in each case (also shown in Figure 5). If the nuts are plated it will be necessary to remove plating prior to soldering.

These three pieces of tinfoil are placed along the rim of the low hemisphere at 120° intervals and are secured in place with two 6BA nuts and bolts passing through holes 'B' and 'C' in each case.

Holes are now drilled in the upper hemisphere in order to correspond with hole 'A' in each of the three tinfoil pieces. The upper and lower hemispheres may now be joined together by passing three 6BA bolts through the plastic of the top hemisphere and screwing them into the nuts on the reverse side of hole 'A' in each piece of tinfoil.

Switches S1 and S2 are secured in place in the top hemisphere in the positions shown in Figure 4. Holes will, of course, have to be cut to accommodate these.

The final touch is added to the design by incorporating a mock 'fuse' which is a short length of white shoelace. If a float with an external threaded section is used this can simply be glued in place. However, for a float with an internal threaded section the hole should be drilled out so that a cork, with the shoelace located through the centre, can be inserted.

All the parts of the unit may now be assembled into the two hemispheres. The batteries sit on top of the loudspeaker as shown in the photographs. Ensure that the circuit board mounting bolt is inserted into the top hemisphere before the mock 'fuse' is glued into place.

# CAR BATTERY MONITOR

by Robert Penfold

\* Check your battery condition instantly

This circuit, in common with the other five in the series which are featured in this issue, uses a multicolour LED. These are a fairly new development and will probably be unfamiliar to most readers, but they are basically little more than a red LED and a green LED in a single encapsulation. The type used in this series of projects have a common cathode connection and separate anode lead out wires, as can be seen from the lead out diagram of Figure 1. The light output of the component is viewed via a diffuser so that with both the red and green sections operating at once the two colours mix and a yellow output is obtained (or orange if the red light level is stronger than the green one). By operating just one

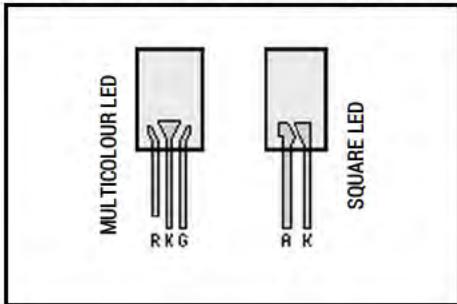


Figure 1. Multicolour LED lead outs.

section a red or green output can be obtained, and these LED's are therefore capable of producing three colours.

This first project is a battery state indicator for use with 9 volt battery operated equipment, although it can easily be modified for use with a 12 volt car battery if preferred. If the battery is reasonably fresh and has a potential of about 8.2 volts or more the LED gives a green indication. If the battery is nearing exhaustion but is still usable, and has a potential of between about 7.5 and 8.2 volts a yellow indication is produced by the LED. A battery voltage of between about 5 volts and 7.5 volts produces a red light from the LED and indicates that the battery is overdue for replacement. Below about 5 volts the battery is inadequate to operate the device and the LED will fail to light at all!

## The Circuit

Figure 2 shows the circuit diagram of the Battery Monitor, and this is based on

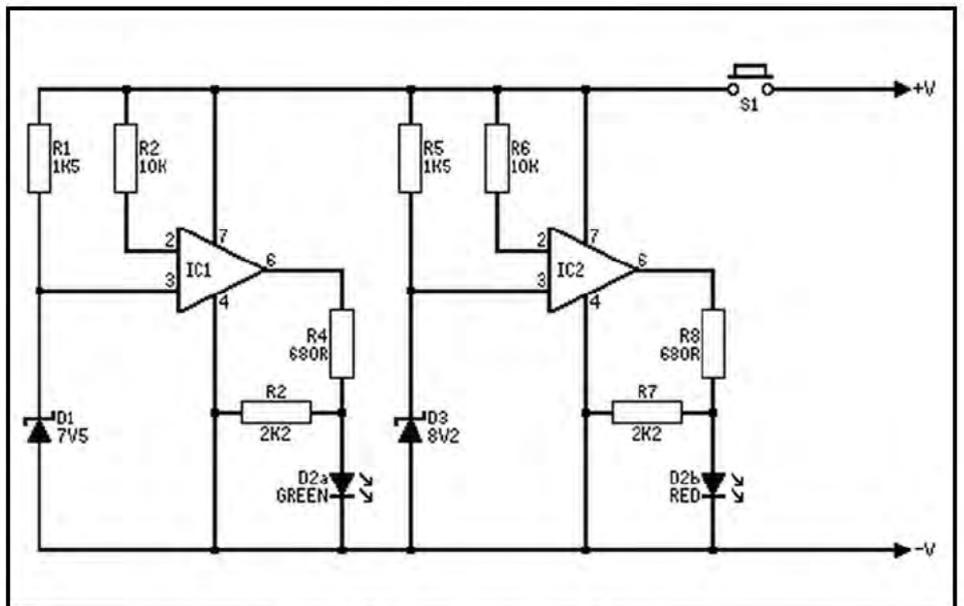
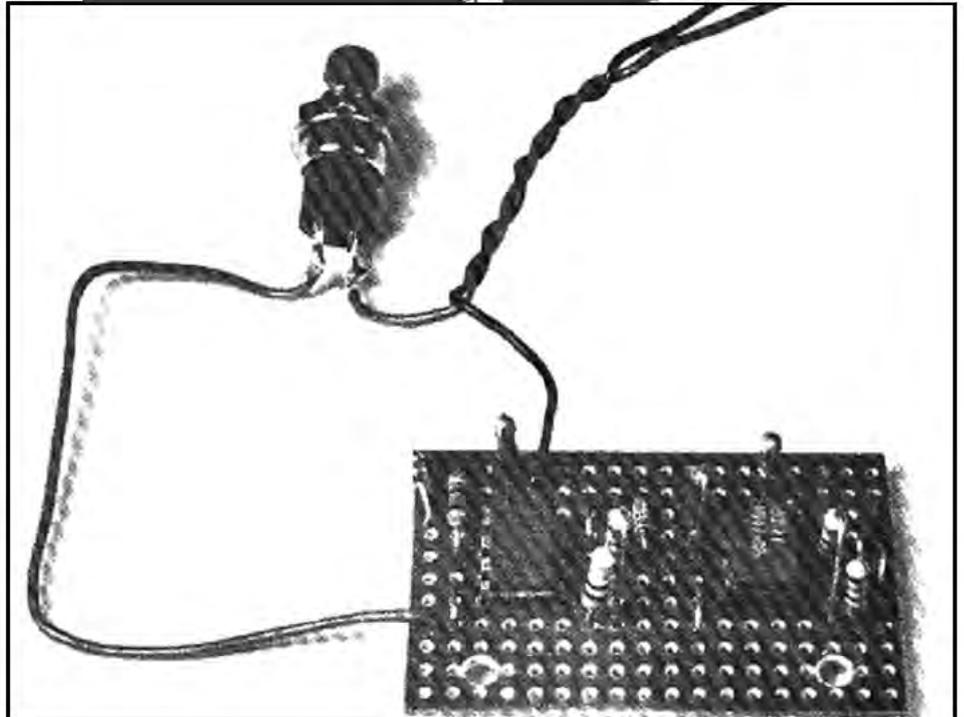


Figure 2. Battery monitor circuit diagram.

two 741C operational amplifiers which are used as voltage comparators in this application.

The green section of LED indicator D2 must switch on only if the supply voltage is above 7.5 volts since it should be off for voltages below this level when the red section alone must be switched on. D2a is

driven from the output of IC1 by way of R4 and will be switched on when IC1's output goes high. The inverting input of IC1 is held at 7.5 volts by the zener stabiliser circuit which consists of R1 and D1, and the non-inverting input is taken to virtually the positive supply voltage due to the coupling through R2. Thus, assuming the supply

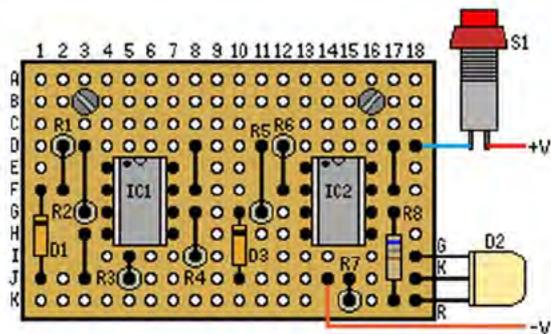
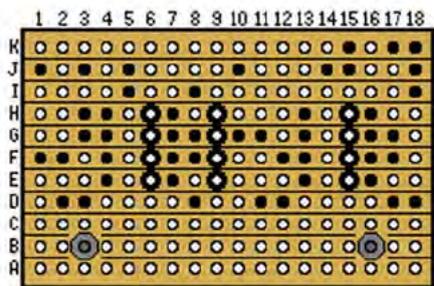


Figure 3. Veroboard layout for the battery monitor.

voltage is more than 7.5 volts, IC1's non-inverting input will beat a higher voltage than the inverting input so the output goes high and switches on D2a. If the supply potential falls below about 7.5 volts D1 no longer conducts significantly and has no effect on the circuit. As the voltage drop through R1 is less than that through R2, due to the higher value of the latter, the inverting input is at the high voltage. This results in the output going low and D2a switching off. R2 ensures that the voltage fed to D2a with IC1's output in the low state is not sufficient to cause D2a to operate at low brightness, which it might otherwise do.

It is necessary for the red section of D2 to switch off if the supply voltage is over about 8.2 volts, as only the green section is then needed. This is achieved using a circuit which is virtually the same as that used to control the green section of D2. Zener diode D3 has an operating voltage of 8.2 volts rather than 7.5 volts so that the threshold voltage of this section of the circuit is set at the required level. Also, the inputs of IC2 have the opposite method of connection to those of IC1 so that with the supply voltage above the 8.2 volt threshold level the inverting input is the one at the higher voltage. The output therefore goes low and D2b is switched off. If the supply potential falls below 8.2 volts the input states are reversed, IC2's output goes high, and D2b is switched on.

The circuit has a current consumption of around 10 mA which could result in a serious reduction in battery life if it were to be left operating all the time the main equipment was switched on. It is therefore connected to the supply lines via push button switch S1, and this is briefly operated in order to test the battery's condition. This method gives a negligible increase in the battery drain.

**Construction**

Like all six projects in this series, the Battery Monitor is constructed on a 0.1 inch matrix Veroboard, and in this case a board measuring 11 copper strips by 18 holes is required. Cut out a board of this size using a hacksaw and then file the sawn edges to a neat finish. Next drill the two 3.3 mm

diameter mounting holes (which accept M3 or 6BA fixings) and make the twelve breaks in the copper strips at the points indicated in the layout diagram which is shown in Figure 3. There is a special tool available for making the breaks in the strips, but they can also be made using a modelling knife or a small twist drill.

Next solder the components and link wires into place, leaving the two integrated circuits and LED until last. The link wires are made from 22 swg tinned copper wire, and these can simply consist of pieces of wire trimmed from the component lead out wires.

Ideally the unit should be built into the main piece of equipment, and this will

probably not be difficult in many instances. However, it can be built as a separate unit if necessary, and connected to the main unit via a twin insulated lead.

If the unit is required as a car battery monitor it is merely necessary to change D1 to a 10 volt component (a BZY88C10V) and D3 to a 12 volt component (a BZY88C12V). The LED will then be red for supply voltages below about 10 volts, yellow for voltages between approximately 10 and 12 volts, and green for supply potentials in excess of about 12 volts. S1 is not essential if the unit is used as a car battery monitor since the current drain of the circuit is insignificant when compared to the high charge capacity of a car battery.

**PARTS LIST FOR THE BATTERY MONITOR**

**Resistors - all ¼ watt 5% carbon**

- R1, R5                    1K5 Brown Green Red (2 off)
- R2, R6                    10K Brown Black Orange (2 off)
- R3, R7                    2K2 Red Red Red (2 off)
- R4, R8                    680R Blue Grey Brown (2 off)

**Semiconductors**

- IC1, IC2                   741C (8-pin DIL) (2 off)
- D1                         BZY88C7V5
- D2                         Two Colour LED
- D3                         BZY88C8V2

**Miscellaneous**

- S1                         Push to make non locking switch
- Veroboard 11 strips x 18 holes
- Interconnecting Wire

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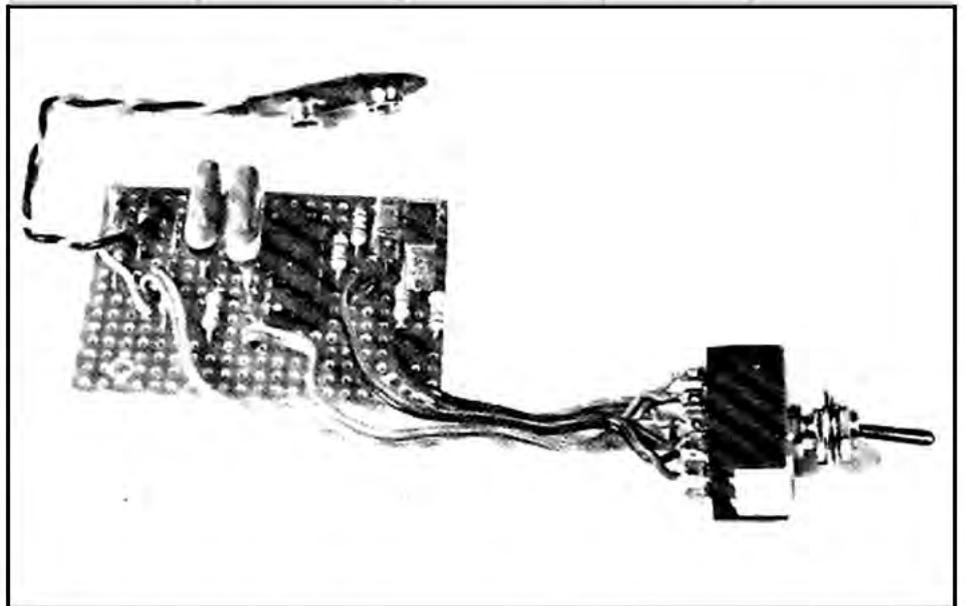
# COLOUR SNAP GAME

by Robert Penfold

\* **Novel variation on this familiar card game**

This electronic game is in essence the same as the popular card game of "snap", but rather than cards there are two LED indicators which flash through their four possible states (red, green, yellow and off) at a fairly fast rate, but not so fast as to make it difficult to see this action clearly. The two indicators are controlled by separate circuits and do not flash in unison. There is a switch which "freezes" the action if it is operated, and the purpose of the game is simply to operate the switch when both LED's are in the same state. If the competitor is successful this will be indicated by both LED's being in the same state when flashing action ceases. It does not matter which particular state this happens to be; it just needs to be the same for each LED.

It may sound very easy to accomplish this, but it should be borne in mind that it can take a short while before a "snap" occurs, and there is no way of knowing what state the LED's will be in when a "snap" does occur. Also, at most the LED's will only remain in the same state for a fraction of a second. To be successful at this game you therefore require both good concentration and quick reactions. The



game can simply be played one round at a time, or, for example, the object of the game could be made to score ten "snaps" in as few attempts as possible.

**The Circuit**

Figure 1 shows the circuit diagram of the game, and this is based on a 40106BE device which is a CMOS hex

Schmitt trigger. The Schmitt triggers are inverting types with built-in hysteresis. Thus, if the input starts at zero volts and is gradually taken higher in voltage, at a certain input voltage the output will trigger from the high state (virtually the positive supply potential) to the low state (little more than the negative supply voltage). The input

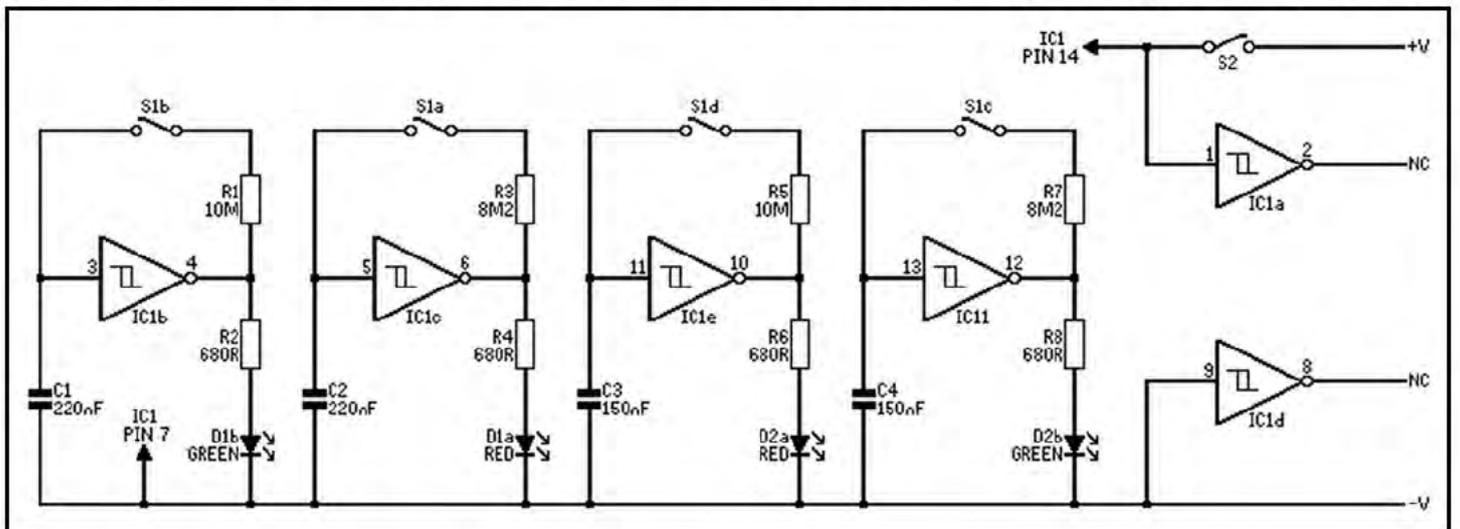


Figure 1. Circuit of the colour snap game.

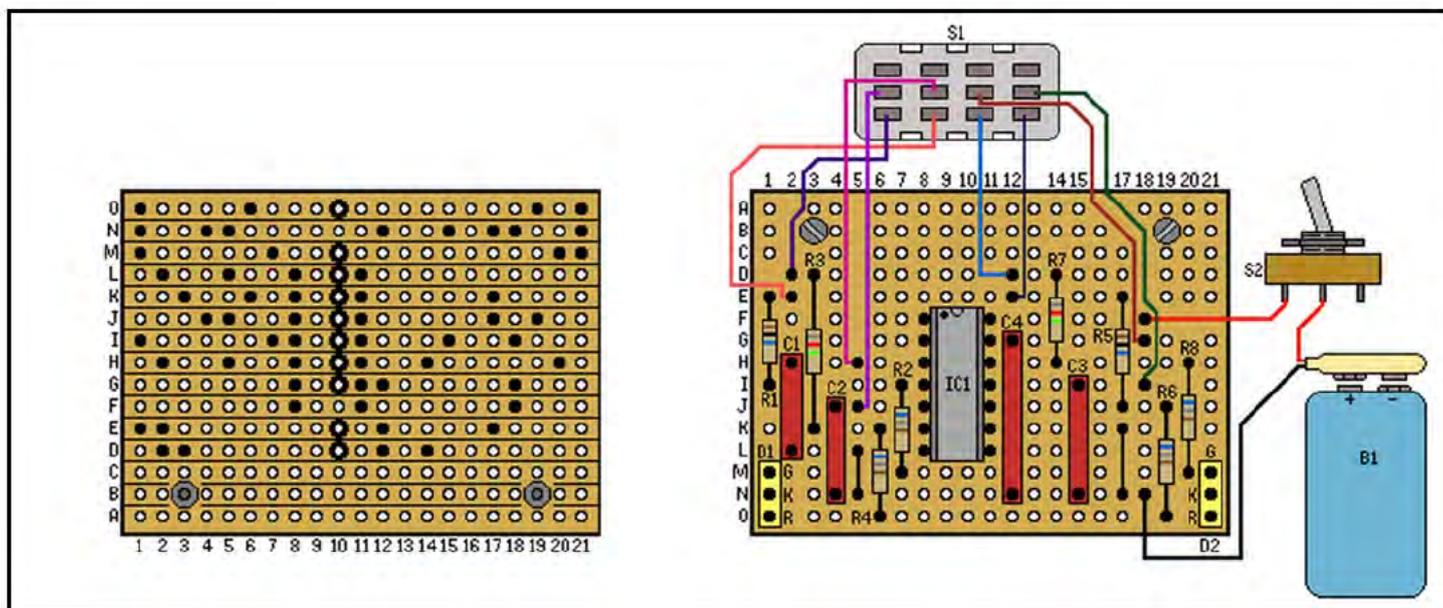


Figure 2. Veroboard layout for the snap game.

voltage must then be reduced quite substantially in order to trigger the output back to the high state again. The hysteresis is incorporated in Schmitt triggers to prevent instability, but paradoxically it enables an inverting Schmitt trigger to be used in the very simple oscillator configuration which is employed here.

Four oscillators are used, one to drive each LED section, and all four oscillators use the same configuration. Each oscillator operates at a different frequency so that each LED runs through its four states in a pseudo random fashion. It is not a true random sequence since the pair of oscillators driving each LED will eventually arrive simultaneously back in their original states and the sequence will then be repeated. This is not likely to be apparent to an observer though, since the sequence of each LED is quite long.

Each oscillator requires just two components apart from the Schmitt trigger; a resistor connected between the input and output, and a capacitor connected from the input to the negative supply rail. At switch-on the capacitor charges from the output of the Schmitt trigger via the resistor until the output switches to the low state. The capacitor then discharges through the resistor and the output of the Schmitt trigger until the output switches back to the high state again. The capacitor then starts to charge up again, and continuous oscillation is produced. Each oscillator drives a separate LED section via a current limiting resistor (R2, R4, R6 and R8).

Two of the Schmitt triggers are not needed and the inputs of these are tied to one of the supply rails in order to prevent spurious operation and

possible damage to IC1. Apart from this the unused triggers are ignored.

The display is "frozen" by opening S1 so that the charge and discharge paths of the capacitors are broken, and the charges on the capacitors hold the triggers in whatever state they happened to be in at the instant S1 opened. As a CMOS IC has been used the input impedance of each Schmitt trigger is extremely high, and the charges on the capacitors leak away at a rate which is too slow to be of consequence. In order to set the unit operating again it is merely necessary to close S2.

### Construction

A Veroboard having 21 holes by 15 copper strips accommodates most of the components, and the component layout plus the positions of the ten breaks in the copper strips are shown in Figure 2. This also shows the wiring to the off board components. As IC1 is a CMOS device it requires the usual MOS handling precautions if the danger of damage by static charges is to be eliminated. Connect this component last of all and leave it in its protective packaging until then. Handle it as little as possible, and either solder it in place using an iron having an earthed bit or use an IC socket.

If desired, the game can be made a little less difficult by using capacitors having slightly higher values than the specified components. On the other hand, if the game seems to be too easy after it has been in use for some time, slightly reducing the values of the capacitors will increase the difficulty factor of the game.

### PARTS LIST FOR THE COLOUR SNAP GAME

#### Resistors - all ¼ watt

R1, R5	10M 10% (2 off) Brown Black Blue
R2, R4, R6, R8	680R 5% (4 off) Blue Grey Brown
R3, R7	8M2 10% (2 off) Grey Red Green

#### Capacitors

C1, C2	220nF Carbonate (2 off)
C3, C4	150nF Polyester (2 off)

#### Semiconductors

IC1	40106BE
D1, D2	Two colour LED (2 off)

#### Miscellaneous

S1	4-pole miniature toggle switch
S2	SPST miniature toggle switch
	Case
	Veroboard 21 holes x 15 strips
B1	PP3 battery and connector

# CMOS LOGIC PROBE

by Robert Penfold

\* Build this practical, low cost test instrument.

CMOS logic integrated circuits are extremely versatile devices which are used a great deal in modern electronic circuits. Like any logic circuits, those which employ CMOS devices can be difficult to test using an ordinary multimeter as both static and pulsing voltages are involved. A voltage reading of half the supply potential could be a static voltage and indicative of a fault, or it could be produced by a high frequency square wave signal giving an average voltage of half the supply voltage with no fault present in this part of the circuit.

Ideally an oscilloscope should be used for testing this type of equipment, but where this is not possible for some reason a logic probe makes an excellent alternative. This simple logic probe is intended for use with CMOS logic circuits, is powered from the circuit under investigation, and has a current consumption of only around 0 to 20 mA (depending on the supply voltage and logic state indicated by the probe). The logic state detected by the unit is indicated by a two LED display: one of the display LED's is a multicolour type and the other is an ordinary green type. The following table shows the display obtained from various input signal conditions.

Input state	D1	D2
Low	Green	Off
High	Red	Off
Intermediate	Yellow	Off
Pulsing fast	Yellow	On
Pulsing slowly	Red/Green	Slowly Pulsing

When the input is pulsing at high speed it is possible that D1 will be red or green instead of yellow, and this simply indicates that the mark-space-ratio of the input signal is far from

being one-to-one. D1 will be red if the input is high for the majority of the time, or green if it is predominantly low. If the input is pulsing slowly, unless the pulses are extremely brief, D1 will be seen to switch from red to green and so on in sympathy with the input signal.

## The Circuit

Separate stages are used to drive the two indicator LED's, a dual operational amplifier being used to drive D1 and a 555 monostable driving D2. Figure 1 shows the circuit diagram of the CMOS Logic Probe.

Both sections of IC1 are used as voltage comparators rather than

operational amplifiers, and these each have one input connected to a reference voltage and the other taken to the input of the probe. The unit must indicate a high input state if the input voltage is more than about 70% of the supply voltage, and a low input state if the input is at less than about 30% of the supply potential. R3 to R5 form a potential divider which gives reference voltages of approximately 30% and 70% of the supply voltage.

If the input is low, IC1a's non inverting input will be at a higher potential than the inverting input so that the output goes high and switches on D1b. IC1b has the opposite input states so that its output

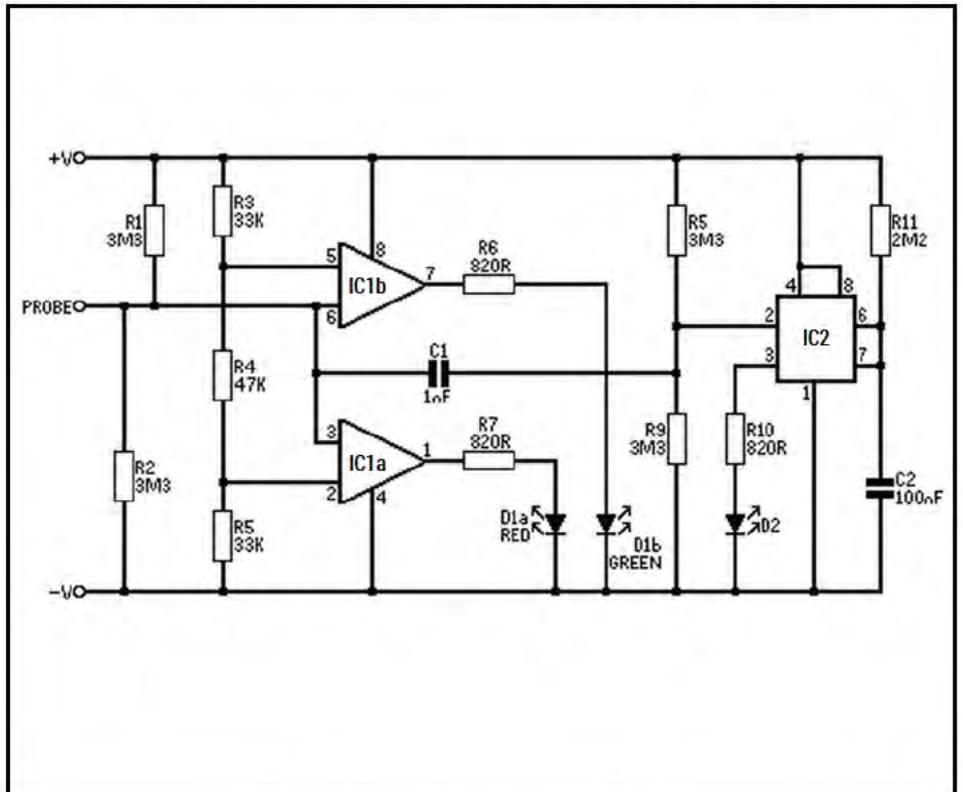


Figure 1. Circuit of the CMOS Logic Probe.

