TV SPORTCENTRE

By A. M. MARSHALL

Mains-powered: no expensive batteries to replace!

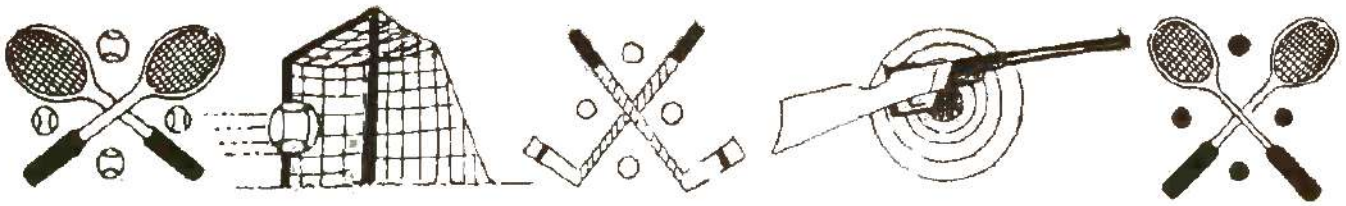
THE TV SPORTCENTRE is based on the AY-3-8500 integrated circuit manufactured by General Instrument Microelectronics. This i.c. provides four basic games, plus two optional extras, with selectable bat size, and selectable ball angles and speed. Automatic scoring and on-screen display of scores are featured, while sound effects add realism to all the games, which are:

● *Tennis*—The picture on the television screen is as shown in Fig. 1 with a centre net, top and bottom boundaries and one bat per side. The scores for each side are counted up from 0–15 and displayed continuously.

After the RESET button has been pressed, the scores will be 0, 0 and the ball will serve arbitrarily from one side of the centre line at one of the angles. If the ball hits the top or bottom boundary it will be reflected and continue in play. The participant receiving service must move his bat to try to intercept the ball.

When a "hit" is detected by the logic, the ball will rebound at an angle determined solely by which part of the bat made the hit. Each bat is divided into four sections of equal length. When using the four-angle option, four different rebound angles are used, as the name implies. When using the two-angle option, the top and bottom pairs of sections are each summed together and only the two shallower angles are used.

The ball will traverse towards the other bat, reflecting from the top or bottom boundary as necessary. The action will repeat until one or other bat misses the ball, whereupon the logic detects a "score". The appropriate score counter is incremented and the new score displayed on the screen. The ball will then serve automatically from the centre line towards the side which had just missed. This sequence is repeated until one score reaches 15, whereupon the game stops. The ball will continue to bounce around the screen but no further hits or scores can be made. Pressing the RESET button zeroes the score counters and restarts the game.



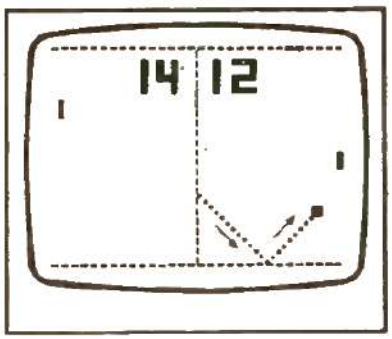


Fig. 1

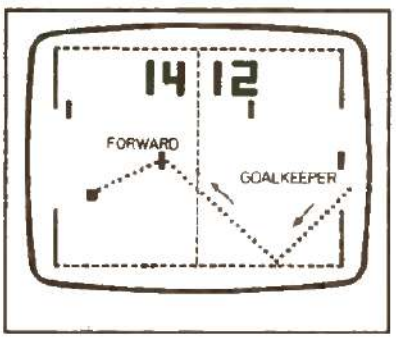


Fig. 2

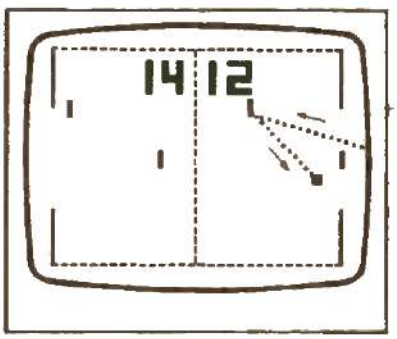


Fig. 3

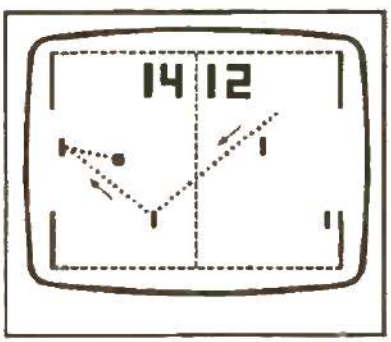


Fig. 4

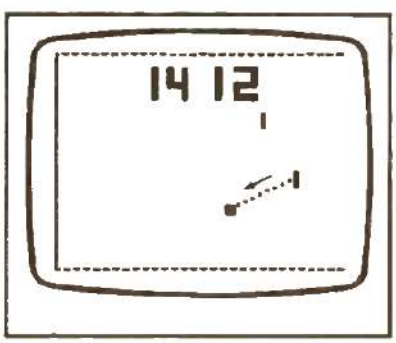


Fig. 5

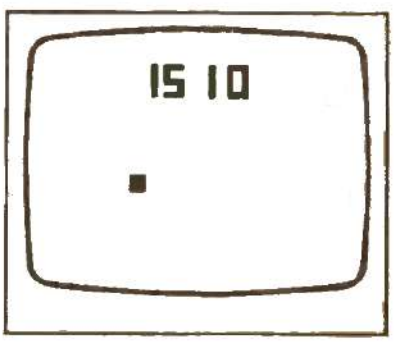


Fig. 6

While the game is in progress, three audio tones are produced to signify top and bottom reflections, bat hits and scores.