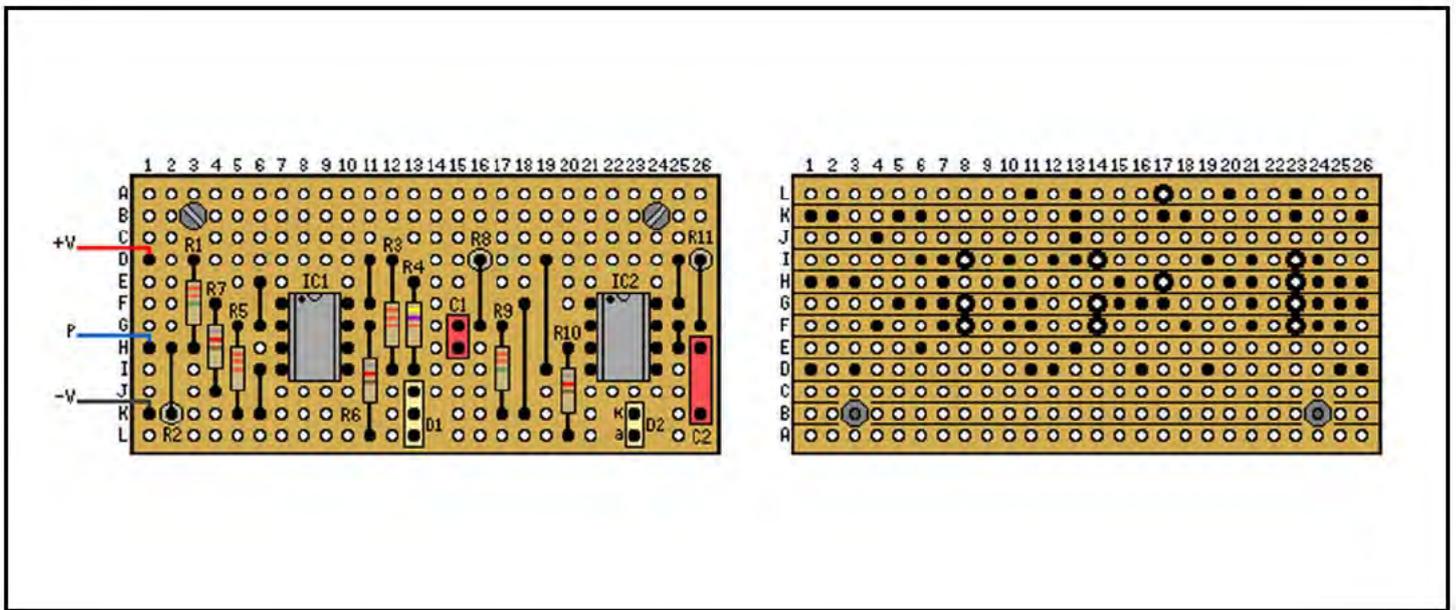


Figure 2. Veroboard layout for the CMOS Logic Probe.

goes low and D1a is switched off. This gives a green indication from D1. With the input in the high state IC1a's inverting input is taken to a higher voltage than the non inverting input, causing the output to go low and switch off D1b. IC1b's non inverting input will now be at a higher voltage than the inverting input, causing IC1b's output to go high and switch on D1a so that a red indication is obtained from D1.

If the input is between the two logic states the outputs of the two comparators will both assume the high state so that the red and green sections of D1 switch on to produce a yellow display. R1 and R2 bias the input between the two logic levels so that the unit will indicate a fault condition (with D1 in the yellow state)

if the input is taken to an open circuit test point.

This section of the circuit does not enable the user to differentiate between a static level between the two logic states and a high frequency pulse signal, since the latter will cause both sections of D1 to switch on in turn and give the impression of a yellow display due to the switching action being too fast to be seen. This is overcome by applying the input signal to the trigger

input of a 555 monostable. Normally R8 and R9 hold the input of IC2 above the trigger threshold, but if there is a pulsing input signal it will be coupled to the input of IC2 by C1 and on negative transitions IC2 will be activated. LED indicator D2 is then switched on for about 0.25 seconds

each time IC2 is triggered, but with a high frequency input signal the circuit will be retriggered almost as soon as each output pulse ceases, and D2 will appear to light continuously. C1 blocks steady state inputs so that IC2 is not triggered, except possibly for a single triggering when the input is taken to a new logic state, with a consequent brief flash from D2.

### Construction

The Veroboard layout for the CMOS Logic Probe is shown in Figure 2 and this is based on a board having 12 copper strips by 26 holes. Construction of the board is quite straightforward apart from the fact that IC1 is a MOS device, and the normal MOS handling precautions must be taken with this device. IC2 is a CMOS device but due to its internal protection circuitry it does not require any handling precautions.

In use the unit will probably be most convenient if it is fitted in a small case that can be comfortably hand-held. The probe tip, which can simply consist of a long M3 bolt, is fitted at the front end of the case and the two display LEDs are mounted off-board at the rear end of the case. The case is drilled to take the two supply leads, and these are about half a metre long and terminated in crocodile clips to permit easy connection to the circuit under test. The crocodile clips are different colours (red for the positive lead and black for the negative one) so that the two leads are easily identified.

### PARTS LIST FOR THE CMOS LOGIC PROBE

#### Resistors - all ¼ watt except where specified

R1, R2, R8, R9	3M3 10%	(4 off)	Orange Orange Green
R3, R5	33K	(2 off)	Orange Orange Orange
R4	47K		Yellow Violet Orange
R6, R7, R10	820R	(3 off)	Grey Red Brown
R11	2M2 10%		Red Red Green

#### Capacitors

C1	1nF Ceramic plate
C2	100nF Polyester

#### Semiconductors

IC1	CA3240E
IC2	ICM7555
D1	2 colour LED Common cathode
D2	LED Green Rectangular

#### Miscellaneous

Small case
Veroboard 26 holes x 12 strips
Pair of crocodile clips

# PEAK LEVEL INDICATOR

by Robert Penfold

- \* Instantaneous detection of signal overload.

The shortcomings of average reading VU meters are well known, and the most important of these is their inability to respond properly to signals having a high peak but low average level, so that a low reading is obtained and overloading often occurs in consequence. In order to avoid this it is common for VU meters of the average reading type to be backed-up by a peak level indicator, and this is usually in the form of a LED indicator which flashes on if the peak signal level exceeds some predetermined level.

This simple peak level indicator circuit can be used in conjunction with an average reading VU meter which does not already have the back-up of a peak reading device of some kind, or it could be used in situations where the cost of a VU meter is not justified. It has a multicolour LED indicator which is green for levels below 0 dB, yellow for levels between 0 dB and +6 dB, and red for levels over +6 dB. The circuit has fast attack and slow decay times, like professional peak reading meters.

## The Circuit

Figure 1 shows the complete circuit diagram of the Peak Level Indicator, and the unit breaks down into three main sections; a preamplifier, a smoothing and rectifier circuit, and the display driver circuit.

The display driver circuit is based on IC1 and is very similar to part of the CMOS Logic Probe circuit which is described elsewhere in this issue. It will not, therefore, be described in detail here. The two circuits differ only in that this one requires stabilised reference voltages so that variations in the supply voltage do not affect the calibration of the unit. R5 and D3 are therefore used to stabilise the voltage fed to the potential divider chain (R6 to R8) which provides the two reference voltages. R6 is merely included to reduce the

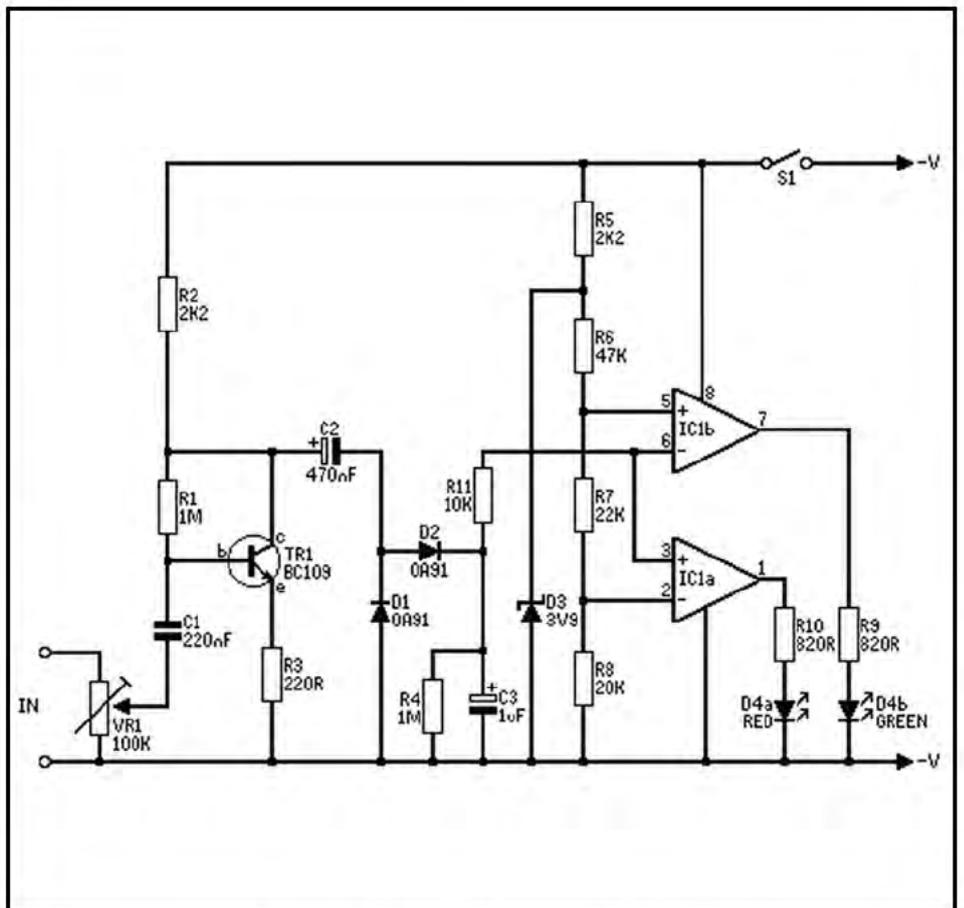
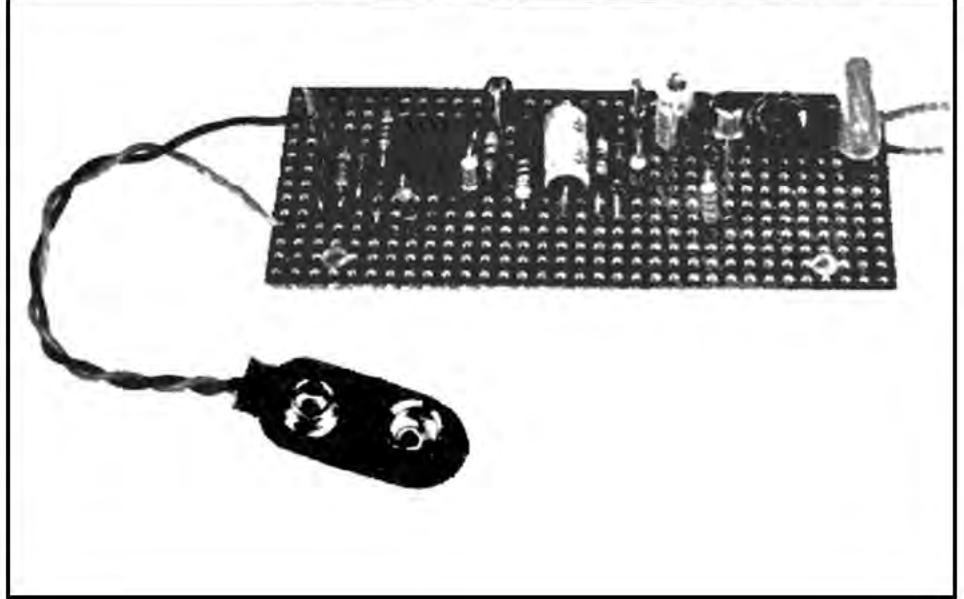
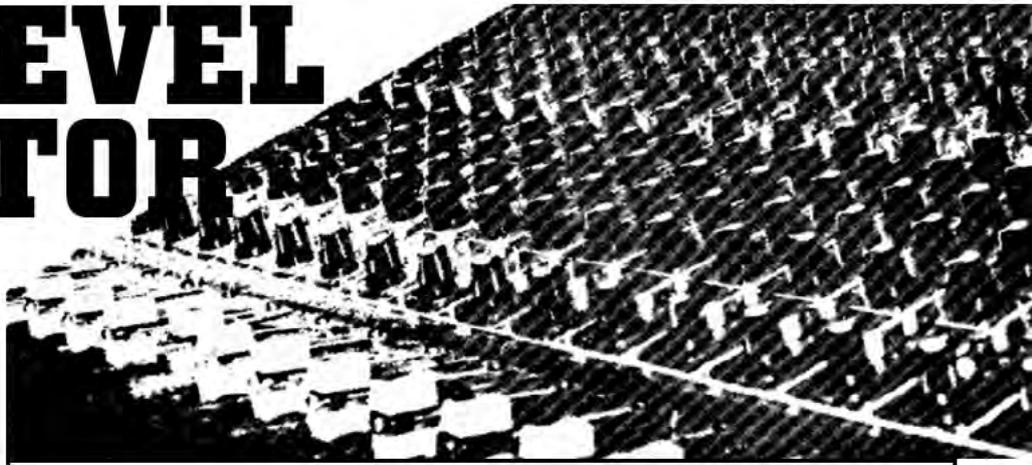


Figure 1. Circuit of the Peak Level Indicator.

reference voltages and thus increase the sensitivity of the circuit.

The input signal could be applied direct to the input of the driver circuit, but this would give low sensitivity, and the rapidly fluctuating input level would give unclear results from the LED indicator as it rapidly switched through its various colours. TR1 is therefore used as a common emitter amplifier having a voltage gain of about ten times (20 dB) to boost the sensitivity of the circuit. VR1 is a preset input attenuator which is used to set the sensitivity of the unit at the correct level. At maximum sensitivity only about 100 mV RMS is needed at the input to drive D4 to the red state, and this should be more than sufficient for any normal application of the unit. The input impedance of the unit is quite high at about 50 to 100 kilohms (depending on the setting of VR1) and it should not have any detrimental effect on the main equipment. Due to the use of a substantial amount of negative feedback over TR1 it does not require a stabilised supply as its voltage gain is largely unaffected by variations in the supply voltage.

C2 couples the output from TR1 to a conventional rectifier and smoothing circuit which consists of D1, D2, R4 and C3. This circuit has a fast attack time so that the circuit responds properly to transients, but a slow decay time so that the display reverts to green slowly and unambiguous results are obtained. The rectifier circuit introduces a degree of non-linearity between the input signal level and the DC voltage fed to the display driver, but the two reference voltages in the display driver circuit

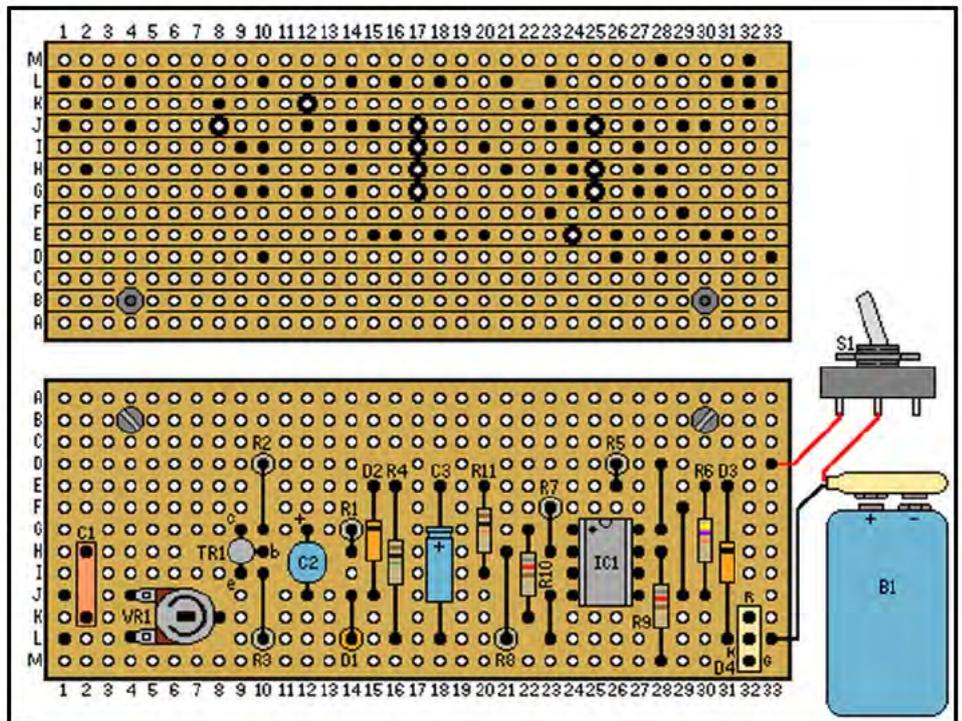


Figure 2. Veroboard layout for the Peak Level Indicator.

compensate for this and ensure good accuracy.

### Construction

The Veroboard layout for the Peak Level Indicator is shown in Figure 2 and requires a board having 33 holes by 13 strips. IC1 is a MOS device and the normal MOS handling precautions should be taken when dealing with this device. Note also that D1 and D2 are germanium devices which are more susceptible to damage by heat than silicon types. Take care not to overheat these two components when soldering them into place.

The unit can either be built as a self contained device with its own on/off

switch and battery supply, or it might be possible to fit it into the main piece of equipment (although this should only be tried by those with sufficient experience to tackle the job confidently). If the indicator is built as a self contained unit the input leads should be taken to a two way audio connector mounted on the front panel. The input signal is then coupled to this socket via a suitable screened lead. The unit can be powered by a PP3 size battery, but as the current consumption is about 10 to 20 mA it would be better to use a larger type such as a PP7 or PP9 if the unit is to receive a great deal of use as this would give lower running costs.

If the unit is built into the main item of equipment it will probably be possible to power it from the supply of this equipment. A supply potential of around 9 to 12 volts is required. The point from which the input signal is obtained will obviously depend on the precise nature of the equipment with which the indicator is used, but if it is used with equipment having a VU meter it will probably be possible to obtain a suitable signal from the meter's terminals.

Calibrate the unit by first adjusting VR1 fully clockwise, and then applying a steady input signal to the main equipment and adjusting the controls to give a 0 dB signal level. VR1 is then adjusted just far enough in an anticlockwise direction to cause D4 to switch from green to yellow.

### PARTS LIST FOR THE PEAK LEVEL INDICATOR

<b>Resistors</b> - all ¼ watt 5% except where specified			
R1, R4	1M	Brown Black Green	(2 off)
R2, R5	2K2	Red Red Red	(2 off)
R3	220R	Red Red Brown	
R6	47K	Yellow Violet Orange	
R7	22K	Red Red Orange	
R8	20K ½ watt 5%	Red Black Orange	
R9, R10	820R	Grey Red Brown	(2 off)
R11	10K	Brown Black Orange	
VR1	100K 0.1W	Horizontal preset	
<b>Capacitors</b>			
C1	220nF	Polyester	
C2	470nF	50V PC Electrolytic	
C3	1µF	63V Electrolytic	
<b>Semiconductors</b>			
D1, D2	OA91		
D3	BZY88C3V9		
D4	Multicolour	LED	
<b>Miscellaneous</b>			
S1	s.p.s.t. miniature toggle switch		
	Case		
	Veroboard 33 holes x 13 strips		
B1	PP3 battery and connector		

# GAMES TIMER

by Robert Penfold

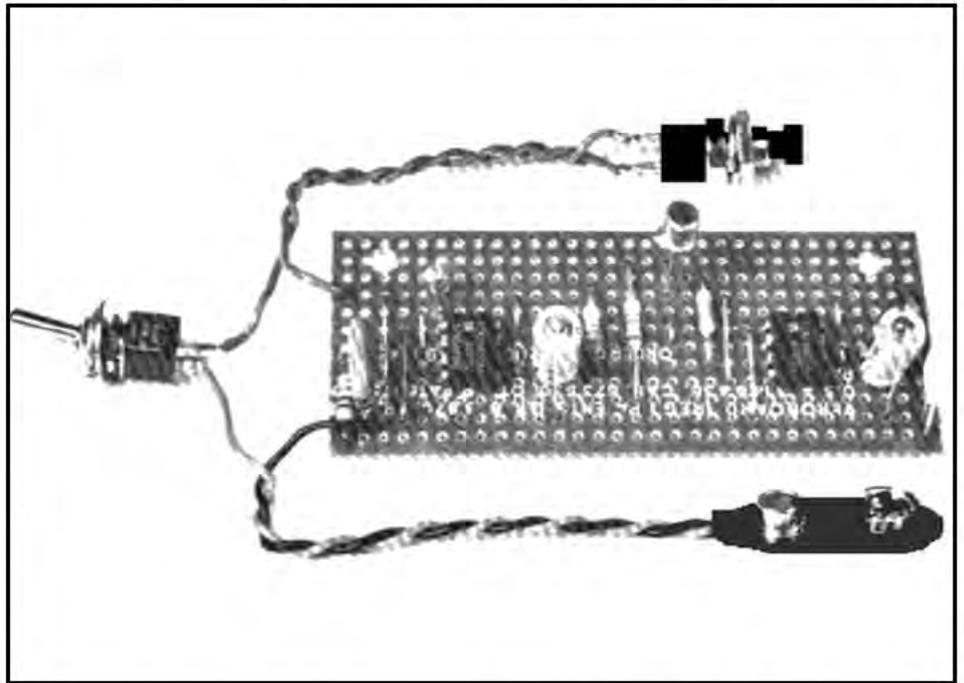
\* Make your board games more exciting with this easy-to-build timing device

There are a number of games where the players make their moves in turn, and progress can be rather slow and tedious if no limit is set on the time available for each move. Chess, Scrabble, and Draughts are three examples of popular games which fall into this category. Imposing a time limit on moves in games of this type can make them much more interesting and exciting with the more skilful player still ultimately winning and the outcome of the game being unaffected.

This simple games timer has a three colour LED indicator which is green at switch-on, and remains in this state for about 15 seconds. After this time it changes to orange to indicate that the available time is running out, and after about a further 10 seconds it changes to red to indicate that the allotted time has run out. If the display reaches the red state either the player must make his or her move immediately or some form of penalty (such as a missed move) must be imposed, as preferred. Once the player has made his or her move, or the display has reached the red state, the timer is reset by momentarily operating a push button switch.

## The Circuit

The circuit is based on two 555 timer devices, one being used to drive each section of the LED indicator. Both are used in the monostable mode. The ICM7555 (CMOS) version of the 555 is employed in this design because this gives a reduction in current consumption of about 16 mA when compared to the standard device, and enables a small 9 volt battery to be used as an economic



power source for the unit. The circuit diagram of the Games Timer is shown in Figure 1.

IC1 is used to drive the green section of LED indicator D1, and at switch-on this must immediately switch on its section of the LED and

keep it switched on for a period of about 25 seconds. R1 and C1 are used to generate a negative trigger pulse when power is initially connected to the circuit so that a positive output pulse is immediately produced from the output at pin 3 of

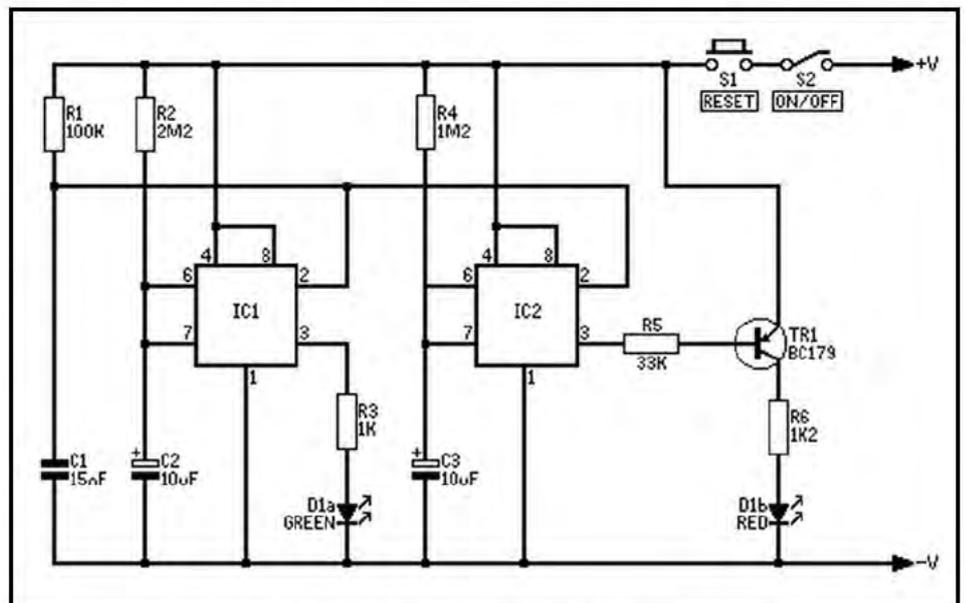


Figure 1. Games Timer circuit diagram.

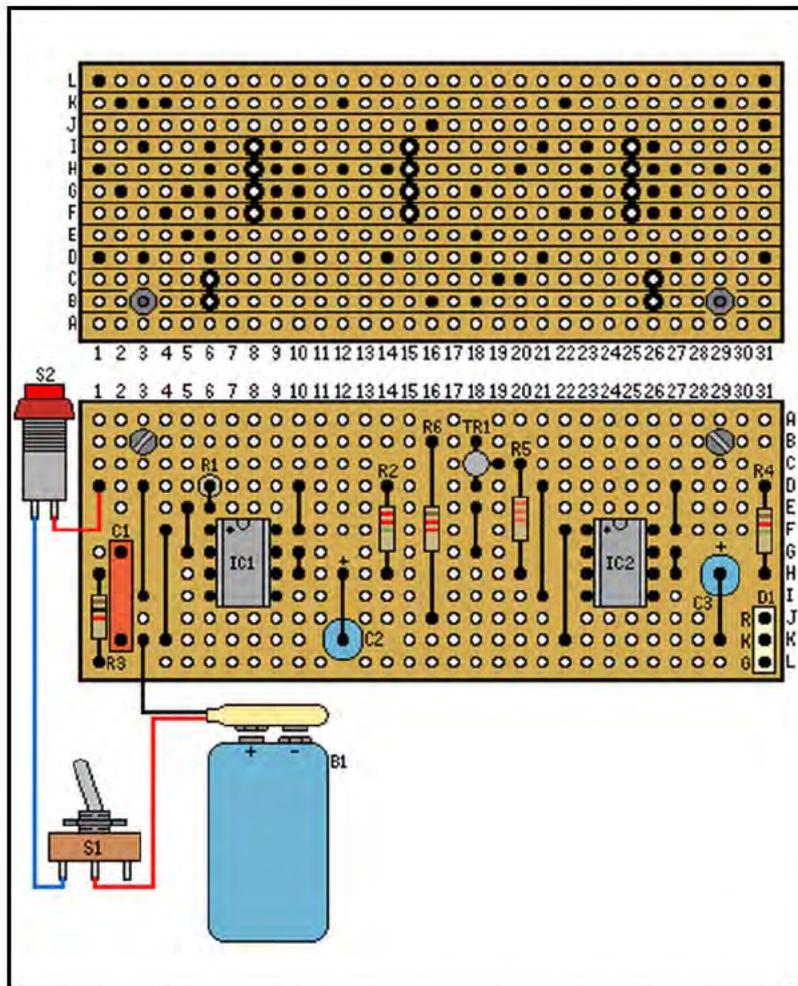


Figure 2. Veroboard layout for the Games Timer.

IC1. This pulse drives the green section of D1 via current limiting resistor R3. R2 and C2 are the timing components which control the length of the output pulse, and the pulse length is approximately  $1.1 CR$  seconds. This gives a nominal pulse duration of 24.2 seconds, but this is likely to be marginally increased in practice due to slight leakage in C2. Much larger errors can occur due to the tolerances of IC1 and the timing components, but fairly large errors in the pulse length are of little importance since they will advantage or disadvantage all players by the same amount.

The red section of D1 is driven via an inverter stage from IC2. The red section must be switched on after about 15 seconds in order to mix with the green section to give the orange display, and it must remain on until the unit is reset so that a red indication is given when the green section switches off after about 25 seconds.

IC2, like IC1, is triggered at switch-on by the pulse produced by R1 and C1,

and its output pulse duration is set at approximately the required time by using suitable values for R4 and C3. The red section of D1 will not light up during this time since with IC2's output high TR1 will be cut off and no significant current will be supplied to D1b. At the end of the pulse TR1 is biased into conduction by the base current it receives from IC2 by way of R5, and TR1 then drives D1b on via current limiting resistor R6. D1b remains on until the circuit is reset by briefly operating S1 so that the supply is momentarily cut off and the two timer ICs are retriggered as the supply is restored. If S1 is operated before IC2 and (or) IC1 reach the end of their timing periods, any charge on C2 or C3 will be rapidly lost through IC1 and IC2 so that the subsequent timing run correctly starts with zero charge on the timing capacitor and the unit operates properly.

### Construction

The timer is built on a 0.1 inch pitch Veroboard which has 31 holes by 12 copper strips, and full details of this are given in Figure 2.

## PARTS LIST FOR THE GAMES TIMER

Resistors - all  $\frac{1}{4}$  watt 5% except where specified

- R1 100K Brown Black Orange
- R2 2M2 10% Red Red Green
- R3 1K Brown Black Red
- R4 1M2 10% Brown Red Green
- R5 33K Orange Orange Orange
- R6 1K2 Brown Red Red

Capacitors

- C1 15nF Polyester
- C2 10 $\mu$ F 25V Electrolytic
- C3 10 $\mu$ F 25V Electrolytic

Semiconductors

- IC1 ICM7555
- IC2 ICM7555
- TR1 BC179
- D1 2 colour common cathode LED

Miscellaneous

- S1 Push-to-break, release to make switch
- S2 Sub-min s.p.s.t. toggle switch
- B1 PP3 battery and connector
- Veroboard 31 holes x 12 strips 0.1 inch matrix
- Case

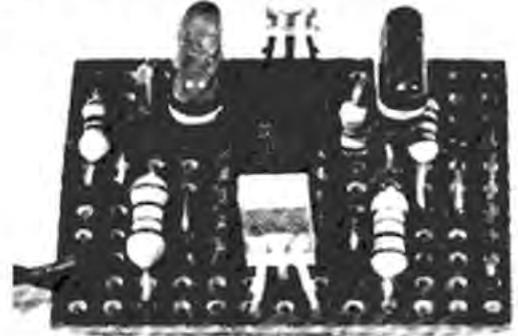
Construction of the unit is quite straightforward, and although IC1 and IC2 are CMOS devices they do not need the normal CMOS handling precautions since the ICM7555 device has internal protection circuitry which gives complete protection against damage by static charges. There should be no difficulty in fitting the board, battery, and other components into a small plastic case measuring about 115 x 75 x 40 mm.

The times provided by the unit using the specified timing component values might be inappropriate for some games, but within reason the times can be changed to suit individual requirements. Both ICs require a timing resistance of about 91 kilohms per second of output pulse. Of course, IC2's timing components govern the time for which a green display is obtained, and it is the difference in the pulse lengths of IC1 and IC2 that gives the orange display time. The display goes red after a time equal to the pulse length of IC1.

# MULTI COLOUR PENDANT

by Robert Penfold

Look to the future with this unusual Electronic Jewellery project



This simple item of electronic jewellery can be constructed as either a pendant or a brooch, as preferred. An attractive effect is obtained by the use of two multicolour LEDs, and one of these flashes through its various states (red, green, yellow, and off) at a rate of a few Hertz. The other LED lights up with the complementary colour of the first LED, so that it flashes green instead of red, red instead of green, off instead of yellow, and yellow instead of off.

## The Circuit

Figure 1 shows the full circuit diagram of the LED pendant, and this uses two oscillators of the type used in the Colour Snap Game described elsewhere in this issue; therefore the oscillator operation will not be considered here.

One oscillator is used to drive the red section of D1 by way of current limiting resistor R2, and the other oscillator drives the green section of D1 via R5. The two oscillators have different timing resistor values and therefore operate at slightly different frequencies. This means that

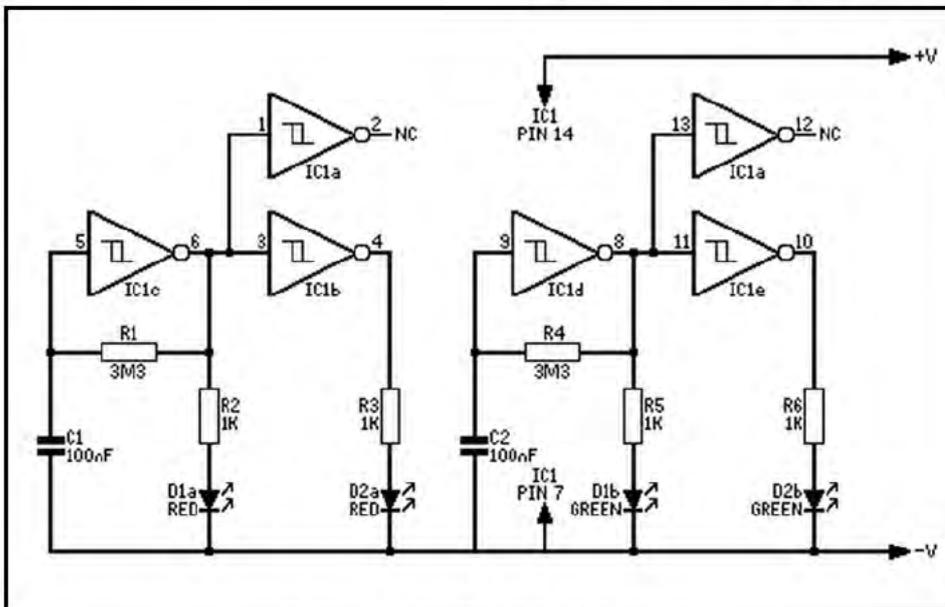


Figure 1. LED pendant circuit diagram.

## PARTS LIST FOR THE LED PENDANT

### Resistors - all ¼ watt

R1 3M3 10% Orange Orange Green  
R2, R3, R5, R6 1K 5% Brown Black Red (4 off)  
R4 4M7 Yellow Violet Green

### Capacitors

C1, C2 100nF Polyester (2 off)

### Semiconductors

IC1 40106BE  
D1, D2 Two colour LED (2 off)

### Miscellaneous

B1 PP3 battery and connector  
Veroboard 11 strips x 13 holes  
Case

sometimes only the red section will be switched, at other times only the green one, and at other times neither or both will be switched on, depending upon what the two output states happen to be at that particular instant. This results in D1 being pulsed through its four possible states at a rate of a few Hertz.

D2 is also driven from the two oscillators, but via an inverting buffer stage so that if the red section of D1 is switched on, the red section of D2 is switched off, and vice versa. Similarly, if the green section of D1 is switched on, the green section of D2 is switched off, and vice versa, giving the complementary LED colours.

Two of the Schmitt Triggers in the 40106 device are not used in this circuit, and their inputs are connected one to each oscillator output so that they are not left floating and vulnerable to damage by static charges. The oscillator outputs are used merely because these are convenient from the constructional point of view.

## Construction

The pendant can be constructed on a small piece of 0.1 inch matrix Veroboard panel measuring just 11 copper strips by 13 holes using the layout illustrated in Figure 2. IC1 is a CMOS integrated circuit and so the normal MOS handling precautions should be employed.

The board and PP3 size battery could be housed in a small ready made case, but ideally a small home constructed case should be used as this can be given the smallest usable dimensions. It is not essential to mount the battery in the pendant, and it could be fitted separately and connected to the main unit via thin insulated leads. With this method it would be possible to encapsulate the unit in clear resin if desired. If the unit is to have an internal battery and the smallest possible size is desired, a small 6 volt camera type battery (such as a PX28 or equivalent) could be used as the power source, although this would be a relatively expensive method of powering the unit and it would be necessary for the constructor to devise a battery holder and connector. It would also be necessary to reduce R2, R3, R5 and R6 to 680 ohms in value in order to maintain reasonable LED current and brightness. This modification can also be made if a 9 volt supply is used and a brighter display is required.

In order to make the unit as small and neat as possible it is not fitted with an on/off switch, and it is switched off simply by removing the battery.

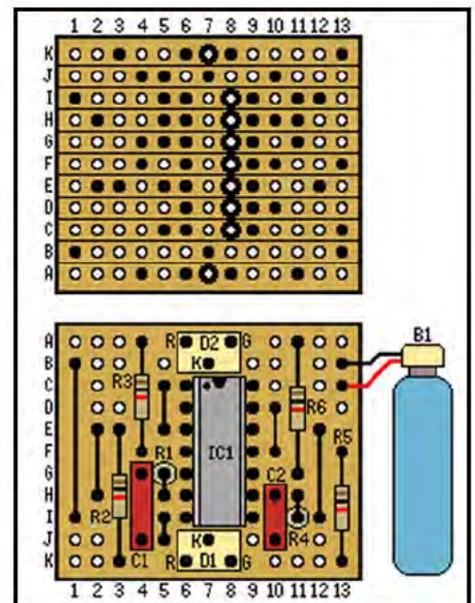


Figure 2. Veroboard layout for the LED Pendant.

# NEW BOOKS



## The British CB Book

by Peter Chippindale Now CB radio is on the road in Britain, here's the book you need. The book contains a beginners guide then covers such topics as how to speak on CB, how CB works, AM versus FM, sideband and DXing, ham rules, buying equipment, technical items, installation, TVI, why governments don't like CB, CB in Britain - how the Home Office got it wrong, complete Home Office 900 MHz tests, emergencies, comprehensive town and city list, British slang, you and the law, and the full government FM specifications. Complete with cartoons, pictures, diagrams and strips. 1981. 224 pages. 210 x 144 mm. Illustrated. Price £3.95NV

## CB Projects

by R. A. Penfold Full construction details of a number of useful CB projects including a speech processor, interference filters and even a simple CB radio receiver. Where appropriate, setting-up procedures are described in detail and no special test equipment is necessary to get the finished projects to function properly. 1981. 96 pages. 180 x 108 mm. Illustrated. Price £2.10NV

## Electronic Projects For Cars And Boats

by R. A. Penfold Contains fifteen different projects each with full construction details and parts lists. Projects include windscreen wiper controllers, car cassette power supply, seatbelt reminder, flasher warning unit, vehicle immobiliser, car burglar alarm, depth alarm, shaver inverter and others. 1981. 96 pages. 180 x 108 mm. Illustrated. Price £2.10/W

## Electronic Timer Projects

by F. G. Rayer The book covers many of the applications of timer circuits with some of the more complicated ones made up from a number of simpler circuits which are dealt with individually. The author shows how these may be combined in various ways to make some quite sophisticated projects. 1981. 96 pages. 180 x 108 mm. Illustrated. Price £2.10NV

## Model Railway Projects

by R. A. Penfold Contains complete circuit and construction details of a number of different model train controllers and accessories. The accessories include a point controller, automatic signal, signal controller and various sound effects. Certain to become one of our bestsellers. 1981. 112 pages. 175 x 110 mm. Illustrated. Price £2.15NV

## The Giant Handbook Of Electronic Circuits

by Raymond A. Collins Contains over 1000 different circuits carefully sorted into 60 different category chapters. A useful sourcebook of ideas mostly taken from IC manufacturers' data books. There is a comprehensive index so that the required circuit can be easily found. American book. 1980. 880 pages. 210 x 130 mm. Illustrated. Price £12.95NV

## The Master IC Cookbook

by Clayton L. Hallmark Contains brief specification and pin-out diagrams for over 350 IC's and includes a description of the function of each IC. The IC's described are mostly standard CMOS 4000 and 74C series and TTL 74 series. There are also a few linear IC's. American book. 1980. 476 pages. 210 x 130 mm. Illustrated. Price £8.45NV

## An Introduction To Radio DXing

by R. A. Penfold The book is divided into two main sections, one devoted to amateur band reception and the other covering broadcast band reception, with advice on suitable equipment and the techniques employed when using that equipment. The construction of a number of useful accessories is also described. An ideal handbook for the beginner. 1981. 112 pages. 175 x 110 mm. Illustrated. Price £2.15NV

## Public Address Handbook

by Vivian Capel A practical guide for those involved in or wishing to learn about PA with answers to all the common problems that are likely to be encountered. There are also chapters dealing with special techniques for outdoor installations, diagnosing and tracing

faults, catering for live music and the provision of auxiliary services. 1981. 216 pages. 214 x 132 mm. Illustrated. Price £8.75/W

## Android Design

by Martin Bradley Weinstein This highly practical book covers designing main mechanical and motor drives, problems of stairways, the battery, collision avoidance, fingers, vision, verbal literacy, mapping, the atlas and probability shells and brains. A very readable and informative book. American book. 1981. 256 pages. 226 x 146 mm. Illustrated. Price £9.95NV

## Karel The Robot

by Richard E. Pattis The book is designed to help you understand the concepts of programming in PASCAL by showing you how to program Karel. By using programs that make a robot do things in our everyday experience, the author is able to cover abstraction and control structures of PASCAL that would be hard to understand if dealt with solely in the context of the computer. American book. 1981. 128 pages. 228 x 162 mm. Illustrated. Price £5.75NV

## Programmer's Guide To The 1802

by Tom Swan Covers number systems and the fundamentals of assembly language then goes on to describe in detail the 1802 instruction set and gives the complete listing of an assembler (and disassembler) that will run on an 1802 microprocessor system. American book. 1981. 168 pages. 228 x 152 mm. Illustrated. Price £6.85/VII

## Introduction To 8080/8085 Assembly Language Programming

by Judi N. Fernandez and Ruth Ashley A guide to enable you to teach yourself how to write programs in 8080/8085 Assembly Language. You will learn to write fast running, sophisticated and complex programs in terms the computer understands rather than in English (like BASIC or COBOL). Scores of sample programs are included to illustrate every technique and concept. American book. 1981. 320 pages. 254 x 172 mm.

Price £7.45NV

## My Micro Speaks Bases (And Loves It)

by Paul Warne Bases is a compact, compiled language that combines the best features of BASIC and assembly language, is up to ten times faster than BASIC, requires about half the memory space of a BASIC program, yet is as easy to learn as BASIC. American book. 1981. 176 pages. 228 x 152 mm. Price £8.85/W

## Programs For Beginners On The TRS80

by Fred Blechman Contains over 20 useful programs with complete listings for TRS80 model 1 level 1 and 2 and model 3, with line-by-line descriptions. Programs include fortune teller, racing alphabet, BINGO, digital clock, adding machine, order form totals, invest or save, mortgage repayments, magic square and others. American book. 1981. 160 pages. 248 x 176 mm. Illustrated. Price £8.25NV

## Programming In Basic-Plus

by Jasper J. Sawatzky and Shu-Jen Chen A comprehensive guide to the features of BASIC-PLUS as used on Digital's PDP11 series computers. The book deals with the BASIC-PLUS standard statements explaining with examples, how to use them and covers use of the text editor, batch processor and TECO editor as well as describing file processing, matrix manipulation, character strings, functions and subroutines using BASIC-PLUS. American book. 1981. 288 pages. 278 x 212 mm. Price £11.75NV

## Introducing Microprocessors

by Ian R. Sinclair The book sets out to explain what a microprocessor IC does and how it does it without requiring any electronics knowledge on the part of the reader. The very readable style enables complete understanding of the special terms described and for those intending to learn machine language programming the book explains very clearly what happens in the chip and how an instruction is executed. Highly recommended. 1981. 128 pages. 214 x 136 mm. Illustrated. Price £4.95NV

# UNIVERSAL TIMER

by L. Harrold

- \* Comprehensive programmable control for 4 mains appliances
- \* Storage for up to 18 program times
- \* Safe low voltage links to controlled points
- \* Relay outputs can switch other circuits

This Universal Timer can be used to control up to 4 mains appliances, switching them on and off at various times throughout the week. Typical applications for the timer would be switching on electric blankets, controlling the heating, recording radio programs when out, or controlling the lighting when on holiday to give the impression that the house was occupied. The timer uses the Texas Instruments TMS 1121 IC, which contains a real time clock which displays the time of day, AM or PM and the day of the week; plus a 4 bit micro-computer which can be programmed to control the 4 outputs. It is possible to store up to 18 daily or weekly program times in the memory. The commands can be ON, OFF or SLEEP; the SLEEP command turns the switch on for 1 hour and then off. The programs are entered by push buttons on the front panel and can be of 2 types:

1. Fixed time programs. These are stored in the memory and executed at the same time every day or every week.
2. Interval programs. These are executed after a certain time has elapsed, say in 2 hours time. These programs are executed once and then deleted from the memory.

It is possible to display the programs that are stored in the memory and to delete them. In addition it is possible to switch the outputs directly from the keyboard. The front panel has a 4 digit LED display showing the time and 7 red LEDs, one for each day of the week. There are 4 green LEDs, one for each output, which light when the corresponding output is on. The 4 program LEDs and the 3 other command LEDs are used during programming and to display the programs in the memory.

## The Circuit

The mains voltage is stepped down to 12 volts, rectified by BR1 and smoothed by C1. REG 1 and associated components C2, C3, R1 and R2 provide a regulated supply

of 9 volts which is fed to the IC pins 20 and 4. The push buttons are connected as a 7 x 3 matrix which is scanned by the TMS 1121, pins 21 to 27, and pins 5 to 7 detect any buttons that are pressed.

The IC has an internal oscillator whose frequency is determined by R5 and C6, and is approximately 300 kHz. Pins 10 to 17 are the multiplexed outputs for the 7 segment and LED displays; these are connected via the emitter followers TR4 to TR11 to drive the display. Pins 21 to 27 are digit and LED select outputs, and are connected via transistor inverters to the LED displays. Pins 22 to 26 use Darlingtons pairs, as the load on these pins is greater. Pins 28 and 1 to 3 are the 4 output control pins, and are connected via transistors to the 12 volt relays and LED indicators. Diodes D11 to D14 protect the transistors from inductive fly back voltages from the relays.

The TMS 1121 clock is synchronised to the mains frequency which is fed via R3 and TR1 to pin 8. This is normally 50 Hz, but if you wish to use the timer on a 60 Hz supply, the strap should be wired across the Veropins connecting D3 to pin 27 of the IC. When the circuit is first powered up, C5 charges up via R4, TR2 and TR3; this inhibits the 50 Hz input and initially holds pin 9 high. Pin 9 is the initialise pin which resets the clock to 12.00 PM on Sunday and erases all programs from the memory.

## Construction

The majority of the components are mounted on 2 PCBs (Figures 2 and 3), which connect together via three 10 way connectors. The timer main board is a single sided board and has 9 wire links to be made. The 1 watt resistors R22 to R29 get

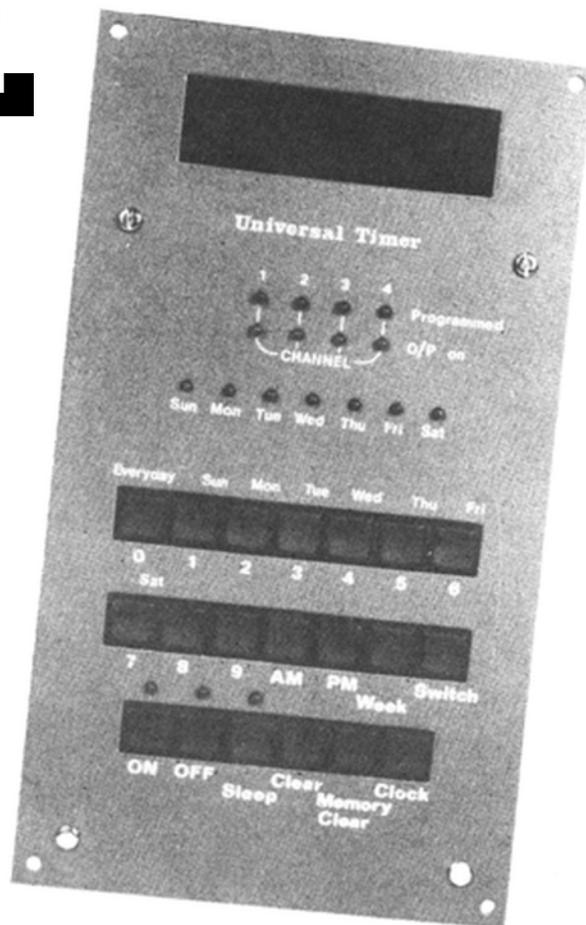
quite hot, so they should be mounted about 1/8 inch off the board to allow the air to circulate underneath them. Capacitors C4 and C5, and the regulator REG 1, should be mounted and bent over onto their sides before soldering. Capacitor C1 is mounted off the end of the board as shown in Figure 6. The 12 Veropins should be inserted from the component side of the board to allow the wires to be connected underneath the board.

The terminals for the connectors should be crimped and soldered onto 20 SWG wire, and then inserted into the housing and cut off about 1/4 inch long; see Figure 7. When all 10 terminals have been made the whole socket can be soldered onto the board. Sockets 1, 2 and 3 should be mounted the right way round, since their holes are offset from the wires. The PCB legend shows the correct orientation.

The other components mount fairly easily, and it is only necessary to check that the diodes and transistors are of the correct type and are the right way round. The transistors should be pushed down so that their tops are about 3/8 inch above the board.

The LEDs, 7 segment display and push buttons are mounted on the timer switchboard PCB. This is double sided, and there are 76 track pins to be inserted to connect the two sides of the board. These should be inserted from side 1, pressed well down, and then soldered on both sides. The push switches can now be mounted together with the 10 way plugs, which go on the opposite side of the PCB.

The 7 segment display is placed on top of the PC Band there are 15 connections to pin through the two boards; at least three of these should be Veropins to provide the



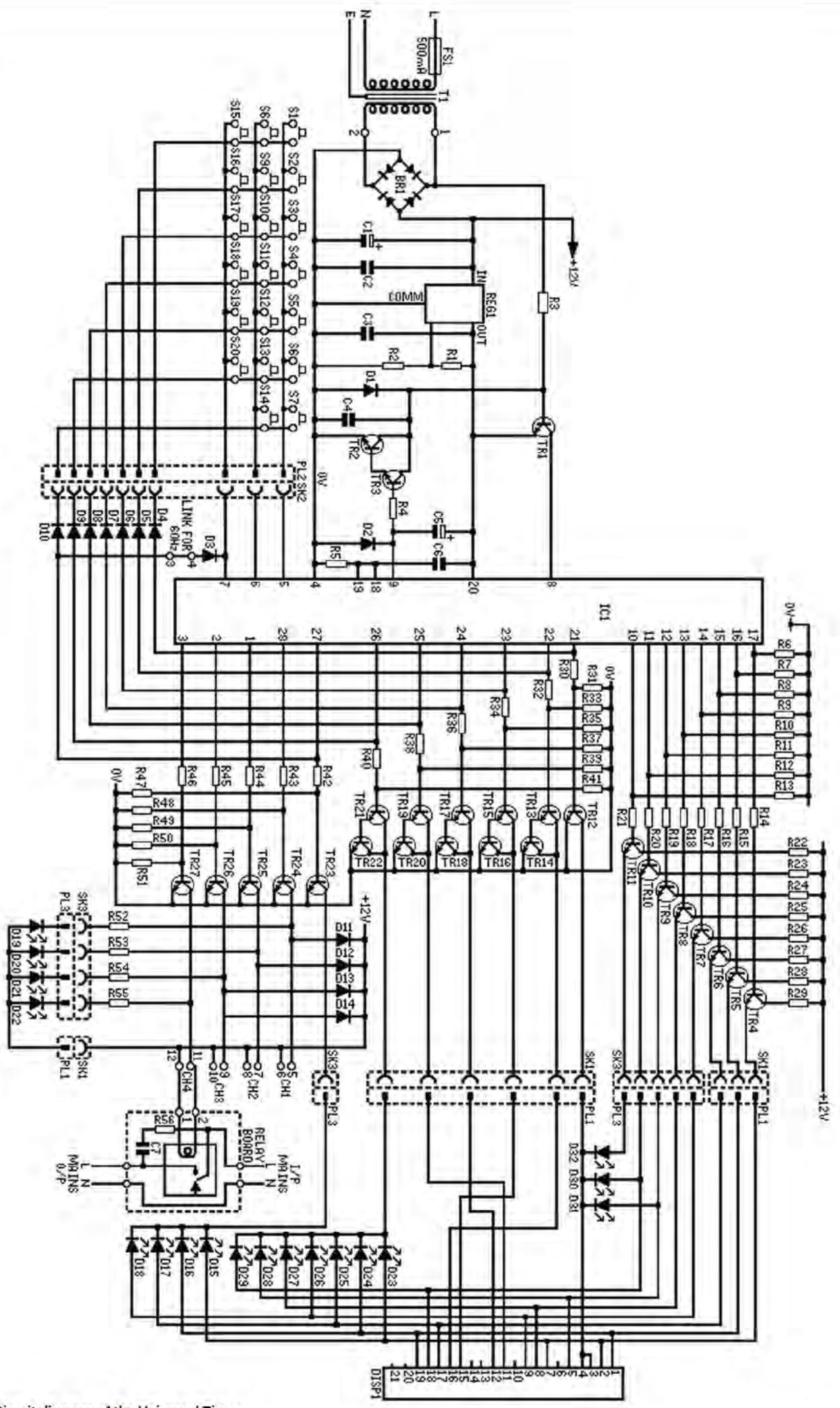


Figure 1. Circuit diagram of the Universal Timer.

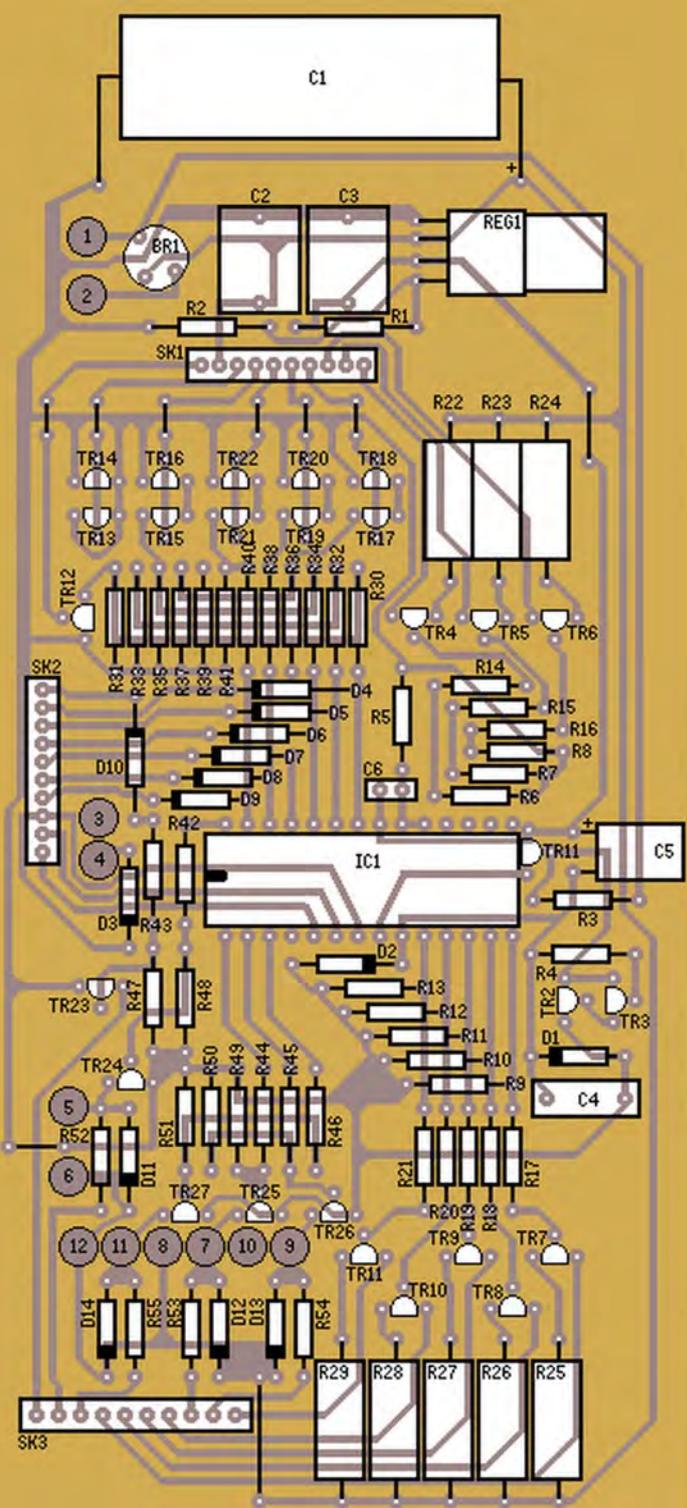


Figure 2. Timer main PCB.

necessary support to the display. The rest can be wired through, which makes it easier to replace the display if necessary.