● *Soccer/Hockey*—The appearance of the game is shown in Fig. 2, where it will be seen that each participant has two players, a "goalkeeper" and a "forward". The goalkeeper is in his normal position and the forward is in the opponent's half.

When the game starts, the ball will appear travelling from one goal line towards the other side. If the opponent's forward can intercept the ball he can "shoot" it back towards the goal (Fig. 3). If the ball is missed it will travel to the other half of the field where the first team's forward can try to intercept the ball and redirect it forward at an angle determined by the player section used (Fig. 4). The players are subdivided in the same way as the bats in the tennis game. If the ball is reflected from the end boundary or "saved" by the goalkeeper, the same forward can intercept the outcoming ball and divert it back towards the goal.

A score is registered when the ball passes through one of the goal-mouths. Scoring and game control are similar to those of the tennis game, and the same sound effects are used.

● *Squash*—This game is illustrated in Fig. 5. There are two players who alternately hit the ball into the court. The proper sequence of play is assured by enabling each player alternately, first the right-hand and then the left-hand.

● *Solo/Practice*—This game is similar to squash, except that there is only one player.

● *Rifle Shooting 1*—In this game (Fig. 6) a large target bounces randomly about the screen. A special rifle containing a lens and photocell is aimed at the target.

When the trigger is pulled, the shot counter is incremented. If the rifle is correctly aimed so that light from the target is reaching the photocell at that instant, the hit counter will be incremented and a hit sound generated. The target will then be blanked for a while. After 15 shots the score appears but the game can still continue.

● *Rifle Shooting 2*—This game is similar to the first shooting game except that the target traverses the screen from left to right under control of the manual serve switch.

RIFLE

As mentioned above, a special rifle is required to play the two shooting games. Such a rifle is presently under development, and we plan to publish full details in a future issue.

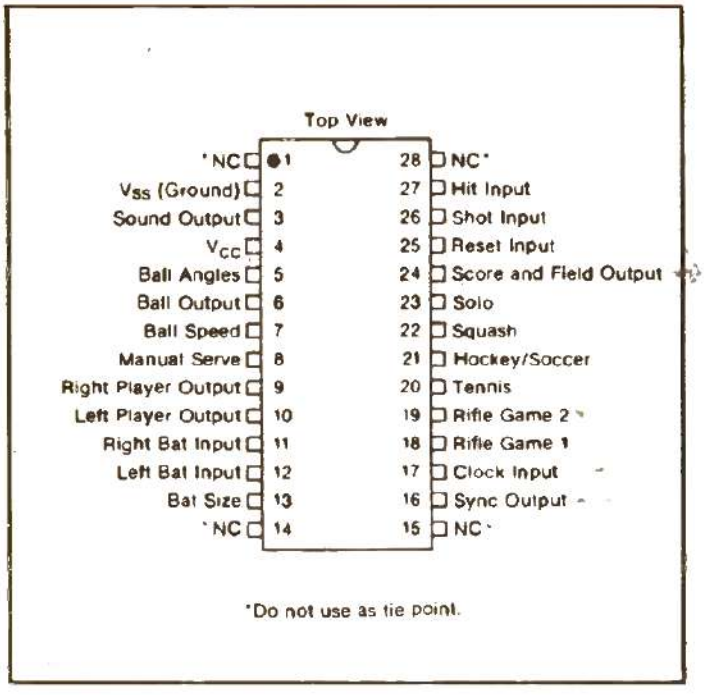


Fig. 7. AY-3-8500 pin configuration

BAT AND BALL OPTIONS

Apart from offering a choice of six different games, the AY-3-8500 chip allows the user to select a number of different options to vary the difficulty of any game. These are (see pin configuration Fig. 7):

● ***Bat Size (pin 13)***—This input is left open circuit to select large bats and connected to 0V by S5 to select small bats. On a 19 in TV screen, large bats are 1·9 in high and small bats are 0·95 in high.

● ***Ball Angles (pin 5)***—This input is left open circuit to select two rebound angles and connected by S2 to 0V to select four rebound angles. When two angles are selected they are ±20°, when four angles are selected they are ±20° and ±40°.