The four nuts, washers and spacers should be bolted to the front panel, and the red filter glued into place. If the LEDs are now inserted into the board, but not soldered, the front panel can be slid over the switchboard and secured with four more nuts. The LEDs are then pushed through the holes in the front panel and soldered. Note that the two top rows of four LEDs are inserted the opposite way round to the rest.

The transformer secondary can now be wired to the Veropins on the main board, and the primary connected to the mains lead via the fuseholder. The mains earth wire should be connected to a tag bolted to the transformer frame. The circuit should be powered up without the TMS 1121 in the socket, and the voltage between pins 20

and four measured as nine volts. If this is correct, switch off and allow the power supply to discharge before plugging the IC pin in.

The relay boards are designed to be situated near the appliance to be controlled, with a pair of low voltage wires connected back to the main board. The relay boards can switch a 2 kW resistive load at 240 volts, and have a suppressor circuit fitted.

If the main circuit board or the relay boards are housed in metal cases, these should be connected to the mains earth, as well as the front panel.

**Programming**

The programs are entered via 17 of the 20 push buttons on the front panel. Most of the number buttons have two or three functions; when they are pressed, the number entered is shown on the seven

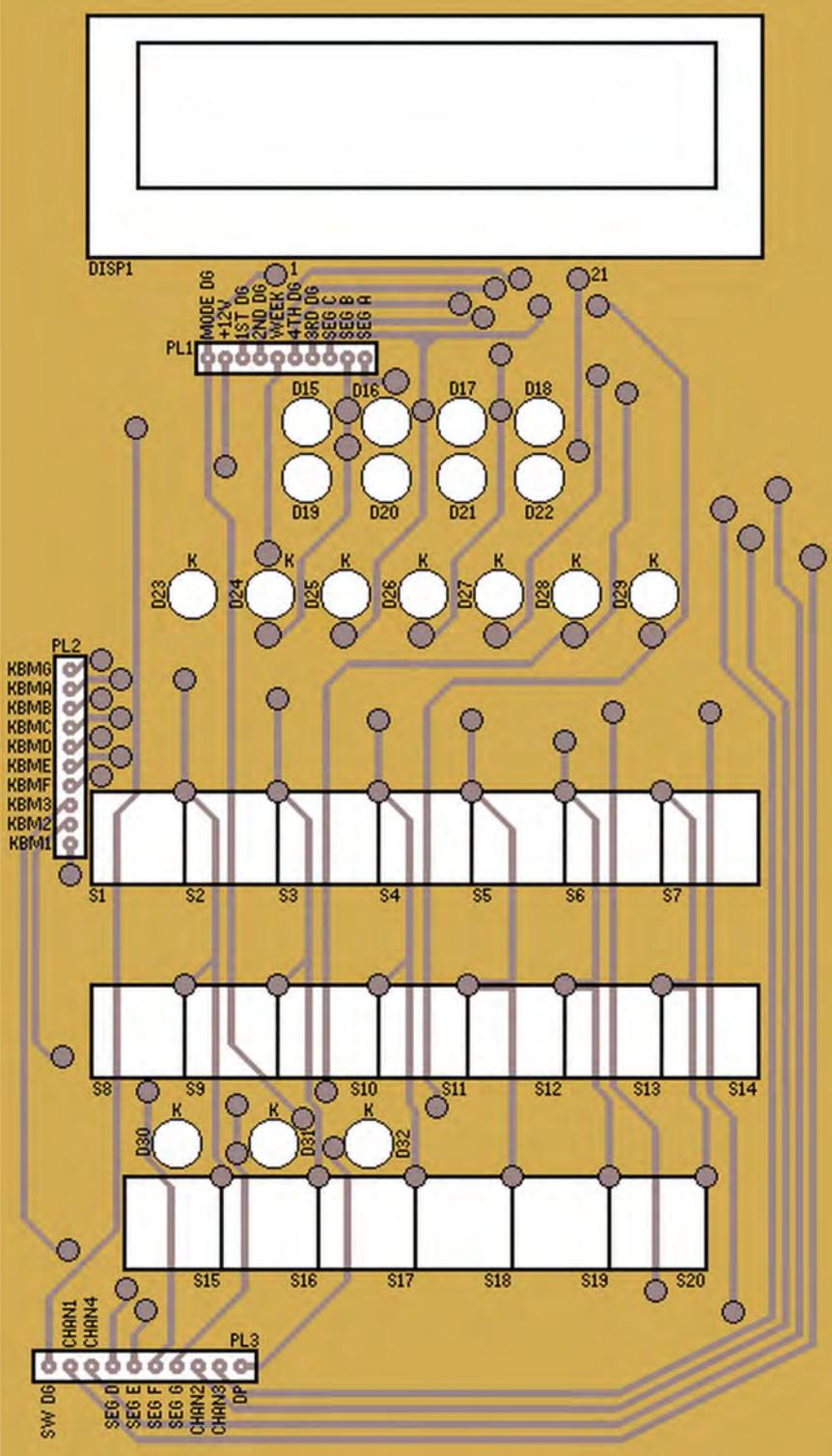


Figure 3. Switch PCB. PL1, PL2, and PL3 are mounted on rear.

segment display. If the SWITCH button is pressed immediately after a number button, the number is entered as the number of the switch to be controlled (1 - 4 only) and is displayed on the 'channel' LEDs. If the WEEK button is pressed immediately after a number button, the number is entered as the day of the week (1-7 only) and is displayed on the 'day of the week' LEDs. The other buttons used in programming are AM, PM, ON, OFF and SLEEP. The CLOCK button displays the clock, MEMORY CLEAR clears all the programs out of the memory, and the CLEAR button clears the display so that new digits can be entered if you make an error.

**Setting the clock**

When the circuit is first powered up, the clock is automatically set to 12.00 PM on Sunday with all the switches off and no

programs stored in the memory. The CLOCK button must be pressed to start and display the clock. To set the clock the following sequence must be entered:

1. Day of the week followed by the WEEK button.
2. AM or PM.
3. The time e.g. one, zero, zero, eight for 10.08.
4. The CLOCK button.

The clock is not actually started until the last button is pressed, so that the time can be accurately set. The timer will convert times from the 24 hour system to the 12 hour system for both clock setting and programming. If a 24 hour time is entered, 12 hours will be subtracted from it, but the AM/PM selection is not altered; therefore AM/PM must still be entered correctly.

#### Errors

If you make a mistake entering items 1 or 2, just press the CLOCK button and start again. If you make a mistake entering the time, just enter zero followed by the proper time. As the time is entered, the digits shift from right to left as with a calculator; this means that the old time will shift off the display and the correct time will be entered. A display of 99.99 occurs if the key sequence is incorrect or a program is attempted with an invalid time, and a display of 88.88 occurs if an attempt is made to store more than 18 programs.

#### Fixed time programs

To enter a fixed time program the following sequence must be used:

1. Number of the switch to be controlled followed by the SWITCH button.
2. Day of the week followed by the WEEK button.
3. AM or PM.
4. The time you want the command to be executed.

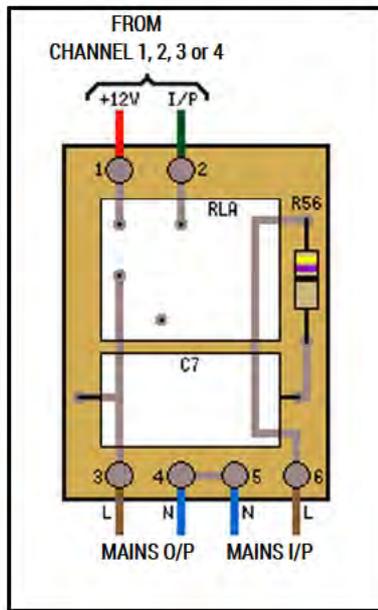


Figure 4. Relay PCB

5. The command. (ON, OFF or SLEEP).

For example the following sequence:

1, SWITCH button, Monday, WEEK button, PM, 5,-, 0, ON would turn on switch 1 every Monday at 5.10 in the afternoon. The day of the week can be any day (Sunday to Saturday) or every day; in this case the 'Everyday' button is pressed instead. Once a command button is pressed the program is stored in the memory. Any mistakes you have made should be corrected (as described previously) before this button is pressed, as it is more difficult to alter the program once it is stored in the memory.

If you wish to enter another command for the same switch on the same day, it is not necessary to enter the whole sequence again; you can just enter parts 3, 4 and 5. This must immediately follow the first sequence without pressing the CLOCK button in between. A succession of short

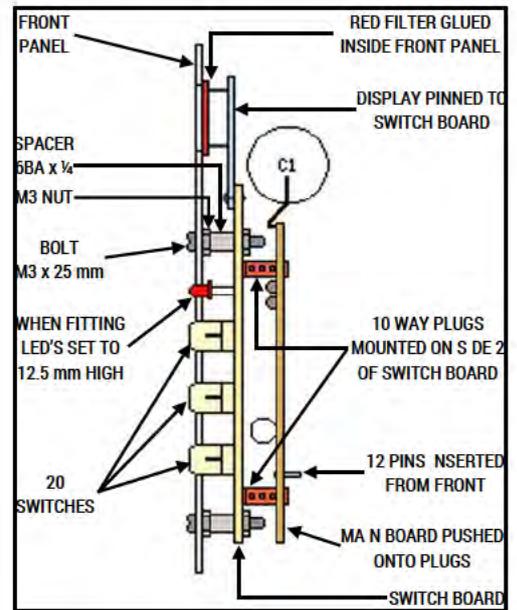


Figure 6. Assembly details.

sequences may follow each other to program several actions of one switch on one day.

#### Interval programs

To enter an interval program the following sequence must be entered:

1. Number of switch to be controlled followed by the SWITCH button.
2. The time interval.
3. The command (ON, OFF or SLEEP). For example the following sequence:
4. SWITCH button, 2, 1, 0, ON would turn switch 3 on, 2 hours and 10 minutes after the ON button was pressed.

Once this had been executed the program would be deleted from the memory. As with fixed time programs, a short key sequence may be used for a succession of programs, as long as the switch being controlled is the same; in this case you just enter parts 2 and 3. The maximum time for any interval is 11 hours 59 minutes.

#### Direct switch control

A switch may be operated directly from the keyboard by entering the following sequence:

1. Number of the switch to be controlled, followed by the SWITCH button.
2. Command (ON, OFF or SLEEP). The command is executed immediately and not stored in the memory.

#### Program display

It is possible to display the programs stored, either for a particular day or for a particular switch. To display programs for a particular switch:

1. Press the number of the switch followed by the SWITCH button.
2. Press the SWITCH button again. The programmed time is displayed and the LED indicators show the day of the week, the number of the switch and the command.

However, if the command is SLEEP and the command is being executed (i.e. the program is being displayed during the 'on' period of 1 hour), the display will show the 'off' time and the OFF LED will be lit. If the program is displayed before the command

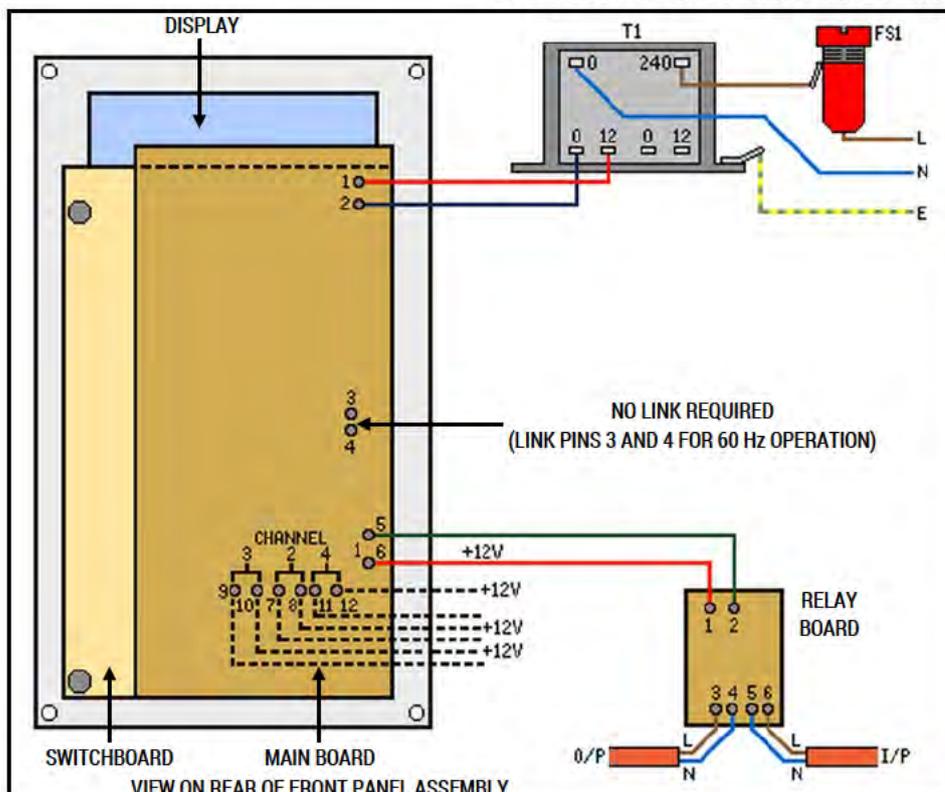
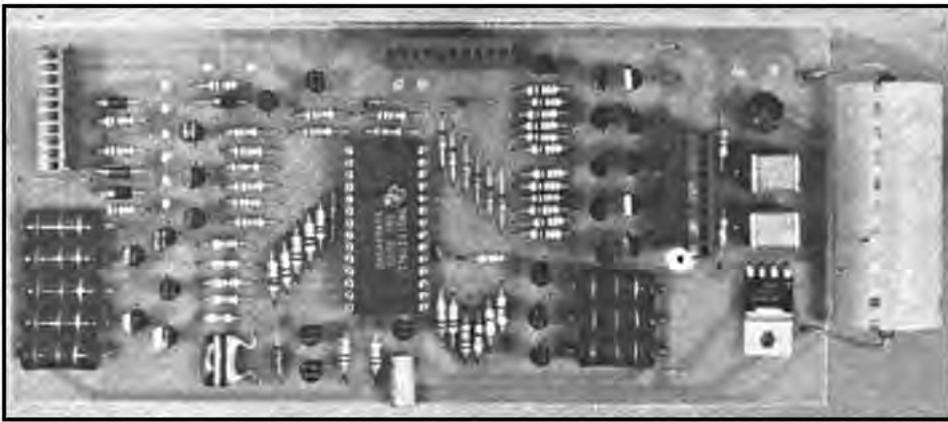
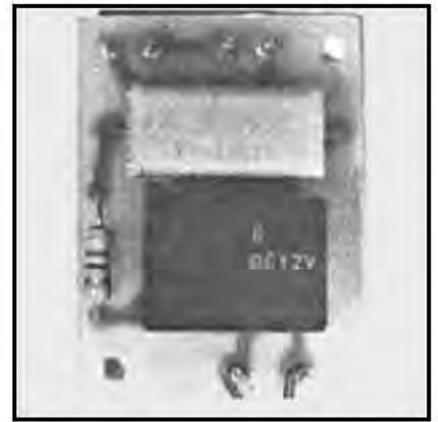


Figure 5. Wiring details.



Assembled main board.



A relay board.

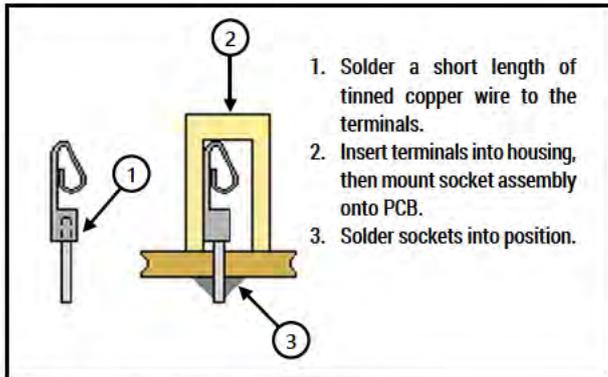
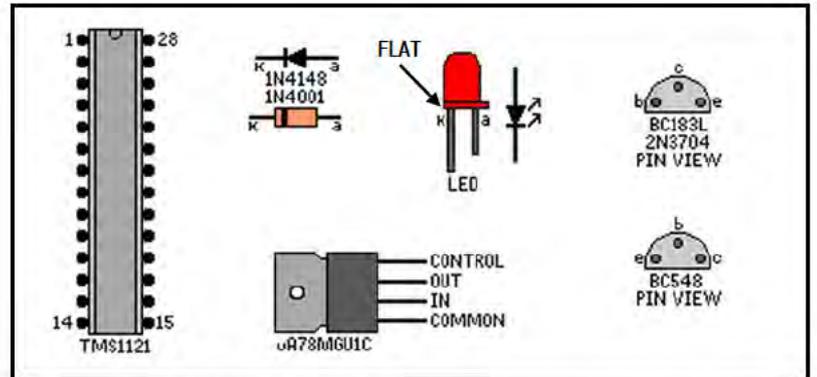


Figure 7. Minicon terminal assembly.



Semiconductor pin connections.

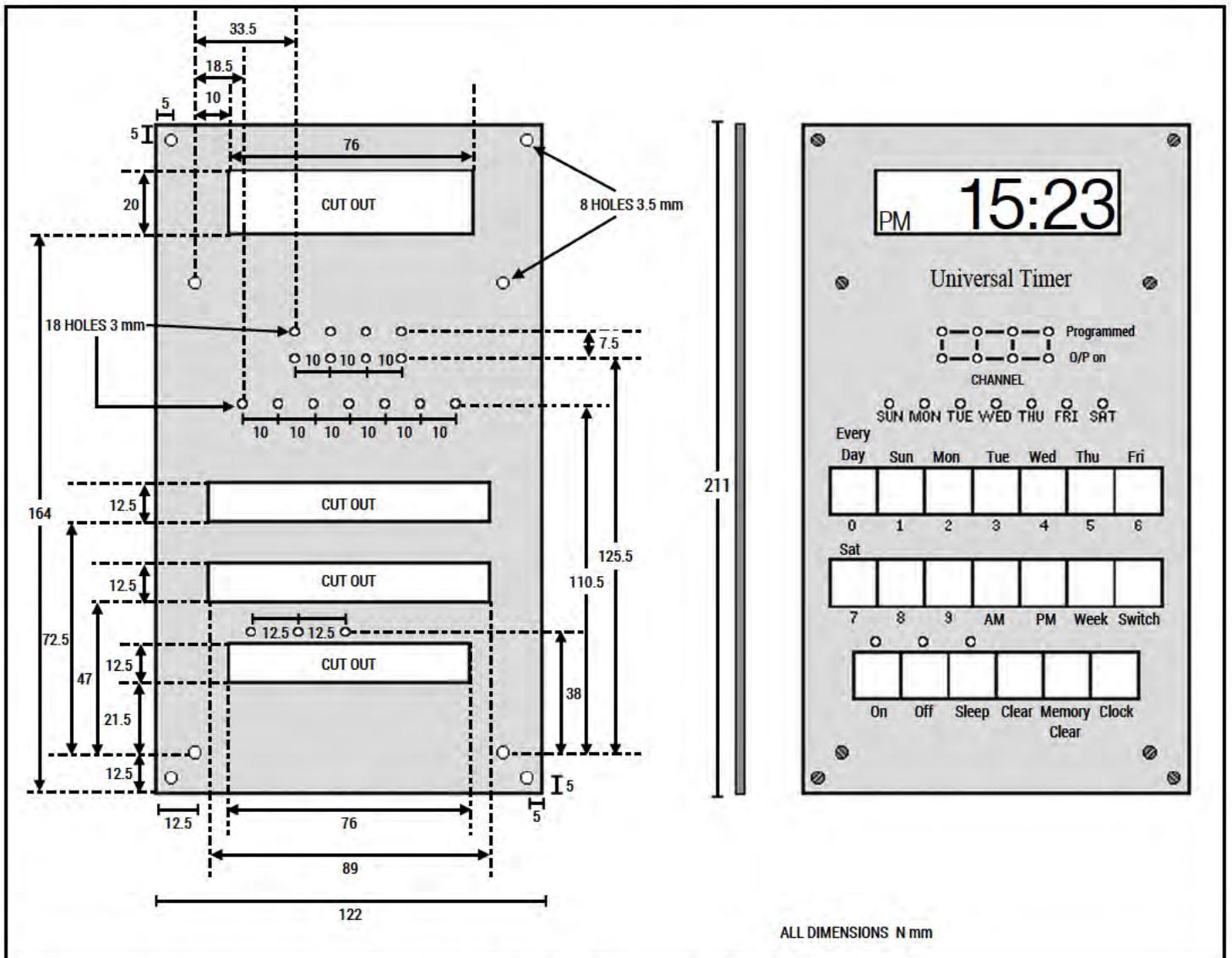
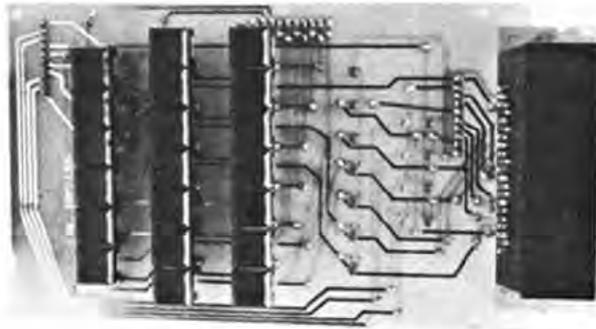


Figure 8. Front panel dimensions and lettering.



Assembled switch board.

## PARTS LIST FOR THE UNIVERSAL TIMER

Resistors - all ¼ watt 5% except where specified

R1	3K9	Orange White Red	
R2	4K7	Yellow Violet Red	
R3, R4	100K	Brown Black Yellow	(2 off)
R5	47K	Yellow Violet Orange	
R6, R13,			
R30 to R41	10K	Brown Black Orange	(20 off)
R14 to R21	470R	Yellow Violet Brown	(8 off)
R22 to R29	120R 1W	Brown Red Brown	(8 off)
R42 to R51	6K8	Blue Grey Red	(10 off)
R52 to R55	1K	Brown Black Red	(4 off)
* R56	47R ½W	Yellow Violet Black	

### Capacitors

C1	4700µF 25V	Axial Electrolytic	
C2, C3	1µ0	Polycarbonate	(2 off)
C4	10nF	Polyester	
C5	470µF 100V	PC Electrolytic	
C6	47pF	Ceramic	
* C7	100nF	Suppression Capacitor	

### Semiconductors

TR1 to TR11,			
TR23 to TR27	BC548		(16 off)
TR12, TR13, TR15			
TR17, TR19, TR21	BC183L		(6 off)
TR14, TR16, TR18			
TR20, TR22	2N3704		(5 off)
REG1	µA78MGU1C		
BR1	W005		
IC1	TMS1121		
D1 to D10	1N4148		(10 off)
D11 to D14	1N4001		(4 off)
D15 to D18,			
D23 to D32	Mini LED Red		(14 off)
D19 to D22	Mini LED Green		(4 off)
DISP1	Multiplex common cathode display		

### Miscellaneous

T1	12V 1A Transformer		
S1 to S20	Click Key Black		(20 off)
PL1 to PL3	Minicon plug 10-way		(3 off)
SK1 to SK3	Minicon housing 10-way		(3 off)
	Minicon terminal		(30 off)
* RLA	10A Mains relay, 12V coil		
	28-pin DIL Socket		
FS1	20 mm 500 mA Fuse		
	Panel fuseholder		
	M3 Bolts x 25 mm		
	M3 Nuts and M3 Washers		
	6BA Spacers x ¼ inch		
	Red Filter		
	Veropins 2145		
	* Veropins 2141		
	Track Pins		(2 packets)

\* These items are used on the relay PCBs. Quantities shown should be multiplied by the number of channels required (except for the Veropins).

is executed, the SLEEP LED will light and the display will show the time entered for the command.

Every time the SWITCH button is pressed twice, the next program for that particular switch will be displayed. Both fixed time and interval programs (before execution) can be displayed. When an interval program is displayed, the time shown is the programmed time of its execution and not the time interval that was entered at the time of programming.

To display programs for a particular day:

1. Press the appropriate day switch followed by the WEEK button.
2. Press the WEEK button again.
3. The first program for that day is displayed. Every time the WEEK button is pressed twice, the next program for that day will be displayed.

Programs that were entered with the 'Everyday' button will not be shown if you are displaying programs for a specific day; these must be displayed separately using the 'Everyday' button instead. When there are no more programs left, the display is blanked. If you carry on displaying programs the sequence will be displayed again.

### Deleting programs

All programs may be cleared from the memory by pressing the MEMORY CLEAR button. To clear all programs for a particular switch:

1. Press the number of the switch followed by the SWITCH button.
2. Press the MEMORY CLEAR button.

To clear all programs for a particular day:

1. Press the switch for that day followed by the WEEK button.
2. Press the MEMORY CLEAR button.

Programs that were entered using the 'Everyday' button must be cleared using this button instead of the day of the week.

### Overlapping programs

If several programs are entered for the same switch and for the same time, all of them are ignored except for the last one entered. This can be used as follows:

Enter 4, SWITCH, Everyday, WEEK, PM, 6, 4, 5, ON.

Enter 4, SWITCH, Sat, WEEK, PM, 6, 4, 5, OFF.

Enter 4, SWITCH, Sun, WEEK, PM, 6, 4, 5, OFF.

All three programs are entered into the memory, but the last two will override the first one on Saturday and Sunday, the result being that switch four will turn on at 6.45 PM every day of the week except Saturday and Sunday. Note that the 'Everyday' program should be entered before the other two programs.

# BASICALLY BASIC

Graham Hall, B. Sc.

A regular series to teach BASIC for use at home and in business or scientific applications. No previous programming experience required. Continuation of our superb series from Electronics & Music Maker.

## Subroutines

Often it is required to perform the same series of operations at different points in a BASIC program. This can be achieved by writing the statements as a subroutine within the main program. When the statements are to be executed the subroutine is referenced (or 'called') by the main program. After the statements of the subroutine have been executed, control is automatically directed back to the main program statement that immediately follows the call to the subroutine.

## The GOSUB and RETURN Statements

The GOSUB statement transfers control of the program to a subroutine and the RETURN statement returns control from that subroutine back to normal program execution.

The general form of the GOSUB statement is:

GOSUB line number

where the line number is the first line of the subroutine. The first line of a subroutine can be any legal BASIC statement including the REM statement. It is good programming practice to make the first line of a subroutine a REM statement followed by a comment which outlines the function of the subroutine.

The last statement of any subroutine must be a RETURN statement. The RETURN statement causes control to transfer back to the main program line following the GOSUB statement. The RETURN statement is not followed by a line number - when the subroutine is entered the computer 'remembers' the line which called the subroutine. The RETURN statement instructs the computer to use this value to return to the statement after the GOSUB.

The use of the GOSUB and RETURN statements to implement a subroutine is best illustrated by considering a BASIC program:

```
10 REM PROGRAM - SORT LISTS OF NUMBERS
15 DIM X(10)
20 PRINT"INITIAL LIST 1"
30 FOR 1=1 TO 10 40 READ X(I)
50 PRINT X(I);
60 NEXT I
70 REM CALL SUBROUTINE - SORT LIST ONE
80 GOSUB 600
90 REM NOW READ SECOND LIST OF NUMBERS
100 PRINT:PRINT"INITIAL LIST 2"
110 FOR 1=1 TO 10 120 READ X(I)
130 PRINT X(I);
140 NEXT I
150 REM CALL SUBROUTINE- SORT LIST TWO
160 GOSUB 600
170 REM NEXT TWO LINES ARE DATA
180 DATA -10,6,3,50,-7,0,41,32,9,15
190 DATA 18,-4,-50,61,11,18,22,-1,99,6
200 END
600 REM SUBROUTINE-SORT LIST IN ARRAY X 610 FOR 1 = 1 TO
9 620 FOR J=I + 1 TO 10
630 IF X(I)>X(J)THEN LET T=X(I):LET X(I)=X(J):LET X(J)=T
640 NEXT J
650 NEXT I
660 PRINT:PRINT"SORTED LIST"
670 FOR 1=1 TO 10 680 PRINT X(I);
690 NEXT I 700 RETURN
```



In this example, the subroutine begins at line 600 and ends with a RETURN statement at line 700. The subroutine uses a simple sort algorithm to sort the numbers stored in the array named X. It then prints the list of sorted numbers before returning control back to the main program.

The program is composed of the following lines:

Line 10 - The REM statement identifies the program. The characters following REM are ignored by the computer.

Line 20 - The PRINT statement outputs the message contained in quotation marks to the terminal.

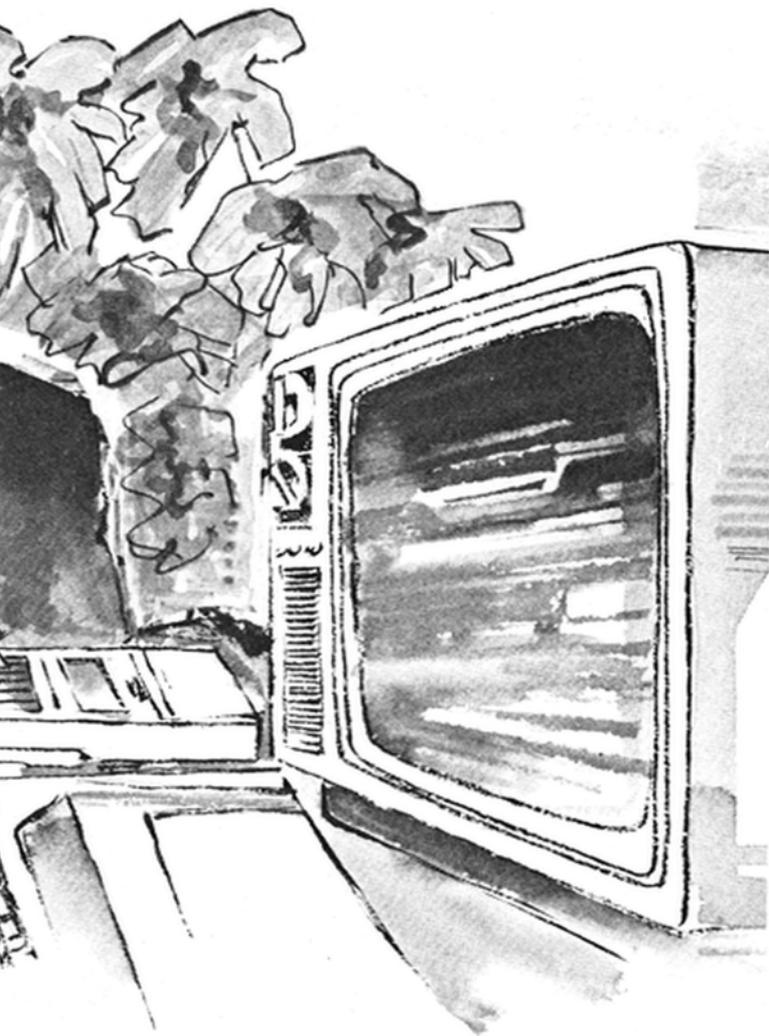
Lines 30, 40, 50 and 60 - The FOR statement initialises the variable I to one and sets the limit of the loop to ten, its corresponding NEXT statement is on line 60. Each time the loop is executed the READ statement on line 40 takes a number from the DATA statement in line 180 and assigns it to the array named X in the position specified by the subscript (the subscript is the variable I within the parentheses after the array name). The PRINT statement on line 50 outputs the number to the terminal. The semicolon after the array element directs the computer to print each number on the same line. When the loop has been executed ten times, program control proceeds to line 70. The array X now contains the ten numbers specified as data in line 180.

Line 80 - The GOSUB statement directs the program control to the subroutine beginning at line 600. The statements of the subroutine are now executed until the RETURN statement on line 700 is encountered. This RETURN statement directs the control back to the main program line following the GOSUB statement (line 90).

Lines 100, 120, 130 and 140 - These statements are the same as lines 30-60 and read into the array X the next ten numbers from the data in line 190. (These statements could also have been written as another subroutine. The main program would then consist of four subroutine calls - first a call to a subroutine to read the numbers into the array and then a call to the subroutine to sort the numbers. Then these two subroutines would be called again to repeat the process for the next set of data.)

Line 160 - The GOSUB statement accesses the same subroutine on line 600 as referenced by line 80. However, when the RETURN statement of the subroutine is executed this time, control shifts to line 170 because the GOSUB at line 160 was the last statement in the main program to be executed.

Lines 180 and 190 - These DATA statements contain the values that are provided for the READ statement.



Line 200 - The END statement signifies the finish of the main program. The statements after the END statement are those of the subroutine which sorts the array.

Line 600 - This is the first statement of the subroutine. Note that it is a REM statement followed by a comment which explains the function of the subroutine. It is given a high line number to make it easier to distinguish between subroutine statements and those of the main program.

Lines 610, 620, 630, 640 and 650 - These statements perform the sort operation on the array X. The IF THEN statement on line 630 compares adjacent array elements, if the first element is greater in magnitude than the second, the elements are exchanged. In order to perform this exchange the original value of the first element is stored in the variable T. The value of the second element is then put into the first element. Now the original value of the first element remembered in T, is assigned to the second element. If the comparison is false the exchange is not performed.

The FOR loop initialised on line 630 is between the FOR and the NEXT statements of the loop initialised on line 620. This is a 'nested loop'. The loop index variables I and J are used as subscripts to reference the elements of the array X. Initially I is one and J is initialised, to two (I + 1). Thus the first element of the array is compared with the second by the IF statement on line 630 and exchanged if it is greater in magnitude. Now line 640 increments J by one to three and the first element of the array, which may have originally been the second element depending on the result of the first comparison, is compared with the third element and exchanged if necessary. This continues until J reaches ten at which point the first position in the array contains the smallest number of the list. Now I is incremented to two and J is initialised at three. The second element of the array is compared with the third and exchanged if greater in magnitude. This comparison and exchange process continues for each element in the array. When I reaches nine the elements of the array have all been compared with each other and arranged into ascending numeric order.

Line 660 - This starts a new line and outputs a message to the terminal. Lines 670, 680 and 690 - The FOR loop index I is used to reference each element of the array which is printed by the PRINT statement

on line 680. This is similar to lines 30-60 except that new data is not read in.

Line 700 - The RETURN statement redirects the program control back to the statement in the main program immediately following the GOSUB statement which called the subroutine.

When the program is run the output to the terminal will be:

```
INITIAL LIST 1
-10 6 3 50 -7 0 41 32 9 15
SORTED LIST
-10 -7 0 3 6 9 15 32 41 50
INITIAL LIST 2
18 -4 -50 61 11 18 22 -1 99
6 SORTED LIST
-50 -4 -1 6 11 18 18 22 61 99
```

The use of subroutines enables programs to be constructed in a modular way. This makes testing and de-bugging easier, since each subroutine can be individually tested using a test program, before it is combined with the main program.

### Nested Subroutines

A 'nested subroutine' call is a call to a subroutine from within a subroutine. Subroutines can be nested to several levels (the limit on the level of nesting is dependent on the version of BASIC being used). Each GOSUB must have a corresponding RETURN statement. The following simple program illustrates how subroutines can be nested:

```
10 REM NESTED SUBROUTINES
20 GOSUB 200
30 PRINT "LINE 30"
40 END
200 PRINT "SUBROUTINE 1"
210 GOSUB 500
220 RETURN
500 PRINT "SUBROUTINE 2"
510 GOSUB 800
520 RETURN
800 PRINT "SUBROUTINE 3"
810 RETURN
```

The GOSUB statement on line 20 calls the subroutine starting at line 200, line 210 prints out the message identifying the subroutine and then the GOSUB on line 210 calls the second subroutine. This subroutine prints a message and then calls the third subroutine. The RETURN statement on line 810 directs the program to line 520, the statement immediately following the GOSUB which called the third subroutine. Line 520 is a RETURN statement which directs program control back to line 220 which in turn directs control back to line 30 of the main program. The output when the program is run would be:

```
SUBROUTINE 1
SUBROUTINE 2
SUBROUTINE 3
LINE 30
```

### The ON GOSUB Statement

The ON GOSUB statement is similar to the ON GOTO statement described previously, in that it is used to implement a semi-conditional branch. The ON GOSUB statement has the general form: Line number ON variable or equation GOSUB list of line numbers For example, 10 ON X GOSUB 600, 800, 1000

Based on the integer value of the variable X, the program branches to one of the list of alternative subroutines. The selection is made in numeric order. So, for the above example:

if X is 1 - the program branches to the subroutine at line 600

if X is 2 - the program branches to the subroutine at line 800

if X is 3 - the program branches to the subroutine at line 1000

When the RETURN statement of the subroutine which is referenced is reached, the program control is directed back to the statement in the main program which immediately follows the ON GOSUB statement.

The number of alternative lines to be branched to is only limited by however many can be written on one program line. If the value of the variable or equation is zero, negative or larger than the number of alternative lines, program execution will stop and an error message will be output by the computer.

# ATARI NEWS

## ATARI VIDEO GAME Latest Cartridge Details

The fabulous Atari Video Game goes from strength to strength. To bring you up to date here are full details of the games released since publication of our latest catalogue. These will be incorporated into our 1983 catalogue due for publication in October 1982.



### Dodge 'Em

For one or two players using joysticks, this cartridge contains three different games. In game 1 you drive a racing car around a four-lane track whilst the computer's car tries to crash into you. The more track you run over, the more points you score, but you must avoid the computer car. If you manage to cover all the track another track appears and if you clear that too, the computer comes after you with two cars!

In game 2, for two players, you and your opponent take turns against the computer, whilst in game 3, one player controls the point-scoring car and one the crash car. After each turn, the roles are reversed.

### Peie's Championship Soccer

For one or two players using joysticks, this game cartridge contains 54 different games. Games 1 to 27 are for two players whilst in games 28 to 54 you play against a computer-controlled team. In single-player games, if your score is higher than the computer's then the computer becomes more difficult to beat and if lower then it becomes easier to beat. Each team has four players: Crash Morgan - the goalie, Nick Danger - the forward, Lumpy Duran - the left-back, and Alexie Putsnowski - the right-back. There is also a linesman and referee, and many of the usual moves are included such as throw-ins, goal-kicks, corner-kicks and dribbling.

In games 1 to 9 and 28 to 36 the teams move slowly. In games 10 to 18 and 37 to 45 the teams move moderately fast and in games 19 to 27 and 46 to 54 the teams move fast. In games 1, 4, 7, 10, 13, 16, 19, 22, 25, 28,

31, 34, 37, 40, 43, 46, 49 and 52 the goals are large and therefore it is easy to score goals. In games 2, 5, 8, 11, 14, 17, 20, 23, 26, 29, 32, 35, 38, 41, 44, 47, 50 and 53 the goals are medium sized and in the other games the goals are small in size.

In games 1 to 3, 10 to 12 and 19 to 21 there are no penalties and balls rebound from the side-lines and goal-lines. In games 4 to 6, 13 to 15 and 22 to 24 there is a penalty if the ball goes over the side-lines. In games 7 to 9, 16 to 18 and 25 to 27 there is a penalty if the ball goes over the side-lines or goal-lines.

In games 28 to 30, 37 to 39 and 46 to 48 the computer is easy to beat, in games 31 to 33, 40 to 42 and 49 to 51 the computer is moderately difficult to beat and in games 34 to 36, 43 to 45 and 52 to 54 the computer is difficult to beat.

### Maze Craze - A game of Cops 'n Robbers

For one or two players using joysticks, this game cartridge contains 256 different games. You're a cop confronting danger and suspense as you and your opponent wind your way across the city blocks. You must reach the exit to the maze to win, though you may encounter armed robbers, blockades and other obstacles that will hinder you finishing your beat.

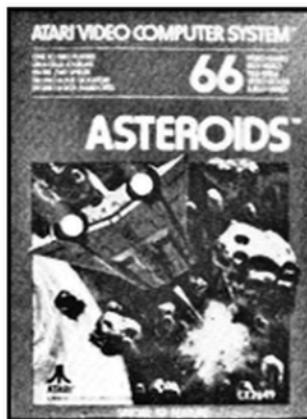
There are 16 basic games and for each you can set the speed at which the cops and robbers travel through medium, fast, slow or calculatingly slow and you can set the visibility. You can either see all the maze, most of the maze, a small part of the maze or the whole maze is invisible.

In game 1, the computer occasionally displays the whole maze briefly during blackouts or low visibility (auto peek). In game 2 there are two robbers and you can press a button to see the whole maze (player peek). Game 3 is as game 2 except that there are three robbers. In game 4 you have to capture three robbers before you can leave the maze (capture) and "auto peek" operates during this game. In game 5 there are three robbers and if they touch you, you are paralysed for a short time (wounds). In game 6 with total visibility set, there are five robbers, but with partial or total invisibility set, the standard game operates and includes "player peek".

In game 7 with total visibility set, there are five robbers, but you cannot leave the maze until your opponent is knocked out by the robbers (terror). With partial or total invisibility set, the standard game operates, but a scout randomly leads the way.

Game 8 features "capture", "player peek" and "blockade", where you can confuse your opponent by leaving a blockade that resembles a dead-end in the maze. In game 9 there are two robbers and also in game 10 which additionally features "terror". In game 11 there are three robbers and "blockade" operates.

Game 12 features "capture", "auto peek" and "blockade". In game 13 there are two robbers and "player peek" and "wounds" are the special features. Game 14 features "capture" and "player peek". In game 15 there are three robbers and "auto peek" and "terror"



are featured. Finally, game 16 is the standard game with no extra features.

### Hangman

For one or two players using joysticks, this game cartridge contains nine different games. In games 1 to 8 the computer chooses a word and you may have 11 incorrect guesses to discover what it is. Games 1 to 4 are for one player, whilst in games 5 to 8 two players compete to find the missing letters. Games 1 and 5 use easier words than 2 and 6 and so on.

In game 9, one player chooses a word and the other player has to guess it. In all games the computer draws part of a monkey every time you select an incorrect letter. You score one point for every game you win and in two-player games, the winner is the first one to score 5 points. With the difficulty switch on the console set to 'A', you only have 20 seconds to choose a letter.

### Video Checkers

For one or two players using joysticks, this game cartridge contains 19 different games. Games 1 to 9 are checkers (draughts) and games 11 to 19 are giveaway checkers in which you try to be the first player to lose all your pieces and in all these games, you play against the computer. Game 10 is for two players competing with each other.

In game 1 and 11 the computer does not study the situation very deeply before making its move. In games 2 and 12 the computer looks further ahead and soon. The video game uses all the standard rules of checkers and makes sure that you jump when able and that a piece is promoted to a king on reaching the back row.

Pieces may be moved and returned and moved again until you signify that you are happy with your move. The computer will not allow illegal moves. Approximate times for the computer move is as follows:

Game 1,11 - 1½ sec.

Game 2, 12 - 2 sec.

Game 3, 13 - 3 sec.

Game 4 - 5 sec. Game 14 - 4 sec.

Game 5 - 10 sec. Game 15 - 6 sec.

Game 6 - 30 sec. Game 16 - 14 sec.

Game 7 - 1 min. Game 17 - 30 sec.

Game 8 - 4 min. Game 18 - 2 min.

Game 9 - 15 min. Game 19 - 8 min.

### Othello

For one or two players using joysticks this game cartridge contains 4 different games.

All the standard rules of Othello apply. Game 4 is for two players opposing each other. Games 1 to 3 are for one player against the computer. In game 1 the computer has the skill of a novice; in game 2 it plays with average skill and in game 3 the computer is expert.

The screen displays a grid of 64 squares and play commences with two white and two black pieces in the centre. When it is your turn you must place a piece on the grid so that that and another piece outflank one or more of your opponent's pieces. You score one point for each square captured and the game ends when neither player can make a move. The computer will not allow illegal moves. The computer will allow you to set up a board so that specific problems or experimental situations can be worked out.

### Video Pinball

For one or two players using joysticks, this game cartridge contains 4 different games. Pull back the plunger and press the red button to fire the ball onto the table. Each spinner you strike counts 1 point, diamond shaped "drop targets" count 100 points and increase the value of the three bumpers by 1 for each one hit. The bumpers count 100 points times their current value. The Atari rollover is worth 100 points and if you hit it over three times you receive an extra ball. The left rollover is worth 100 points increasing each time you hit it and you get 1000 points per hit when the ball drains. A special target lights up every now and again and if hit, scores 1000 points. You control the flippers and you can nudge the ball using the joystick, but beware. If you nudge too much the tilt light will come up and your game is ended.

Game 3 is a more difficult version of game 1 and both are for one player. Game 2 is a two-player version of game 1 and game 4 is a two-player version of game 3. In two-player games each player takes a turn with one ball at a time. Set the difficulty switch to 'A' if you're a pinball wizard.

### Asteroids

For one or two players using joysticks, this game cartridge contains 66 different games. You are the commander of the Cosmic Space Patrol in the midst of an asteroid belt. You must position the ship and fire your photon torpedoes to break up and finally destroy the asteroids. If the difficulty switch is set to 'A', satellites and UFO's appear at random and

must be destroyed also, but look-out, because they'll fire back at you.

You score 20 points if you hit a large asteroid, 50 points for a medium asteroid, 100 points for a small asteroid, 200 points for a satellite and 1000 points for a UFO. With each game you have four spaceships. Games 1 to 33 are for one player whilst games 34 to 66 are for two players taking turns. All odd numbered games up to 33 are slow speed games while even numbered games are fast and from 34 to 66 even numbered games are slow and odd numbered games are fast. In games 1, 2, 9, 10,17,18,25,26, 33, 34, 35,42,43, 50, 51, 58, 59 and 66 you are awarded an extra ship for every 5000 points you score. In games 3, 4, 11,12,19,20,27,28, 36,37,44, 45, 52, 53, 60 and 61 you are awarded an extra ship for every 10,000 points you score. In games 5, 6, 13, 14, 21, 22, 29, 30, 38, 39, 46, 47, 54, 55,62 and 63 you are awarded an extra ship for every 20,000 points you score. In the remaining games no extra ships are awarded.

In games 1 to 8, 3 to 41 and 66 you can jump into hyper-space to get out of a tricky situation, but you could reappear in the path of another asteroid so only use this as a last resort. In games 9 to 16 and 42 to 49 you can surround your ship with shields, but don't leave them up for more than 2 seconds or you'll explode. In games 17 to 24 and 50 to 57 you can flip your spaceship through 180°. Games 25 to 32 and 58 to 65 have no extra features. Games 33 and 66 are especially easy versions for young children.

### Missile Command

For one or two players using joysticks, this game cartridge contains 34 different games. Aliens from the planet Krytol are firing interplanetary ballistic missiles and cruise missiles at your cities. Defend them with your antiballistic missiles. Each wave of ballistic missiles comes faster than the previous wave. In odd numbered games up to 17 and even numbered games from 18 your target moves slowly whilst in all other games it moves quickly. In games 1, 2, 5,6,9,10,13,14,17 to 19, 22, 23, 26, 27, 30, 31 and 34 the attacking missiles move in straight lines, but in the other games they can detect and try to avoid your antiballistic missiles. Games 1 to 17 are for one player and games 18 to 34 are for two players taking turns. In games 1 to 4 and 18 to 21 the first wave of missiles is very slow, in games 5 to 8 and 22 to 25 the first wave of missiles is faster, games 9 to 12 and 26 to 29 start faster still and games 13 to 16 and 30 to 33 start very fast. Games 17 and 34 are very slow and the attacker has less missiles making them suitable for young children.

### Coming Soon

Three new cartridges are planned for release in November this year. Full details in the next Maplin Magazine.

War Lords

28 games using paddle controllers.

Super Breakout

Flag Capture

10 games using joystick controllers.

**And look out for four more fantastic games due in early 1982: Sea Wolf, Stellar Trek, Battle Zone and Lunar Lander!**

# ATARI NEWS

## ATARI COMPUTERS

With thousands of the Atari 400 and 800 computers already sold around the country, you're sure to be interested in more details about the software available. Here's some information about four of the programs that have been available as well as three new ones and two new books specially written for the Atari computers.

### Graph It

Graph It is a suite of 5 programs which are:

Bar Charts

Pie graphs

Two-dimensional x, y plots

Two-dimensional polar plots

Three-dimensional x, y, z plots

### Bar Charts

Each chart can have a title of up to 20 characters and may control up to 32 columns. It is possible to produce bars with 3 factors contained in each bar and each factor will be displayed in a different colour. Column labels are 3 characters.

### Pie Graphs

You may display 1 to 12 slices and each graph may have a main title and sub-title of up to 20 characters. Labels for slices may be 3 characters.

### Two Dimension X, Y Plots

From 1 to 3 functions can be plotted and you have a choice of 4 plotting speeds. Optional auto-scaling on the Y axis is also included.

### Three Dimensional X, Y, Z Plots

You have a choice of 2 plotting speeds. It is also possible to remove hidden lines and the plotting may be speeded up by the "non display whilst drawing" option which means you only see the plot when it is finished. Many other facilities are offered in this package, including the ability to move a cursor using the joystick. The cursor may be positioned over the graph and if the stick button is depressed then the graph parameters at that point will be displayed numerically at the bottom of the screen. The documentation provided is of a step by step nature and should be easy to follow.

To use this package you require a 16K machine and an Atari 410 recorder.

### Energy Czar

Energy Czar is a simulation game of energy management in the USA. You have to solve the problems of increasing demand and decreasing supplies. The simulation is designed to teach you about energy, economics and politics.

The President of the United States has given you total control of energy policy and you can promote or ration your resources. You also have to take into account taxes, price regulations and environmental risks and controls.

To retain your position you must hold the support of the people and maintain sufficient



energy supplies to meet demand. If you fail in these requirements you will be sacked.

Every 5 years you face a possible opinion poll which rates your overall performance. If at least 75% of the people think you are doing a good job you win and may retire.

Graphics on this simulation consist almost entirely of graphs which give you a very rapid overall picture.

This software is provided on cassette and requires a 16K machine and 410 cassette recorder.

### Statistics

This program will provide a good basis for data analysis. Functions provided are mean, mode, median, standard deviation, variance, skewness, kurtois and root mean square in a single process. You are provided with a data editor which allows quick corrections of data errors.

This software is menu driven and the options are:

INPUT	new database
EDIT	data points
SAVE	database to cassette or disk
LOAD	database from cassette or disk
PROCESS	data
PRINT	data points
RETURN	to BASIC

All information may be printed to the screen or to the printer and facilities are given for on screen graphs.

The program is provided on cassette and requires a 16K machine and Atari 410 cassette recorder. If you have a larger memory machine it will give you the ability to hold a larger database. Also you may copy the statistics program disk allowing faster loading time.

### Scram

Scram is an educational simulation that teaches the principles of nuclear power generation.

The object is to generate as much electricity as possible without causing a melt down. From time to time an earthquake will occur and you must then locate and fix broken parts of your reactor.

Graphically the game is excellent with good use of colour and animation. This software was written to encourage the development of:

Logical and objective thinking.

Problem recognition in complex systems.

Spotting cause and effect relationships.



Effective analysis and solution of problems. Two versions of this program are provided on the cassette, one requires 16K, the other 24K. It can be used with either 400 or 800 computers.

### NEW ITEMS OF SOFTWARE

Our first shipment of Personal Software has just arrived and includes:-

#### Visicalc

The world's best selling program ever, has now been re-written for the Atari systems. This package is invaluable for the businessman who does not have the time to write programs but requires a specialist piece of software. It can replace any calculations that are normally done in tabulated form on paper.

You provide the relationships between the rows and columns and from then on any figure that is adjusted and used in any calculations on the sheet will automatically update the rest of the data.

Calculation sheets with or without data may be saved to disk and recalled at a later date or merged with other files of data. Printout facilities are also provided so that you can take a hard copy.

Requires: 32k 800 and 810 disk drive.

#### Microchess

An implementation of the ever popular Microchess by Peter Jennings.

IQ level may be set so that you can progress as your skill grows. Makes excellent use of the Atari's ability to support re-defined character sets.

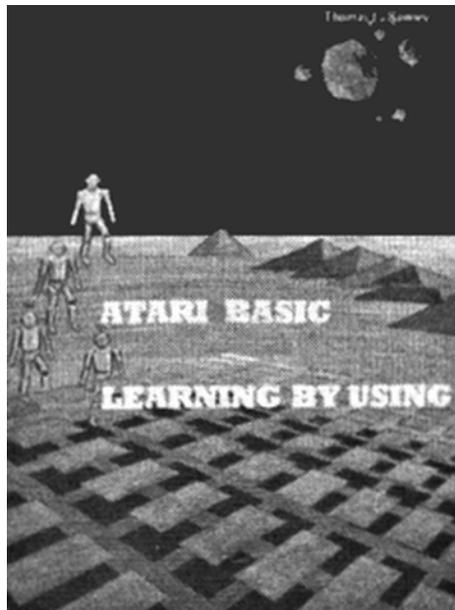
Requires: 16k 400 or 800 and 410 cassette recorder.

#### Checker King

An absolute must for Draughts fanatics. This program written by Michael Marks provides a very worthy opponent. Again the IQ level is selectable, making this program appeal to a wide age range.

Special attention has been given to the movement of the pieces as you play and Player Missile Graphics is used to make the pieces glide around the board.

Requires: 16k 400 or 800 and 410 cassette recorder.



### Atari Basic Learning by Using

by Thomas E. Rowley

This book has been written specifically for the Atari owner and contains many program listings.

Some of the programs contained in the book are of a very simple nature and so will be suitable for the complete beginner, however a rudimentary knowledge of the Atari BASIC reference manual will be necessary to completely understand each program. Many of the listings can be used as sub-routines and incorporated into your own software. Much can be learned from playing around with them as a complete program in their own right.

The book is divided into several sections which are headed:

- Screen drawing
- Special sounds
- Keys, paddles and joysticks
- Specialised screen routines
- Graphics and sound applications
- Peeks, pokes and special instructions

For the more advanced Atari programmer, this book offers many interesting sections and some of the techniques described have not previously been documented by Atari. These include explanations of display lists, player missile graphics and character set redefinition. Display list routines enable you to create your own screen modes and graphic pages i.e. mix text and plotting areas on the same screen.



Player missile graphics and character set redefinition may be used together or independently and either way they both enable the user to perform animation simply. Whether you are just starting or more advanced with your Atari computer system, this book is a must for you.

### Atari Personal Computer System Operating System Users Manual and Hardware Manual

This is a large and very useful document and may be considered as the best documentation available from Atari at present.

The manual provides a description of the resident operating system and provides information on:

The functions provided by the system and how to use them

The organisation of the various subsystems  
The characteristics of the Atari peripheral devices which may be attached Standard techniques for going beyond the basic operating system capabilities The general nature of the hardware involved

The manual assumes a reasonable knowledge of the internal workings of a microcomputer system and some knowledge of 6502 assembly level programming would be helpful. The first part of the manual deals with I/O routines and gives very comprehensive details of peripheral, screen and keyboard handling. Perhaps the most interesting sections are those at the back of the manual which cover Display List creation and Player Missile Graphics memory maps and controlling registers, indeed any OS register that is shadowed in RAM is described in great detail thus allowing the user to write powerful routines using facilities hitherto undocumented.

### Subscribe To 'Analog' Magazine - The New Mag Especially For Atari

We are now offering subscriptions to 'Analog' Magazine. This is an independently produced publication from two of America's leading Atari owners and provides program listings, hints and tips, programming ideas and software reviews, along with all the latest news from Atari themselves.

Supplies are a little erratic and the subscription is for six issues (it takes a variable amount of time to import these items and they will be shipped as we receive them).

More Atari News on page 62.



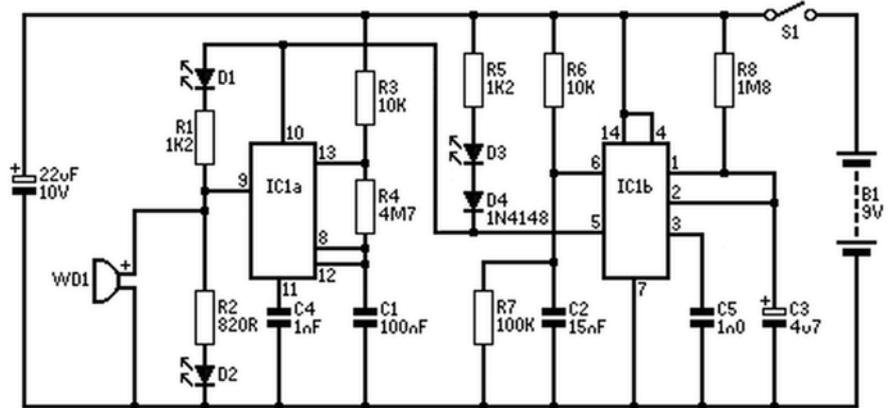
# CIRCUIT MAKER

Readers contributions can be an original feature or constructional article describing electronic or electro-musical equipment which is ideally a complete building block that will aid the circuit-maker. All ideas and circuits presented for publication should have been proved before submission and should include a circuit diagram and explanatory text.

## Car Race Starter Mods

The E&MM Car Race Starter (August 1981) worked perfectly on the test bench, but was rather prone to false triggering if placed near the car track. This problem became worse as the battery discharged. In order to avoid this some extra decoupling was added, and the circuit was modified so that a dual CMOS timer (7555) could be used instead of the two discrete timers used in the original, with the consequent reduction in current consumption.

In the original a bipolar timer was used for the monostable period during which the lights flash and the buzzer sounds. A bipolar version was necessary because it had to source the entire supply current for the astable timer, buzzer and LEDs. The modified version here uses the reset line of the astable timer to inhibit its operation. This reset line is connected directly to the output of the monostable timer. As a result the astable



will only oscillate when the monostable output is high. The LED D1 must also be a source from this reset line so that it will go out when the monostable period is over. Consequently, the timer for the astable may have the supply

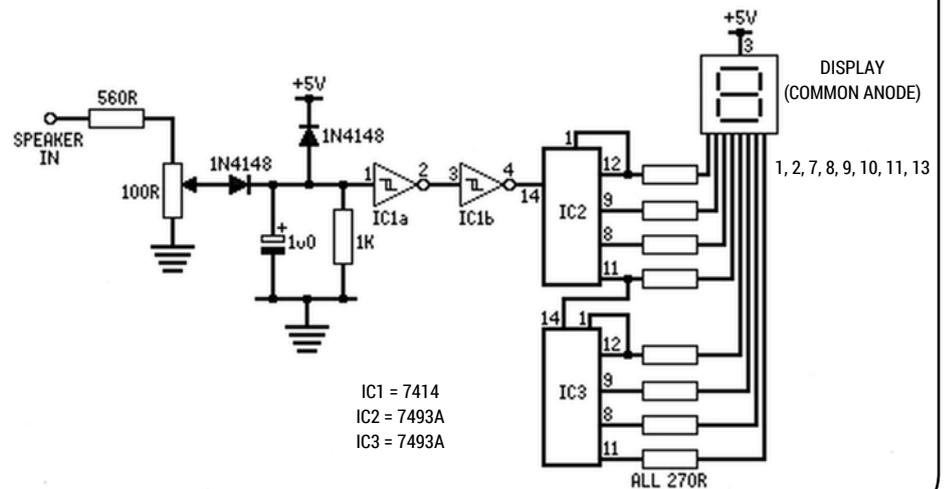
connected permanently thus allowing the use of the dual CMOS 555.

Additional decoupling in the form of two 1n0 capacitors to the control voltage inputs and a 22µF supply line decoupler is also suggested.

## Novel sound to light

Jeremy Hendy, Bishop's Stortford, Herts

This small unit provides a pseudo random pattern on a LED seven segment display which changes in time with a musical input. The actual display is driven from two 7493 counters connected in series, the outputs being connected to each segment and the decimal point via 270 ohms resistors. In this way, as the counters are clocked up to a maximum of 256, each number will correspond to a different pattern. The clock is derived directly from a , loudspeaker output and, after being rectified and smoothed by the capacitor, it is squared up by the Schmitt trigger gates. Note the addition of a diode to the +5 volt rail; this must be included in case high amplifier levels are used. The potentiometer acts as a level control and should be adjusted for the most pleasing effect.

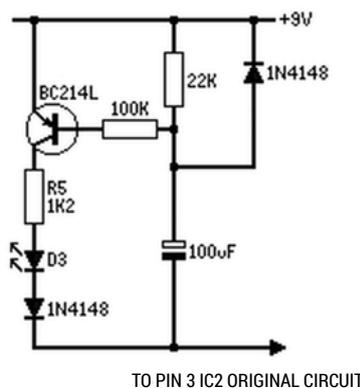


IC1 = 7414  
IC2 = 7493A  
IC3 = 7493A

## Car Race Starter Power Saver

One of the main reasons the E&MM Car Race Starter (August 1981) uses up power is because the red 'start' LED remains on once the race has started and people are too busy controlling cars to think about turning the unit off. The circuit may be modified such that the red LED lights to full brightness as soon as the flashing and buzzer stops, as in the original but over the next six seconds fades away leaving a standing current of only 6 mA (or 1 mA if the dual CMOS 555 version is built - see in other Circuit Maker: Car Race Starter Mods). Needless to say this offers a considerable saving over five minutes!

The circuit shown replaces the LED and resistor which were connected from pin three of IC2 in the original (D3



and R5). During the timing cycle pin three is high, and so the 100µF capacitor is fully discharged since the same voltage is present on both plates. Obviously the LED does not light and the entire circuit may be said to be nonfunctional. Once pin three falls towards 0 volts at the end of the timing cycle the voltage at the top end of the capacitor will also fall since it is still discharged. This turns on the transistor and the LED lights. The capacitor will start to charge up, and as it does so the transistor will become progressively less 'on' until the LED goes out, leaving only a small leakage current.

It has been found necessary to add the extra diode in series with the LED when using some 555's to prevent the LED glowing. This seems well worth adding at the same time.

### Car Lights Reminder

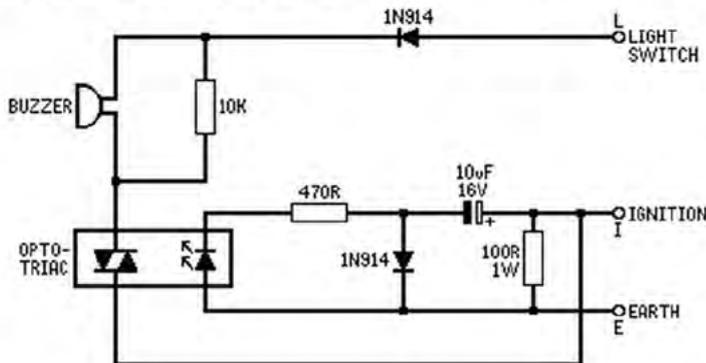
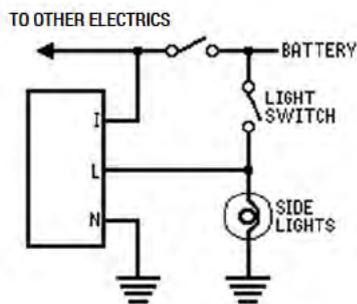
P. Glover, Ockbrook, Derby

This circuit will produce an audible alarm if the lights are left on when the ignition is switched off. If the lights are turned on when the ignition is off the alarm will not sound.

With the ignition on the capacitor charges via the diode. If the ignition is switched off the capacitor discharges through the LED in the optotriac. With the lights on there will be a voltage present across the triac so that it will trigger and sound the buzzer.

The circuit can be reset by turning the lights off for a short moment, which allows the triac to switch off and not switch on again.

The circuit is connected to the car via three wires; to the ignition switch, light switch and earth as shown in the circuit diagram.



### Construction tip:

#### Lettering front panels

It is very hard to remove a rubdown letter from an anodised panel without either scratching the panel, or leaving a slight dark area. If the panel is sprayed with a couple of coats of suitable varnish prior to lettering, subsequent removal of letters becomes much easier. After lettering, the panel is finished in the usual way; the final version is often more scratch resistant than the normal method because the lettering is sealed between two layers of varnish.

### Jack Plugs

Many high quality mono jack plugs are held together by a nut screwed to the top of a shaft connecting directly to the tip. After much use this nut tends to work loose, eventually resulting in the loss of the tip from the plug. It is well worth dismantling all plugs of this type and re-assembling them with a drip of Loctite Torqueseal on the screw thread. This prevents the nut from working loose and saves the cost of a new jack plug every time the tip is lost.

### Audio Lead Connections

Every time an audio lead is made up, particularly those using DIN plugs, the question of which wire is which occurs. The lead is invariably made up wrongly, necessitating alteration afterwards with the end result that the lead is not as neat or reliable. This Circuit Maker guide should help avoid this, hopefully all the common lead connections for audio use are covered.

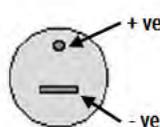
One useful tip is for dealing with 5-pin DIN leads for interconnecting tape recorders and amplifiers. The problem is that although a tape recorder may be connected directly to an amplifier using a straight through lead (pin 1 to 1,4 to 4 etc), connection of two tape recorders requires a back to front or 'mirror' lead (pin 1 to 3,4 to 5 etc). This implies that any lead set must have a collection of straight and mirror leads. It is, however, much easier to wire all leads straight through and make an adaptor using a DIN plug and socket wired in mirror form about 6" long. Any straight lead may be then transformed to a mirror lead with the adaptor, thus saving the "is it mirror or straight?" question.

It is also useful to own a channel reverse adaptor for when problems occur in one channel. The channels can then be easily reversed until the cause of the problem is isolated (pin 1 to 4, 4 to 1 etc).

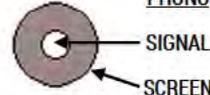
### DIN EQUIPMENT SOCKETS



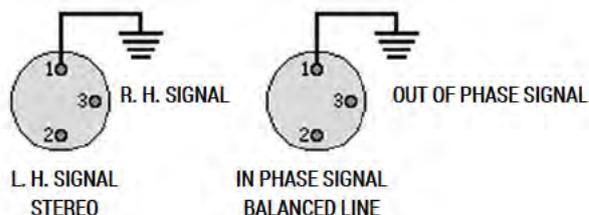
### DIN SPEAKER



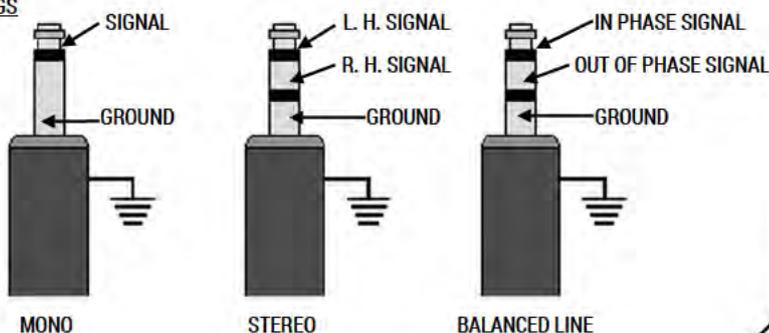
### PHONO



### XLR CANNON



### JACK PLUGS



# HOW TO SOLDER

by Richard Bushell

Soldering is a term applied to an alloying process in which the applied solder combines with the metals to be joined together. To achieve this it is essential that the surfaces to be joined are clean. It is not sufficient, however, solely to clean the surfaces and then hope to make a joint with solder. It is necessary to apply - during the soldering operation - a wetting agent or flux, which removes the existing oxide film on the surfaces to be soldered, and prevents further formation of oxide.

The solder in common use is in wire form, ranging from 60/40 to 20/80 tin/lead composition, with a core of activated resin to provide the correct proportion of flux.

## Soldering Irons

Soldering irons are available in numerous shapes, sizes, power consumption and bit temperatures; the following factors should be considered when choosing an iron:

1. Supply voltage available.
2. Heat capacity, depending on size of joints required to be soldered.
3. Temperature required to ensure that the solder flows freely.
4. Size and shape of tip for adequate contact with joint.

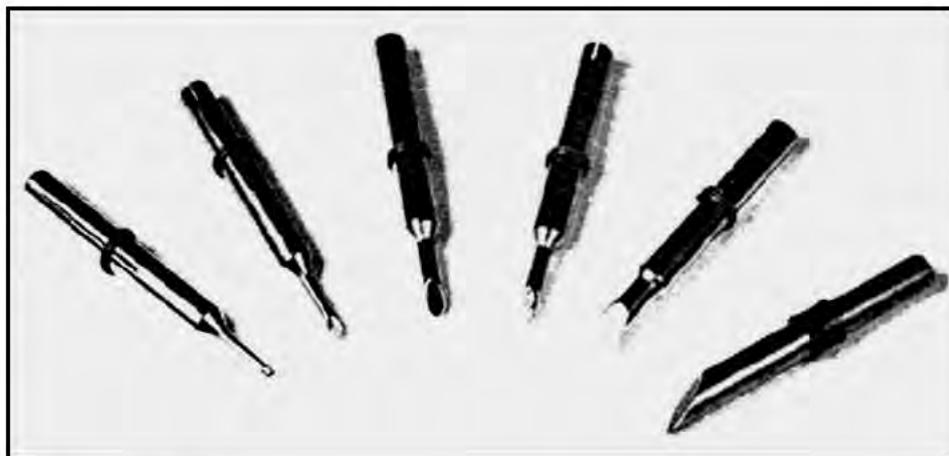
In general, for circuit wiring and similar work, the smallest types are the most useful. These are usually described as miniature or sub-miniature irons. A miniature type iron weighs 55-85 grams and enables useful finger tip control; it is also less tiring to use than the heavy types which usually have to be held in the palm of the hand. Miniature irons are available in power ratings from 8-40 watts.

The temperature at the tip of the bit must be high enough so that the heat transferred to the joint permits the solder to flow freely. One should remember that there is always a loss of temperature when making a joint because the heat transfer to the jointing metals, melting the solder. Therefore, the bit temperature should always be approximately 100°C higher than the melting point of the solder, or, for continuous work, 150°C higher.

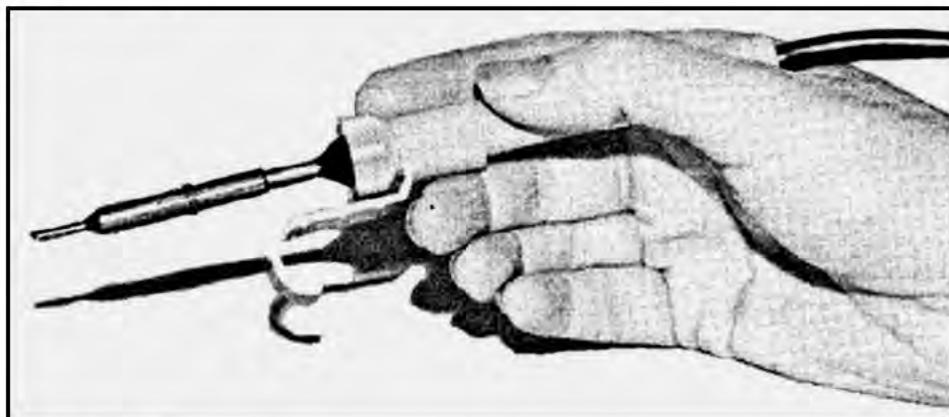
These bit temperatures apply to miniature soldering irons and allow for a drop in "tip" temperature as it is applied to the joint. The tip temperature is closely related to the size of the tip; the smaller the tip, the lower the temperature at the tip for a given power consumption. The size of the tip is, of course, determined by the size of the joint requiring to be soldered and should be large enough to match as precisely as possible the size of the joint. This way, adequate conduction of heat from tip to joint is ensured.

## Tips and Bits

A feature of the modern soldering iron is the material and finish or coating deposited on it. The most important of the many



A selection of bits.



Holding the iron.

material combination features are the following:

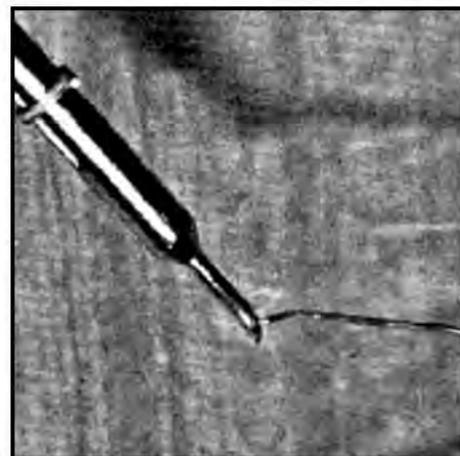
1. Bits made of high conductivity copper coated in iron, nickel or chromium.
2. Bits made of copper alloy, usually chromium copper, or beryllium copper and nickel, or cadmium coated to prevent scaling.
3. Copper bits fitted with iron or nickel tip.

The use of a high copper content provides the most efficient bit, but scaling occurs at a comparatively low temperature and the bit will be subjected to pitting in use.

These objections are overcome by coating both the bit and the tip with other materials. Iron coating is usually employed which prevents loose scaling and considerably increases the life of the bit, the latter being dependent on the thickness of the coating applied. Here again, a compromise is necessary, as a thick coating on the tip impairs the efficiency. The copper bit treated in this way may be used at considerably higher temperatures but care must be taken to keep the tip tinned or a rough oxide coating will build up and so prevent further use.

## Using the Soldering Iron

The iron must be correctly connected to the power supply before use. The circuit to



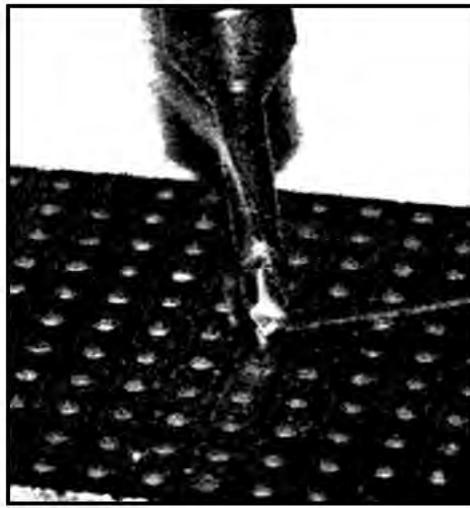
Tinning the bit.

which it is connected should provide adequate protection for the operator in the event of a fault occurring, or, for example, as a result of damage due to dropping the iron. This protection is usually provided by the fuse.

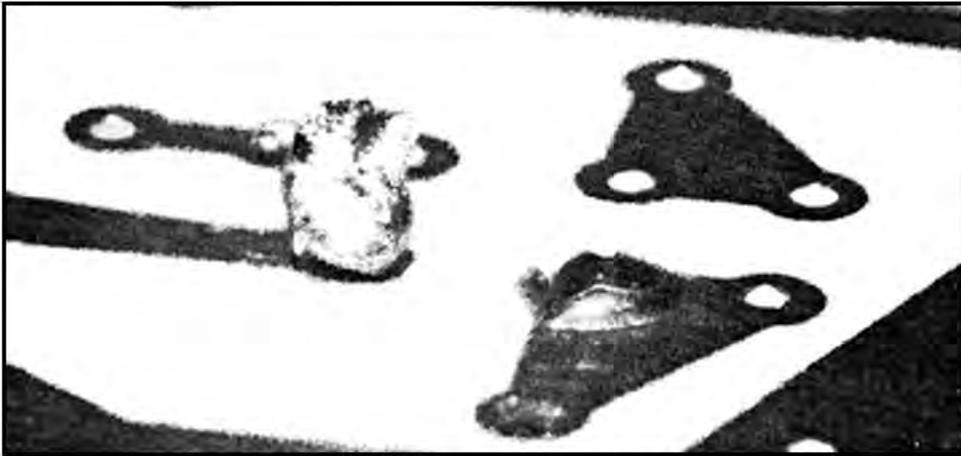
Surplus solder should be wiped from the tip of the iron. Do not shake the iron free of solder. This action is not only dangerous to the operator but may damage the work being soldered and/or the soldering iron. The iron should never be knocked on the bench in order to remove surplus solder. This will inevitably cause damage to the iron and may



Heating the joint before applying solder.



Making the joint.



Example of a dry joint (left) and a good solder joint (right).

result in serious burns or shock to the operator.

Before the soldering iron can be used, the tip of the bit must be tinned and this operation is best carried out using the resin cored solder. It is essential to tin the tip before the oxidation temperature of the bit material is reached. To ensure this, apply the solder to the tip immediately the iron is switched on and, as the solder melts, apply it over the whole surface of the tip. Some surplus solder will remain, this can be removed carefully with the wiping pad.

The iron should then be used immediately - prolonged heating of the bit may result in the solder forming a film of oxide which will impair the strength of the solder joint. Before the iron is left idle, some surplus solder should be applied to the tip to prevent oxidation of the basic metal of the tip.

If the iron is not to be used for a considerable time, it should be switched off. Modern irons heat up quickly so little time will be wasted in taking this precaution.

When the iron is heated up and the tip properly tinned, it is ready for use. All miniature and sub-miniature irons are intended to be held as one would hold a pencil, between the fingers and thumb, with the handle projecting between the first finger and thumb and the connecting lead resting over the wrist.

When soldering a joint, first apply a small amount of fluxed solder to the tip of the bit. This will ensure a better heat transfer to the joint since the interface will be a molten solder which can cover a greater surface area. Place the tip on the joint and keep it in contact until the joint reaches the melting point of the solder, then apply sufficient solder to the joint (not the tip!) such that the whole joint is embraced by solder. Leave the tip in contact with the joint to ensure complete solder flow around the joint. A joint that is dirty or heavily oxidised cannot be soldered with normal resin cored solder; it is therefore essential, before attempting to solder a joint, to see that it is clean.

It is common practice to pre-tin all components and wires before assembling them ready for jointing. An excessive amount of solder should not be applied, either to the tip or the joint. It is difficult to remove surplus solder from a joint, and excessive application of solder to the tip causes premature tip wear.

Inexperienced operators usually use far too much solder which results in excessive operating costs and premature erosion of the tip of the bit. Also, more often than not, they apply the solder to the tip instead of the joint, usually well before the joint has reached the required temperature.

In continuous soldering processes it should not be necessary to remove any surplus solder from the tip. If it is necessary, too much solder is being used. In mass

production, an operator usually solders only one or two joints on an assembly and uses a soldering iron fitted with the correct size and shape of bit for the size of joints to be soldered. In batch production work, however, it is necessary for the operator to solder several joints on an assembly which could be of different sizes. This type of work requires different size tips and often different size irons; the operator often has two or three irons, each fitted with the type and size of bit for the corresponding size joint. This method is usually more economical than continually changing the bits. In an experimental laboratory, it is usual to find at least three different sizes of soldering iron because the work is so varied.

## Soldering Joints on Transistor Circuits

Special problems arise when soldering circuits involving joints near transistors because these delicate components are easily damaged by the application of too much heat to the connecting wires. This is overcome by using a heat shunt, clipped on to the wire between the joint and the transistor. It is necessary to solder the joint as quickly as possible, and it is therefore essential that the tip of the bit is hot enough to melt the solder quickly and that the wires to be jointed are cleaned and, preferably, pre-tinned.

The wiring in transistor circuits should always be earthed correctly and the circuit board disconnected from any test gear and power supplies, otherwise an earth loop may be created when the bit is applied to the joint, creating a potential difference across the electrodes of a transistor in excess of its maximum rating.

## Care and Maintenance of Soldering Irons

In common with all tools, the soldering iron has to be maintained in good condition. Two categories of maintenance are necessary:

1. Re-conditioning the bit and cleaning the iron.
2. Replacement of worn or broken parts.

The bit should always be kept in good condition and well tinned on the working surface. Excess solder on other parts of the bit should be quickly removed as this may cause rapid pitting of the surface and so shorten the life of the bit.

Prepared or coated bits should not be filed to shape or cleaned with any abrasive material. The coating is applied in order to prevent or reduce the effect of pitting and considerably increases the life of the bit.

If the soldering iron is fitted with a removable bit, this should be removed at intervals and any loose oxide film removed from the iron and bit. This will prevent the oxide building up and eventually fixing the bit to the iron shaft, making removal of the bit difficult if not impossible.

All parts of the iron should be kept clean and free from grease or moisture. The connecting lead should be regularly inspected for burns and cuts.

# VIDEOTEXT

by I. J. Sturley

Teletext & Viewdata.

What's it all about?

And who needs it?

## TELETEXT

There should be few people reading this article who have not heard of Teletext. It is the system which brings up-to-date news and information to your television screen whenever the BBC or IBA are broadcasting. The information services are known as CEEFAX (See Facts) on BBC and ORACLE (Optical Reception of Announcements by Coded Line Electronics!) on ITV.

The broadcast Teletext standard was first published in 1974; jointly by the British Broadcasting Corporation, the Independent Broadcasting Authority and the British Radio Equipment Manufacturers' Association. It was revised and enhanced to the current specification of September 1976 and is currently undergoing further revisions to include such features as high resolution graphics and alternative character sets.

To receive Teletext a special decoder is required. This is either incorporated into the television set or it may be a separate adaptor which modulates the information on to a UHF carrier, so that the aerial socket of a standard black and white or colour television receiver can be used. The quality of the displayed text from a built-in decoder is superior to that of the adaptor since the RGB drive does not introduce 'patterning'.

Teletext is a system by which the digitally coded information is inserted into the lines in the vertical fly back interval of the TV signal which carry no picture information. The coded information consists of a header, which incorporates special codes for page erase, newflash, subtitle and update, and a page display which contains up to 24 lines of 40 characters of text and/or graphics in 7 colours, including white. The header and data lines contain hamming codes for error detection and single bit error correction at the receiver. The system is directly applicable to 625 line 50 Hz television systems with a video bandwidth of greater than 5 MHz. At 2 lines per field it is capable of transmitting four full pages of text per second, or more if unoccupied rows are not transmitted. This rate of transmission means that the average time to select a page is approximately 12 seconds per magazine. The system has a capacity of eight 100 page magazines where each page may have 3200 versions which may be transmitted and selected by a 4 digit time-code which is not necessarily related to the displayed clock time.

## Up-To-Date

So why should you have Teletext and how much will it cost? Well, if you have irregular working hours or are always complaining that the news in your morning or evening paper is out of date when you get around to reading it then Teletext is for you. It provides pages of up-to-date news and weather, financial



information and sports news approximately 17 hours a day for 7 days of the week. In addition there are puzzles, recipes, features and radio and TV guides; in fact the only thing that is missing from Teletext will be strip cartoons and photographs, like page 3 of the Sun!

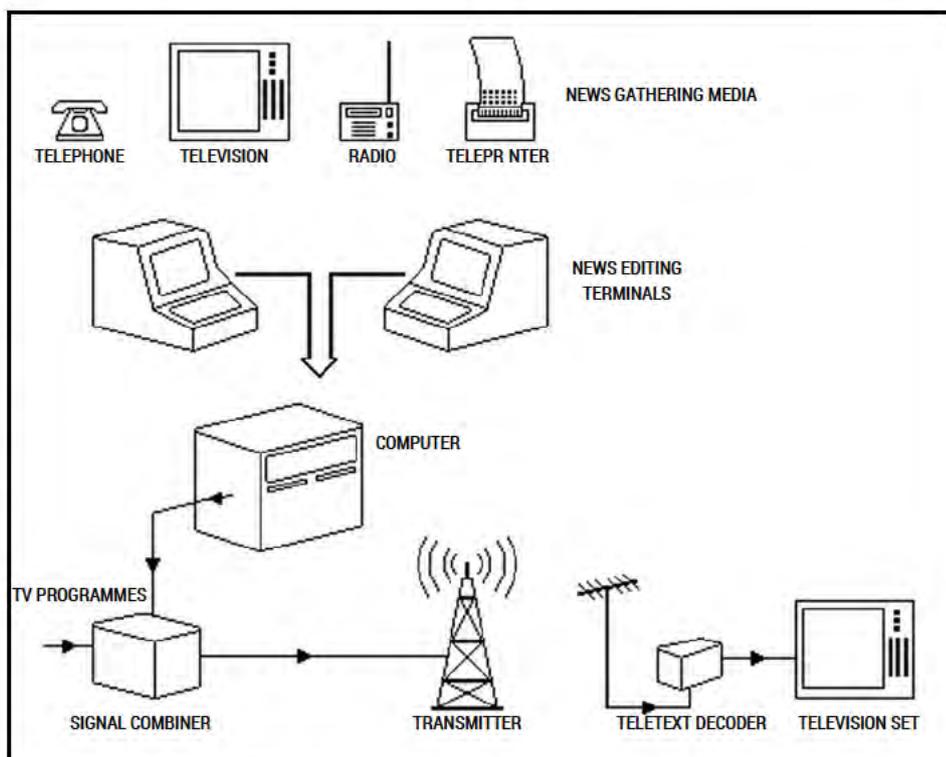
You can buy a colour television with Teletext for between £400 and £600 or rent for between 60 pence and £1.50 per week above the standard colour TV rental. Adaptors are relatively expensive at between £150 and £300. Of course it is always possible to build your own adaptor and there are IC sets available from Mullard and Texas Instruments, but this may prove about as cost effective as constructing your own pocket calculator before too long.

It should be noted that the reception quality must be good and it would be as well to check with the BBC and IBA engineering departments if you are doubtful about receiving and, more to the point, successfully decoding a Teletext transmission. The importance of a good quality aerial cannot be emphasised enough for Teletext reception.

## New Developments

As mentioned earlier there are now moves towards the production of high resolution pictures and alternative character sets. More recently further advances have been made into the transmission of Telesoftware, that is small computer programs that are of general use such as home accounting, education and games.

The BBC Research Department are one of the prime movers in the advancement of the Teletext code set and have produced a draft amended Teletext Specification, as part of one of their research reports. The department has suggested alterations to the decoder to permit the selection of groups of pages which are held in a memory which is capable of storing more than one Teletext page. It is also possible to link pages so that once a page in a sequence has been selected the next page can be captured ready for viewing. This latter facility would normally require a rigid structure to be imposed on a magazine and so, to avoid this, a page



Teletext news gathering system.

service row is introduced into each frame to cause 6 pages to be captured from which the user may then select one for viewing. A second item in the report suggests the use of currently unused control bits to select alternative character sets or sub-sets. The final item in the report examines the possibility of transmitting high resolution graphics and pictures. It is clearly possible to produce still pictures, limited only by the display, given sufficient page memory but the problem is to establish the levels of resolution that are appropriate to the applications which would make use of this feature.

Telesoftware is a means by which the non-interactive nature of Teletext can be partly overcome and is under development by the IBA in collaboration with the BBC. In order to use Telesoftware it is necessary to have a microprocessor in the television set that will interpret a coded page as a computer program using instructions stored in ROM (Read Only Memory). In such a TV receiver it is useful to have a number of standardised interfaces for a full alphanumeric keyboard, cassette recorder, printer and games controls. Of course a separate computer with an adaptor and interface to receive and load Telesoftware is also capable of providing this facility. Telesoftware is currently under evaluation in a number of schools but receivers of this type are not generally available at present.

### The Magazine

The BBC1 magazine, CEEFAX, may be compared to a newspaper but it is updated much more frequently. The main index for BBC1 CEEFAX is on page 100 and the alphabetical index is on pages 193 to 195. Financial information is available on 20 pages, is updated hourly on weekdays, and includes selected shares, stock market reports, exchange rates, and commodity prices. The news information is available on 18 pages with an index on page 190 and headlines on 101. A newsflash is on page 150 which is displayed as a box at the bottom of the picture. There is a newsreel on page 199 and this consists of several sub-pages which appear at approximately 30 second intervals with the main news items. Subtitles for the deaf appear on page 170 for a selected few programmes which have, in the past, included 'Blankety Blank' and the 'Onedin Line'. There are 19 pages of sport with an index on page 140 and a 5 page food price guide with a separate page for a recipe.

The BBC2 magazine, CEEFAX, also, more popularly, known as ORBIT, is of general interest with puzzles, news and sport background, home finance, features, handy tips and reviews. The main index is on page 200, newsflash on page 250, subtitles on 270 and a radio and TV programme guide on pages 271 to 274. The ORBIT magazine is unlike the BBC1 magazine in that its contents are not changed as frequently.

The ITV magazine, ORACLE, takes some 70 seconds to transmit but the news, sport and financial information is transmitted twice in each transmission of the full magazine to provide a faster response. Strictly speaking, there are several magazines and each is aimed at a separate subject area. The main index is on page 100 and is followed by the TV program guides and weather and travel guide. Page 200 is the general news index, with pages 201,202 and 203 containing the news index, sport index

P100 CEEFAX 100 Mon 9 Mar	
NEWS HEADLINES	101
NEWS IN DETAIL	102-119
NEWS FLASH	150
NEWS INDEX	190
NEWSREEL	199
FINANCE HEADLINES	120
FINANCIAL NEWS	121-131
SPORT HEADLINES	140
SPORT PAGES	132-159
FOOD GUIDE	161
FOR THE DEAF	169
SUBTITLES	170
TV/RADIO	171-4
TV CHOICE	177
TOMORROW	178
WEATHER/TRAVEL	180
INDEX	180
GENERAL INDEX	193-5
CEEFAX BUDGET COVERAGE 179	
LIMERICK CONTEST RESULTS BBC2 293	

P200 CEEFAX 200 Mon 9 Mar	
ORBIT INDEX	
NEWS BACKGROUND	202-9
FUN & GAMES	210-19
BBC PRIZE QUIZ	219
FINANCE BACKGROUND	220-29
SPECTRUM	230-39
SPORTS BACKGROUND	240-49
NEWSFLASH	250
FEATURES	251-259
CONSUMER	261-269
TV & RADIO	271-79
REVIEWS	280-89
JAZZJAYS	290
VOLUNTEER	291
FOR THE DEAF	292
LIMERICK CONTEST	293
RESULTS	293
ENGINEERING	297-9
FULL INDEX	296
CEEFAX BUDGET BRIEFING 220-229	

P414 ORACLE 414 Mon 9 Mar ITV 2044 34	
ITV ORACLE	
ITN MAIN INDEX	200
HEADLINES	201
SPORT	202
BUSINESS	203
NEWSFLASH	250
THE POUND	228
THE BUDGET	221
NEWSFILE	290
WEATHER AND TRAVEL INDEX	102
ALPHABETICAL INDEX	190
SUBTITLES	199
TV INDEX	101
REGIONAL	300
DIARIES	300
LONDON DIARY	303
LEISURE INDEX	700
Review Index	701
Crossword	705
"Blockheads"	707
Horoscope	715
ORACLE KIDS	777
FARMING	358/432
TECHNICAL	499
ADVERTISERS	401

and financial index respectively. The newsflash is on page 250.

Page 400 is the regional index giving the page numbers of the TV programme guides, local entertainment and weather. The entertainment guides and regional weather are held in the same magazine. Page 301 is the advertising index and page 360 is the technical index. The intervening pages contain job vacancies, demonstration pages, test pages and engineering news.

Page 300 is the leisure index to a magazine that contains a crossword, horoscopes, children's pages, food prices, recipes and reviews.

### Personal Opinion

In my opinion it is worth changing the television set for Teletext since the quality of the text compared to many adaptors is considerably better. The information provided is always 'hot' from the news agencies, even though this means that sometimes it is inaccurate due to lack of detail in initial reports. The new developments are promising but apart, perhaps, from Telesoftware, their availability is a little way off yet.

As far as the magazines are concerned, they are well produced with good use of colour text and graphics. The use of page 200 for the index on BBC2 is inconvenient since most decoders select page 100 from power-on or reset leaving a blank screen when text is selected. Non-standardisation of the newsflash

P303 ORACLE 303 Mon 9 Mar ITV 2310 31	
LONDON	
WEATHER	302
TELEVISION	118
EXHIBITIONS	304
WEST END	304
OPERA DANCE	304
WEST END	304
MUSIC	308
THE TRE	308
CARDEN FESTIVAL	310
Out Of Town	310
91	311
Out Of Town	307

page is another annoying feature but one can live with these minor problems. The size of the ORACLE magazine tends to make it as clumsy as the meaning of the acronym by which it is known. When the regional information is only available in that region instead of nationally the problem will be reduced. Alternatively, IBA's 4th channel might provide a solution but the appearance of Teletext on this channel is not yet certain.

If you are keen it would take approximately 5 hours to read all of the pages available and during that time it is likely that most of the information will have been updated. Considering the speed at which the pages are updated and the amount of text involved the typographical errors are relatively few and far between. Errors due to poor reception are also rare in good colour TV reception areas except where a transmitter is on low power due to maintenance work or where there is severe external interference.

Broadcast Teletext has the advantage of only costing the standard colour licence fee once the appropriate decoder has been obtained. It is possible to sample a large proportion of the news information by watching BBC1 or BBC2 when CEEFAX IN VISION is on and the CEEFAX pages are broadcast sequentially as a standard TV picture although the quality of the displayed text is inferior to that of the true decoded Teletext.

### Acknowledgement

Thanks to the BBC Research Department for the information on new developments in Teletext.

### VIEWDATA



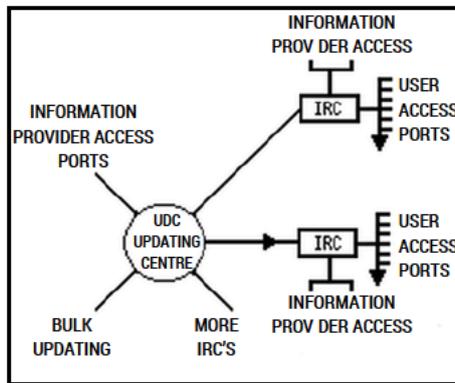
Viewdata is the name given to a system which permits the owner of a terminal or appropriate television set to access pages, or more correctly frames, of information stored on a computer via the public telephone network. British Telecom has a Viewdata service which goes under the Post Office trademark of PRESTEL. Large individual companies operate their own Viewdata services to provide national availability of their internal marketing and commercial data. This may be done as a public service if the size of their database is large enough to justify the use of a privately controlled system over renting space on the public system.

From a technical viewpoint, the Viewdata frame is made up of 24 lines of 40 text and/or graphics characters in 7 colours including white. The characters used are similar to those making up the standard Teletext code set but they are received at a rate of 1200 bits per second in serial form after demodulation. Information that is transmitted from the keypad is sent at a rate of 75 bits per second. Connection to the computer is normally achieved automatically by the Viewdata terminal. A single key depression initiates an auto-dialling sequence which dials the number of the computer and on receipt of the carrier tone places the terminal on-line. The computer outputs an introductory message and a request for the user number which is also usually programmed into the terminal and is output by a further single key operation. The user obtains an introductory frame and may then select the required pages.

#### What to Use

There are an increasing number of Viewdata terminals and adaptors becoming available, mainly in response to the needs of business users. Adaptors providing a UHF modulated colour TV signal cost between £150 and £300 to buy or £100 to £200 a year on rental. Complete terminals, which may or may not receive television programmes or Teletext, cost between £600 and over £1,000. It is important, however, to ensure that the Viewdata adaptor or terminal is approved for use by the British Post Office and is not for export only or pending approval. It is for this reason that making your own Viewdata adaptor is not really advisable unless you can obtain the necessary approval! An alternative to obtaining either an adaptor or a new television is to use a home computer, if one is available. There are interfaces now becoming available for Commodore PET and Apple, amongst others. These are fairly expensive but once obtained have the added advantage of storing frames on cassette or disc and potentially running Telesoftware, as obtained from PRESTEL. The home computer will also have a full alphanumeric keyboard which will be required if there is a need to send written messages. Such keyboards are not, at present, available for many of the terminals marketed for the domestic user.

It is assumed that a Viewdata service is available in the telephone area of interest. If it is, then having decided on a terminal it is necessary to ensure that a private exclusive exchange line is available; a shared line being unsuitable for the operation of a Viewdata terminal. A jack socket, PO Type 96, is required and the appropriate application should be made to the local telephone sales office. At the same time an application for consent for the



Prestel information retrieval network.

connection of a private attachment to the Post Office installation should be made by stating the nature and supplier of the attachment. The terminal will normally be registered with the regional PRESTEL headquarters by the supplier. In order to use PRESTEL or any other Viewdata service the terminal must be registered to facilitate billing of its owner.

Incidentally, PRESTEL charges consist of time and frame charges. Time charges exist at a standard rate and a cheap rate. The standard rate is 4 pence per minute and the cheap rate, after 6 p.m. and weekends, is 4 pence for four minutes. The frame charge is set by the supplier of the information and may be up to 50 pence. The time charge is subject to VAT but the frame charge is not. Businesses are subject to a further quarterly charge of £12.

#### Public Service

As mentioned earlier PRESTEL is the public Viewdata service and it currently serves about 10,000 subscribers. The service is theoretically available 24 hours a day, seven days a week and response times are in the region of one or two seconds per frame. There are approaching 200,000 frames of information although much of this currently consists of financial information for companies including stocks and shares, commodity prices and company performance information. There are also plenty of news items, in addition to consumer information, especially on travel, and some direct ordering, although this is limited at the present time.

PRESTEL is operated by British Telecom who are basically responsible for the connection of subscribers to the database and for billing those subscribers on behalf of the Information Providers in addition to levying their own time charges. Information Providers pay British Telecom a service charge plus a fee for each frame they use and in return receive those amounts due to them as a result of users accessing their frames.

Since it is a public service then what could the man in the street obtain from PRESTEL? Well, if he is a business executive in a moderate to large company he would undoubtedly find PRESTEL of some use, even indirectly. Travel agents will also gain much benefit from the use of PRESTEL where they have access to Closed User Groups which specifically cater for their needs, for example, availability of airline seats and hotel rooms. But what of the domestic users? PRESTEL headquarters has obviously been of the opinion that its domestic users are in the affluent sector as a large proportion of the selling presently done on PRESTEL is for expensive items such as watches, wine, holidays and video recorders. However, details of electric cookers and other domestic appliances are also available. In addition, it is possible to obtain information on what you should be doing in the garden, what the local weather forecast is and if certain houses, museums or gardens are open on a particular day. You can book a hotel, establish the time of a train, and discover your rights as a consumer when buying by mail order. It is really a question of how much this sort of information is worth to you in order that one can make a decision as to whether PRESTEL is a worthwhile investment.

#### It's All Jargon

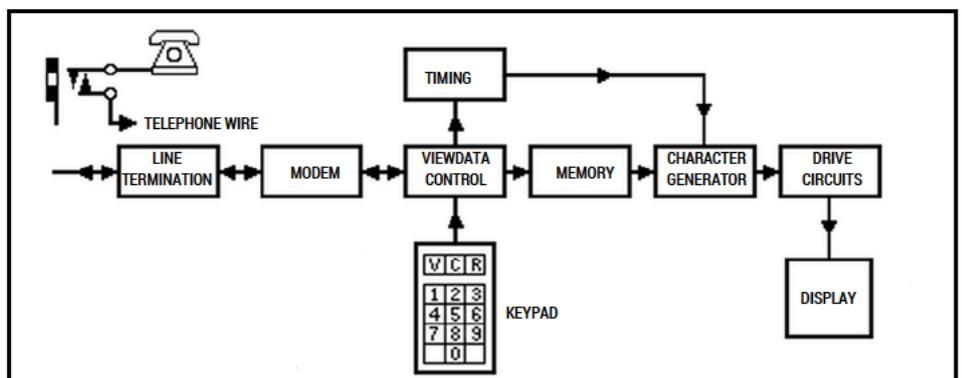
It is a sad fact that a lot of jargon has been attached to Viewdata that has not been attached to Teletext. This is probably because Viewdata is an interactive media, i.e. you can talk back, and this has brought the internal features of the system to the attention of the user. This is as a result of security procedures, which do not apply to broadcast systems by their nature, and of message facilities. To help out, here is a brief introduction to some of the more commonly used terms:

A PAGE is one or more frames which have an associated number of up to nine digits. The first frame of a page maybe selected directly by the user entering the page number and it is identified by the suffix 'a'. Subsequent frames have the same page number with a suffix in the range 'B' to 'Z' in alphabetical order.

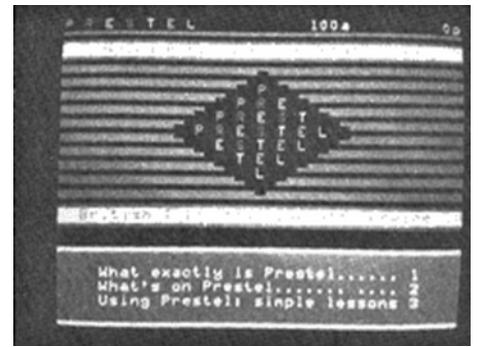
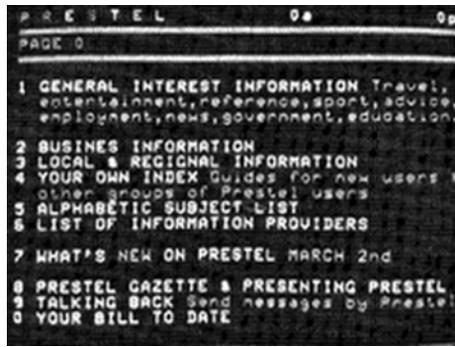
A FRAME is the basic unit of information storage as far as the user is concerned and is formed by a combination of up to 24 lines of text and graphics characters which are displayable on a television receiver.

The Updating Centre or UDC is a computer used by Information Providers to alter the database by editing and replacing frames of information.

The Information Retrieval Centre or IRC is used by subscribers to access the information contained in the database.



Viewdata User Terminal.



The INFORMATION PROVIDER is a person or body to whom permission has been given to provide information in respect of a Viewdata service and who is subsequently responsible for the generation and updating of frames in that section of the database owned. CLOSED USER GROUP or CUG is a group of frames that have been set up in such a way as to enable an Information provider to restrict access to all or some of his frames in the database. This term normally refers to those groups where the membership, of users able to access these frames, is controlled by the Information Provider. It can also refer to a total ban on access to particular frames which are being updated or set up.

RESPONSE FRAME is a frame within the database which has been set up so that a user may enter data into fields, much like a form, and send it to the Information Provider that owns the frame.

PERSONAL PASSWORD is a four character code that may be entered by a user to prevent unauthorised entry using his account number.

The FRAME CHARGE is set by the Information Provider and is associated with a particular frame of information. It is displayed at the top right-hand corner of the screen.

The TIME CHARGE is set by British Telecom (PRESTEL) and applies to fixed units of time spent connected to the computer. It is also called the system charge.

**I Think . . .**

The advent of interactive Videotext services has opened up a new era in communication by the use of two familiar items, the telephone and television set. The eventual connection of the home computer will allow the user to load programs, Telesoftware, which are fully tested from a central database and thus play games, work out mortgage repayments, provide educational assistance, and perhaps even play electronic music! Written messages, high resolution pictures and extensive mail order by response frame are all promised for the future. But what of the present?

The PRESTEL service has just exceeded the 10,000 users mark but early Post Office forecasts were 50,000 users by the end of

1979. Why have things gone wrong? Surely with a general public acceptance of the telephone and television there should be no great marketing problem? There is a large mass of public opinion, aided by the media, that claims that the service is too expensive, and, as things stand, they are probably correct in this belief. The domestic receiver is fairly expensive as a capital expenditure item for the average family. The information provided by PRESTEL is actually quite cheap but it is the time taken to find that information, to recognise whether it is independent or concealed advertising and to read the information amongst frames or irrelevant graphics that make it expensive. Directories do help in locating information but have a tendency to become out of date at an alarming rate as the database changes daily.

PRESTEL, for the domestic user, is sold on its ability to provide prices and consumer information and to accept orders directly by the use of response frames. It is unfortunate that this latter facility is not, as yet, widely available. Many information providers still require a letter and where a stamped addressed envelope is requested for a reply it would be better to charge 15 pence to use a response frame.

So PRESTEL is for the future, when the arguments have died down and the database has taken shape, when adaptors are £100 and televisions are only £50 more than the equivalent non-Viewdata receiver. This, of course, may not be far off now.

**The Future in Viewdata**

Apart from the introduction of message facilities that will enable PRESTEL users to

communicate with one another by means of written messages, and 'Picture PRESTEL' that will allow part of the television screen to display a high resolution full-colour picture there are other significant developments on the horizon.

The first of these, due for early 1982 on current estimates, is called 'Gateway' and is a facility which permits PRESTEL users to access 3rd party databases. It has been developed by Systems Designers Limited and is designed to overcome the existing problems of cumbersome indexing, lack of search facilities and immediate confirmation of requests by response frame. The idea is to place the third-party database, held in their computer, on-line to a PRESTEL user and to achieve this by a PRESTEL compatible 'front-end' so that the user is unaware of any change-over between the two databases. This means that mail-order can then be performed directly on the mail-order company's own computer rather than involving that company in the retrieval of response frames from the PRESTEL computer and subsequent manual processing of the order.

The second development is Sea-View which may provide a Viewdata service to ships by the use of radio links which could be in the high to ultra-high frequency range. Such a service could provide not only public Viewdata but a private Marine Information service as well.

VIDEOTEXT is an international name for all services.

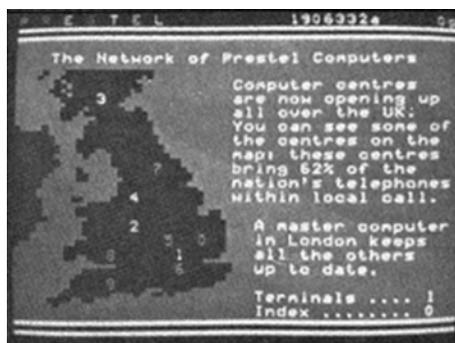
TELETEXT is the name for the service in which pages of data are broadcast encoded onto television transmissions. It is sometimes called BROADCAST VIDEOTEXT.

CEEFAX is the name given to the Teletext service of the British Broadcasting Corporation and is derived from 'See Facts'.

ORACLE is the name given to the Teletext service of the Independent Broadcasting Authority and is an acronym for 'Optical Reception of Announcements by Coded Line Electronics'.

VIEWDATA is the name for the service in which pages of information are obtained, on request, by use of a telephone line.

PRESTEL is the Post Office trademark for the Viewdata service provided by British Telecom.



# TEMPERATURE GAUGE

by Ian Miller

- \* Temperature range -10°C to 100°C
- \* Indication by multicolour LED array
- \* 100°C warning

This thermometer gives a visual indication of temperature in approximately 10°C intervals from -10°C to 100°C. It uses the LM335Z temperature sensor and the LM3914 bargraph display driver. The latter converts the sensor's output to drive LED indicators which are formed in a block display.

The design presented is for a general purpose temperature gauge, being hand-held with the sensor on a flying lead. However, in response to many requests, information for adaptation to a car thermometer is given.

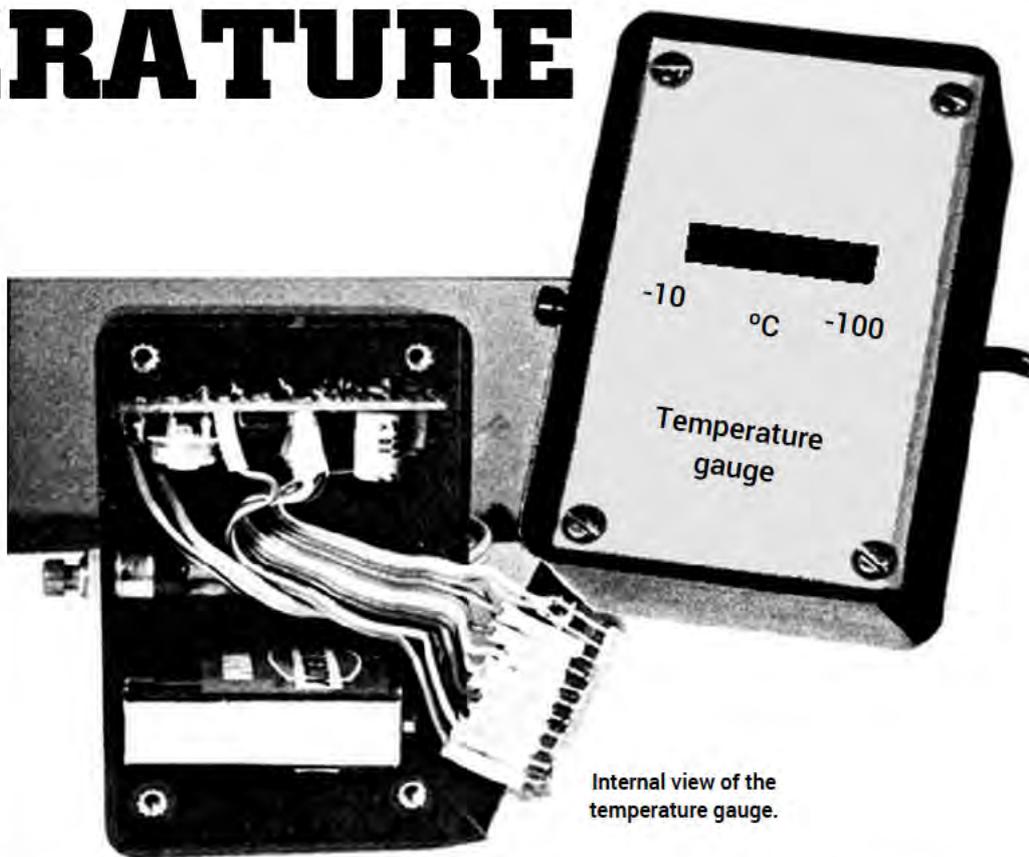
## Circuit

The circuit, which is mounted on a piece of Veroboard measuring 10 strips by 20 holes, is shown in Figure 1. The LM335Z sensor, IC1 acts similarly to a zener diode where the breakdown voltage is directly proportional to the absolute temperature. It gives an output of 2.63 volts at -10°C and 3.73 volts at 100°C and has three terminals: +ve, -ve and adjust. The adjust is used for calibration purposes but as it is accurate to 2°C without calibration this facility is not used.

The sensor requires a current of between 400µA and 5 mA. This is supplied via the 10 kilohm resistor R1 which is connected to the 9 volts supply.

The LM3914 bargraph display driver IC2 has a buffer input stage, a potential divider chain, comparator and a precise 1-2 volts reference source. The resistor chain divides the input voltage from the sensor to drive the LEDs wired to the outputs. The driver is used in the dot mode where the outputs are sequentially switched 'on' with an increasing input voltage.

The total voltage change of the sensor is 1.1 volts which is close enough to the 1.2 volts reference source to make the



biasing circuit fairly simple. The zener diode D1 reduces the 9 volts supply to 2-7 volts and is connected to the low reference terminal, pin 4 of IC2. The 5 kilohms preset VR1 is used to adjust this voltage to exactly 2.63 volts, the minimum temperature sensor output, at calibration.

The high reference terminal pin 6 is connected to the 1-2 volts reference source pin 7 and through R2 to the low reference pin 4. Thus the total sensor range is divided across the resistor chain of IC2 so that at -10°C the first output is 'on' and at 100°C the tenth output is 'on'.

The outputs of IC2 are connected directly to the display LEDs except the

tenth which is taken to IC3, an LM3909 LED flasher. This drives two LEDs, D11 and D12 which are the 100°C warning indication. The frequency of oscillation of the flasher is determined by the capacitor C1.

All the LEDs are the rectangular type and in the version built D1 to D4 are green, D5 to D9 red and D10 to D12 yellow, thus signifying the change from cold to warm to hot. These colours are a matter of choice; you may have your own ideas for a particular application.

The gauge is powered by a single PP3 9 volt battery which is wired via the push button switch S1. This switch is biased 'off'

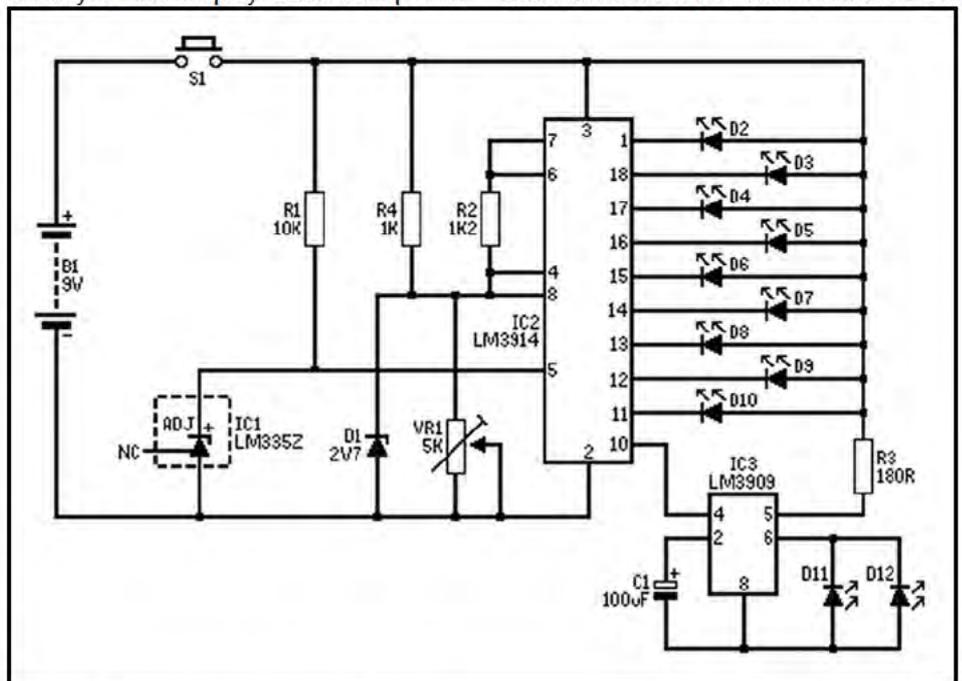


Figure 1. Temperature gauge circuit diagram.

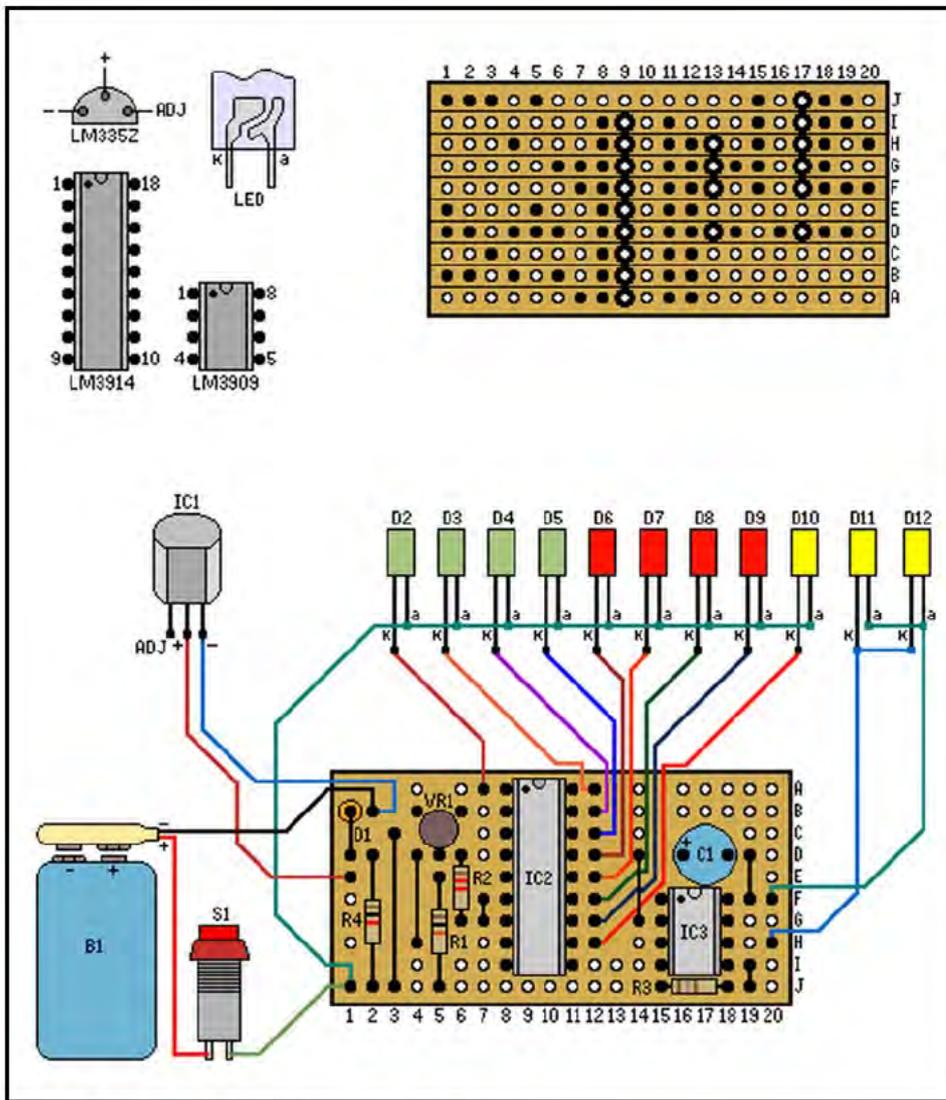


Figure 2. Temperature gauge layout and wiring diagram.

front panel 32 mm from the top edge. Insert the LED block into the slot with the low temperature LEDs at the left and glue them in place.

Mount the push button midway along one of the long sides of the box. Directly opposite this drill a hole for the flying lead.

The battery and connector will conveniently locate at the bottom of the box if two sets of vanes are removed from one side of the box with a modelling knife.

To form the sensor, solder and sleeve the flying lead as shown in the wiring diagram, Figure 2 using small twin cable. Cut a square hole the same size as the sensor's flat face in a push-on connector cover. Insert the sensor so that the flat face is exposed and, if liquid temperatures are to be measured, seal the sensor in place with an epoxy adhesive. However, ensure that the exposed face remains clean so that the reaction time of the sensor is not lengthened.

Finally wire all the components according to Figure 2 using a small length of ribbon cable for the LEDs. The Veroboard slots into the top set of box vanes.

### Calibration

Connect a voltmeter to the input and 0 volt terminals and insert the sensor into the freezer compartment of a fridge. When the voltmeter registers 2-63 volts adjust the preset VR1 so that D1 is just 'on'.

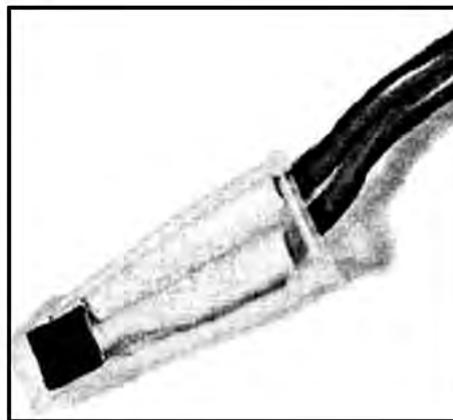
Check this setting at the high temperature end by holding the sensor over the spout of a boiling kettle, when the voltmeter registers 3-73 volts LEDs D11 and D12 should be flashing.

### Adaptation to a car thermometer

This can be carried out in various ways but in all cases the sensor must be attached to the water cooling system. The simplest method of doing this is to glue the sensor to the thermostat housing. Another way would be to obtain an old car temperature element, which would replace the one at present in the car's engine and drill a hole along its centre large enough for the LM335Z. Glue the LM335Z in place and swap elements.

Now carry out one of the following methods of adaptation:

- (1) Having mounted the sensor, change the push button switch for an on/off type and use the gauge as previously described.
- (2) As above, but instead of using the battery the supply is taken from the car's 12 volts supply via the ignition switch, thus eliminating the on/off switch.
- (3) As in (2) but instead of using the LED block use a single digit 7-segment display with a diode encoding matrix as used on the Digital Petrol Gauge featured in the July issue of E&MM. Note that in this circuit the LED flasher is retained but drives two ordinary LEDs for the 100°C warning.



Temperature gauge sensor.

so that as a hand-held device the push button must be held in whilst monitoring a temperature.

### Construction

Begin construction by mounting all the components on the Veroboard according to the layout shown in Figure 2. Take care with the orientation of IC2 and 3. Having decided upon the colour display you require glue the LEDs together using a contact adhesive to form a solid block.

A plastic box with an aluminium front panel is used. Cut a 27 x 5 mm slot in the

## PARTS LIST FOR THE TEMPERATURE GAUGE

### Resistors - all ¼ watt 5% carbon

R1	10K	Brown Black Orange
R2	1K2	Brown Red Red
R3	180R	Brown Grey Brown
R4	1K	Brown Black Red
VR1	5K	Cermet Preset

### Capacitors

C1	100µF 10V PC Electrolytic
----	---------------------------

### Semiconductors

D1	BZY88C2V7 Zener Diode
D2, D3	
D4, D5	Rectangle LED Green (4 off)
D6, D7,	
D8, D9	Rectangle LED Red (4 off)
D10, D11,	
D12	Rectangle LED Yellow (3 off)
IC1	LM335Z
IC2	LM3914
IC3	LM3909

### Miscellaneous

S1	Push Switch
B1	PP3 Battery and Connector Box
	Veroboard 10 strips x 20 holes
	Ribbon Cable 10-way

# READERS LETTERS



## Statistical Resistors Are Mean Beasts!

Dear Sir,  
A small point about your reply to I. Gregory, in your Sept-Nov issue. If you make a 0.5 ohm resistor from two 1 ohm's in parallel, you will be unlucky if the tolerance is not improved. In fact, if you can manage to get the two from different batches (of manufacture) you have a good chance that 1% tolerance will be reduced to 0.07%. With n similar values combined in parallel (or series for that matter), if the tolerances are truly random, you should finish up with 1/n of the tolerance of one component. (Appeal to 'common sense' says that if you pick a couple from a box-full, you ought to have equal chance of picking one which is 'high' and one 'low'. But if they are all from the same batch, they will probably be all 'high', etc.)

M. ARMITAGE  
City University, London

## Hands Off The Price List

Dear Sir,  
I read on page 4 of your June/August newsletter that you are proposing to sort the components by their order codes in order to allow those who do not own the current catalogue to find components. Now I can well appreciate this problem as I experienced it myself a few months ago when I had a current newsletter, but an old catalogue, and it was extremely difficult to find some components. However, the solution you propose is an extremely poor one and I shall be most annoyed if you adopt it. At present if one is reasonably familiar with the order of the sections in the catalogue it is possible to find most components simply by flicking through the price list. What is more, all the components of a similar type are re grouped together, making it a simple matter, for instance, to compare the prices of all the different types of knobs in stock. However, if these were sorted by order code, they would be scattered throughout the price list, and it would be necessary to look up the order codes in the catalogue in order to find them. I find the price list as it currently is a very handy quick reference when I am weighing up the costs of different

ways of realising a particular project; this benefit would be lost if the components were sorted by order codes.

A better solution would be to divide the price list into sections headed in the same way as those in the current catalogue, and possibly to include also the alphabetic component finder table on the last page of the catalogue. This would facilitate the use of the price list for both new and old catalogue owners alike.

J. SIMON VAN DER WALT  
Edinburgh

## Price List Can Be Improved

Dear Sir,  
I am pleased, but not surprised, that your newsletter/price list has been voted to remain in operation. I have very limited time to spend on projects, but have found your service by far the best available, and one which automatically keeps me in touch with price and latest items.

I would much prefer to pay for this, and the latest catalogue when issued, for the convenience of receiving by post.

I do not go for the Magazine idea (there are enough already - are costly, repetitive and provide a very poor system of information retrieval) and I hope your venture in this direction does not impair your already well established high standards.

Your overall service is excellent - to all concerned, well done.

You invited comments on the price list format, and I attach some suggestions for this, and also the catalogue, for your consideration which I hope will be of some use:  
PRICE LIST FORMAT

I feel that the list would be better if it was made completely Code Alpha-numeric (i.e. all stock). In this way the catalogue could have complete freedom of layout.

The list would be easier to use as only one entry to find (as opposed to 'Section' and then 'Code', as you suggest).

Viz:

Order Code	Page	Des	£.p
AC			
AC00A	98	Vid Gme Cnsl	
109.00			

AC01B 98 AirseaBattle 16.95  
AF  
AF00A 71 Booster Amp 17.70  
etc.

NB £.p made a heading to give columns vertical consistency.  
CATALOGUE FORMAT

As you refer to the catalogue by 'year' date it would be useful to add the 'year' to the front cover I would suggest that, for example, all Meters are listed under 'Meters' (etc) as at present it is tedious to search for the complete range of one type of COMPONENT. It is incongruous to have 'component' sections with a 'car' section (etc).

For example: index gives Meters as 141, 142, 290-295 and Ammeters as 68, 69 (if you think to look) but no voltmeters.

It would be better to put Meters in one section and to Index as follows:

M	
METERS Panel	
Batt Charger	—
Car Ammeter	—
Ilium Kit	—
Level	—
M/coil	—
M/iron	—
Strength	—
Tuning	—
VU	—
METERS Test	
Accessories	—
Clamp	—
Freq Dig	—
Grid Dip	—
Multi M Ana	—
Multi M Dig	—
RF	—
Shunts	—
etc.	

I can appreciate the idea behind, for example, a Car section, but I feel that COMPONENTS should be the prime consideration.

I would suggest, therefore, the following scheme:

CATALOGUE  
Sect 1 Index by Hobby/interest  
Car, Musical & Effects, Radio Control, Treasure Hunting, Hi-Fi, Model Railways, Computer, Home Lighting & Effects, etc.

Under these headings could be an expanded photo/written index, similar to your past catalogue, but again not mixing 'Hobby' with 'Components.' Sect 2 Components  
All components, with relevant design data (regulation figures are not given for transformers by the

way) and typical use where necessary (not finished project), with data/application sheets back up.

Sect 3 Data/application sheets available list

Sect 4 Projects available list

Sect 5 Order Code/Page cross ref. index

Sect 6 Main Component index

Outer) Sect 1 idents

Cover) Sect 2 idents

DATA/APPLICATION SHEETS

By manufacturer and/or your own publication.

PROJECTS BOOK

Individual or a series of projects i.e. specific project with all relevant information required to build finished unit. (This backs up and simplifies Catalogue Sects 1 & 2).

Name and address supplied

## Drowning In 4600 Synthesiser

Dear Sir,  
I am constructing the 4600 Synthesiser and I am in over my head.

Understandably your technical dept is no longer able to help with the 4600 due to it being so old.

I should like to ask, through the medium of your newsletter, a Maplin customer (or E&MM reader) familiar with the 4600 Synthesiser principles who would be willing to act as technical advisor to me during my construction of 4600. I give my word that I will pay all expenses (post, telephone etc) and would be a willing pupil to anyone willing to teach (for a small fee). It may be useful (but not necessary) for you (the helper) to make the occasional visit.

Please write or phone at the address below if you are at all able to

A. STEVEN  
3 Bushey Croft, Harlow, Essex  
Tel: (0279) 39679

## Disaster Strikes

Dear Sir,  
I am coming to the end of building the 4600 Synthesiser kit, which has given me great enjoyment and been incredibly interesting, but unfortunately I have mislaid the 4600 building manual. I have been told by your shop that it is unavailable.

My only hope is that one of your newsletter readers may have a copy I could buy (or borrow) or even photocopy.

I would gladly pay for any costs.

J. RUSHTON

Gwynedd. Tel: 0341 49252

### Special Offer Problem

Dear Sir,

Firstly I feel I must congratulate you on your excellent magazine 'Electronics & Music Maker'. One very favourable point is that all the components used are available from one supplier — yourselves. I do, however, have one moan.

This is my moan, I purchase E&MM each month and obtain a price list and newsletter when due. Whilst I agree with the mailing list for those folk who do not wish to purchase E&MM, I have no use for this service. Here is the problem; how can I take advantage of your special offers without the special coupon supplied free to ... etc? How about a special offer coupon in E&MM for those who buy this excellent publication.

A. S. BEAL

Witham, Essex

*Fortunately we are about to solve your problem for you. As from issue 2 of this magazine we will be including all the special offers in here. The special offer coupon for customers on our mailing list will be discontinued shortly.*

### Matinee Is Wonderful Value

Dear Sir,

Having purchased and built your Matinee organ may I say, bearing in mind that it is a budget organ, what wonderful value it is. However, there are one or two things I would like to suggest to improve it.

1. Conversion of the swell or expression pedal to a light-sensitive resistor (my pot is already noisy).
2. A method of stopping the rhythm whilst playing i.e. knee or foot.
3. An increase in power output. I have tried to feed the external amplifier connections in to several large amplifiers or tape recorders and all to the same end, total distortion and yet my Matinee is as clear as a bell. Any suggestions and/or circuitry would be most welcome.

D. S. UPTON

Newtown, Powys

*Firstly we are very surprised to hear that the pot is noisy on your swell pedal. We have been selling (and using ourselves) these swell pedals for some eight years now and we have never had any noise problems with them. The three Matinees we have, get continual heavy use, yet there is no audible noise from the swell pedal whatever. So we are confident that if you spray the pot once with switch cleaner you will solve the problem. Secondly, the rhythm start/stop switching is*

*unfortunately rather complex and whilst it is feasible to do what you suggest, it will require some development time.*

*Finally, if you are having problems with the power amp output proceed as follows: Connect a 4k7 resistor at the headphone socket to the wire coming from pin 1 on SK9 and a 47k resistor to the wire coming from pin 2 on SK9. Connect the other ends of the resistors together, then connect the centre conductor of a piece of screened cable to the point where the two resistors join and the screen to the other end of the 4k7 resistor. The other end of the screened cable can be connected to the radio, tape or aux input of a Hi-Fi amplifier. If the signal is too loud, reduce the value of the 4k7 and if too soft, increase the value.*

### Matinee: A Beginner Writes

Dear Sirs,

I recently bought a Matinee Organ Kit, and have just finished the work on the keyboards. As a beginner in electronic construction I would like a few points made a bit clearer before moving on to the PSU and main PCB.

Firstly, resistors. Can these be fitted either way in the two holes provided for them? Secondly, can any of the components have their efficiency impaired by soldering e.g. heat etc? If so, what precautions can be taken?

Also, can you recommend a multimeter in the Maplin catalogue, to carry-out the setting up of the Matinee, and finally, what size bit on a soldering iron is suitable?

T. CLAYTON

Thornton Cleveleys, Lancs.

*Unless specifically mentioned in the text components can be fitted either way round - resistors can always be inserted either way. Before starting the PCB practice soldering as described in the "How To Solder" section of the text. Only progress to the Matinee PCB when you are proficient at this art. You should only need to hold the iron on the component lead for about one second and longer application may result in damage to the component. If you are worried, use a heat shunt where possible.*

*Any multimeter is perfectly satisfactory for setting-up the Matinee, but if you are going to do more electronic construction after the Matinee, then choose the best meter your budget can run to. Finally, for the Matinee boards we would recommend a 3/32 inch soldering iron bit.*

### Keyboard Switch Can Be Panel Mounted

Dear Sir,

I am writing to point out an omission in your catalogue description of a switch which may well be losing you orders.

The item in question is KEYBOARD SWITCH (cat. ref.

FF61R) on page 278 which is correctly described as being suitable for mounting as a 'click-in fit' into a ½ inch diameter hole in a metal panel. Two small holes are also needed for the two locating pins.

I suspected that this may be the case from the catalogue photograph and ordered one switch to examine and I will shortly be ordering a quantity of the switches to build up a keyboard for my particular requirements. The majority of keyboard switches advertised will mount into a square hole in a panel, but as it is so much easier to punch round holes I feel that due to the omission of the details from the catalogue customers are passing the switch by, in favour of other suppliers.

J. E. EDGE COCK

Harlow, Essex

### More Car Components Required

Dear Sir,

I cannot be one of your best customers, but as electronic component shops in this area are few and far between, and never have what you require, I deal almost exclusively with your good selves. Further, I live nine miles from each of the three towns Barnsley, Huddersfield and Wakefield, and shopping trips need planning. An order to you on a Monday can have stuff back to me before the following weekend and certainly before I can get into one of the three towns.

There are a number of items which are essential for fixing electrical/ electronic gadgets but neither you nor the shops stock them. I have been held up for weeks whilst I find a local supplier or devise an alternative. The following are all useful and I suggest that you expand your range to include them.

1. Tracery wire, assorted current ratings, for use in cars. (Have just rewired a car rear window heater via a relay. The original wire was of doubtful rating and I have used 'Power Connection Wire 6A Commercial Rating 10A, about the best you stock for such work. I used a 5 amp fuse which blew. The next size fuse is 10 amp which may be above the capacity of the wire. Heavier duty flexible wire is desirable for safety but cannot be obtained.)
2. Lucar male and female connectors of different sizes (current ratings). Also piggy backs and double connectors (e.g. speaker connectors. Wire can be soldered direct on to terminals but, in a car, it is desirable to have speaker leads which can be pulled off easily).
3. Lucar spade terminal strips; singles, doubles, trebles, multiples, similar to Tag Strip but for use on car or other

components. (I installed a Maplin Electronic Ignition on my wife's car. It was very awkward wiring into the plastic connector, there being insufficient room for the screwdriver. Lucar connectors would have been ideal).

4. 90 degree Lucar connectors for side connections. Also insulating covers.
5. Illuminated switches, several types for use in different cars or situations.
6. Earth Terminals, similar to Solder Tags but more robust and with a wiring end to the Lucar connectors.
7. Continental and British car fuses.
8. A series of car relays for either replacement work or additions. There must be other items besides.

C. BARNFIELD

Huddersfield

### Sunday Belongs To The Church

Dear Sir,

When we received your newsletter we became enthusiastic at the thought of the visit of your 'Road-Show' to Manchester; however, on turning over the page, we found to our regret that it was taking place on a Sunday. We are sad about this as it means that we cannot attend.

We believe that one of the main reasons for the present recession and chaos in England is due to the increasing commercialisation of Sunday, the Christian Sabbath. It is particularly offensive to Almighty God, because the Coronation, which is the basis of the British Constitution, is either a reality or a sham and the hypocrisy which Jesus so sternly castigated. We believe it is the former.

I therefore hope you will consider this when you have a 'Road-Show' in the future.

J. HEATON

Warrington

*Approximately 350 people came to the Manchester Road-Show which was the largest turnout of any of the venues.*

### Faster Than Light

Dear Sir,

Thank you for your very prompt and efficient service. The book I ordered was received within 20 hours of placing the order!

D. SHIOFF

Bagley, Thirsk

If you have any interesting comments to make about your hobby in general or Maplin in particular then please write to: The Editor, Maplin Mag, P.O. Box 3, Rayleigh, Essex SS6 8LR. Please write clearly and keep your letters brief and to the point. Thank you.

# MAPLIN NEWS



## DUAL-BEAM SCOPE IMPROVED

Our dual-beam scope described on catalogue page 289 is now improved. The new model has a larger screen: 10 x 8 cm and an improved sensitivity of 2 mV per division, over the full bandwidth up to 10 MHz.

In addition to its new switch mode power supply the scope has add and invert facilities as well as X-Y operation. Although the scope is slightly more expensive it is supplied with two probes to compensate for the increase. Please allow 10 days for delivery.



## MATINEE BOOK NOW AVAILABLE

A book containing all the construction details with numerous photographs and diagrams to build the Matinee organ is now available. The easy-to-follow instructions will enable even a beginner to build this superb organ. Treat yourself this Christmas.

## ... AND A CASSETTE AS WELL

A one hour cassette is also available demonstrating the sounds of the Matinee organ. Thirty minutes to help you when setting up the organ and thirty minutes of tunes played by a professional organist.

## MAPLIN CAT PRICES OVERSEAS

Our current 1981/1982 catalogue is available overseas by post at the following prices:

Europe surface mail	£1.68
Europe air mail	£2.75
Outside Europe surface mail	£1.68
Outside Europe air mail	£3.26
(depending on distance)	£4.23
	£4.88



## ELECTRONICS FOR ALL

Light transistorised  
easy-plugging  
improved 2000  
series 1000 series  
transistor kit

Build a  
Microchip and logic with  
IC's

2 octave electronic organ  
with 1000 series  
Electronic dice  
and lots more...

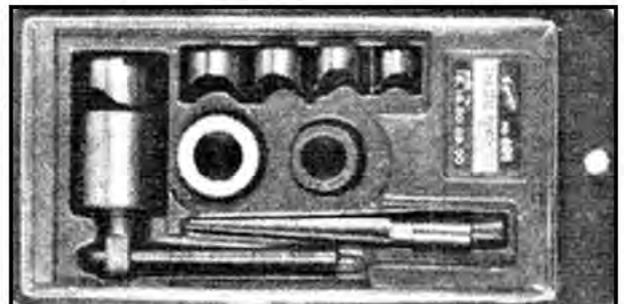
maplin

## ELECTRONICS FOR ALL

Here's an ideal Christmas gift for you and your children. This exciting new kit will get you started in this fascinating hobby. You will build projects using the latest micro-chips and you will learn to use the actual components (its not all in little plastic boxes like most other kits). But you can still use the components over and over again. It is completely safe for children as there is no soldering and there are no dangerous voltages.

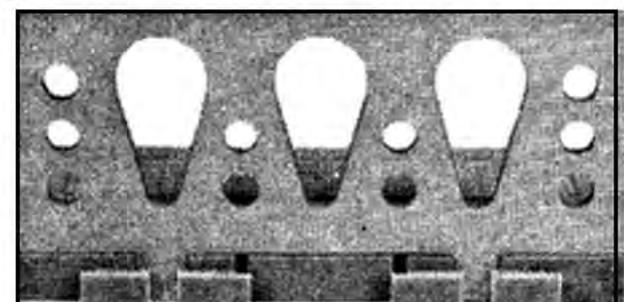
Even if you've never touched a transistor before, the superb book in the kit will show you exactly how to build the projects. You will build a two waveband radio, a two-octave organ and lots more interesting projects. And even a nine year old, following the simple instructions should be able to get every project working first time.

Superbly packaged in a full colour box, this kit makes an ideal gift. Order now!



## CHASSIS PUNCH SET

A set of five punches for thin tin or aluminium sheet. These punches make it easy to make neat round holes where drills are not practical. Sizes are 16, 18, 20, 25 and 30 mm. The set is supplied with a reamer.



## SUPPORT BRACKET FOR VERO PLUG BLOCK

This aluminium bracket will clip on to the outside edges of down the centre of the Vero plug block. The bracket has six 4.8 mm and four 4.5 mm round holes and three tapered holes from 5 mm to 13 mm diameter punched in it, enabling mounting of potentiometers, rotary and toggle switches, lamp holders, push button switches and other components normally mounted on panels.

# COMING IN OUR SUPERB SECOND ISSUE

ON SALE  
15<sup>th</sup> FEBRUARY  
1982!

Our incredible new  
multi-channel, two  
wire



## ***MODEL TRAIN CONTROLLER***

- Control up to 14 different locos on one section
- Up to 4 trains can be operated simultaneously
- Engine module will fit in most 00 locos
- Cost saving over ready-made systems
- Remote control and computer interface, points and signal controllers to be described in later issues.



Save petrol with our  
**MILES PER GALLON METER**  
Digital display shows you how economical your  
driving is as you go along.



**A 600 note SEQUENCER for your 3800/5600 Synthesiser**  
This Z-80 micro-based unit has a 4-digit display and 15 key control pad and records in real time or step, up to 600 notes. Sequences may be edited, saved on cassette, played at different speeds from a footswitch selection, and linked together forwards or backwards.

## **BURGLAR ALARM**

Protect your home and valuable possessions. Part 1 shows you how to build the master control box and tamper-proof external alarm box, and how to connect up door and window switches.