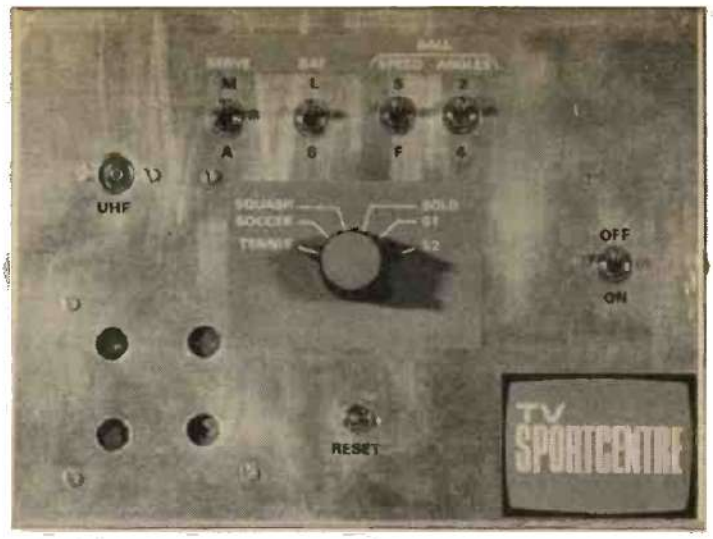
● ***Ball Speeds (pin 7)***—This pin is left open circuit to select low speed (1·3 seconds for the ball to traverse the screen). When connected by S3 to 0V, high ball speed is selected (0·65 seconds for the ball to traverse the screen).

● ***Manual Serve (pin 8)***—When this pin is left open circuit, the game stops after each score. The next serve is achieved by momentarily connecting the pin to 0V via S4. Leaving this pin connected to 0V gives automatic serving. The most convenient form for S4 is that of a push-to-break momentary switch. Alternatively a push-to-make switch can be connected in parallel with S4.

● ***Sound Output (pin 3)***—Audio signals of three different frequencies appear on this pin. These are 976Hz for a hit, 488Hz for a boundary reflection and 1950Hz for a score.

BLOCK DIAGRAM

The block diagram Fig. 8 shows the input, output and control requirements of the AY-3-8500 games integrated circuit. The master oscillator provides the clock signal for the i.c., from which its internal dividers produce the line and field sync pulses as well as the horizontal and vertical components of the video signals of the game.

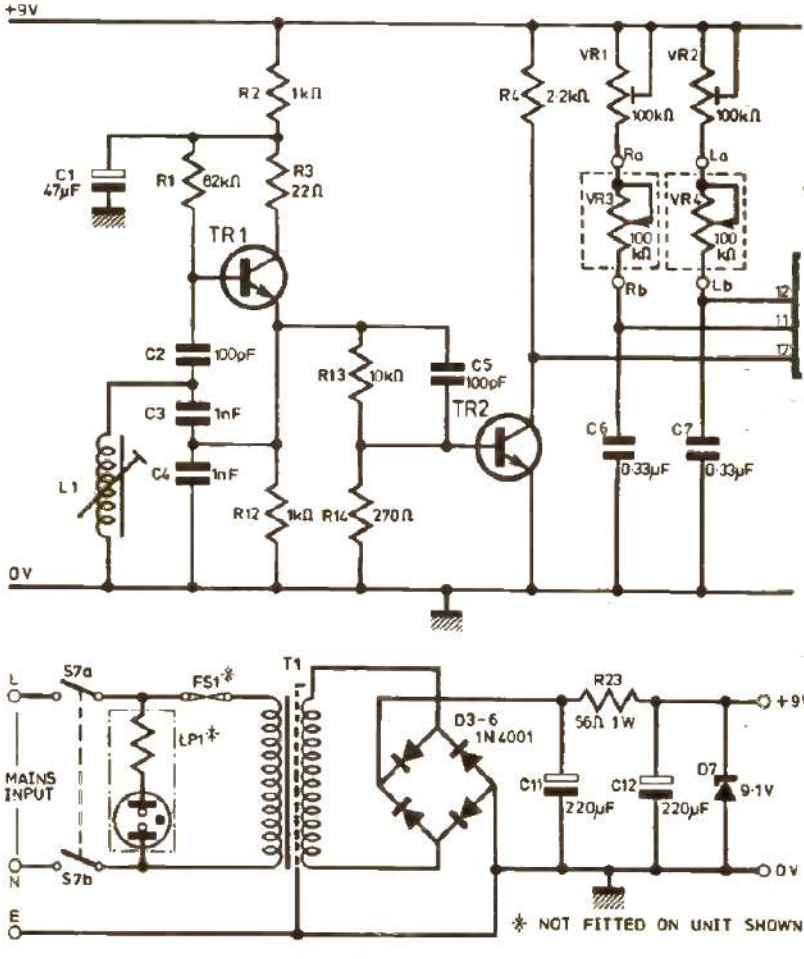


These are combined in the video/sync mixer, the output of which modulates a simple u.h.f. oscillator.

The modulated signal is suitable for feeding into the aerial socket of a standard 625-line receiver tuned to around channel 50. A single transistor buffer enables the audio signals from the i.c. to drive a small moving coil loudspeaker. The whole system operates from a stabilised 9V d.c. power supply which should be capable of providing a current of 100mA.

CIRCUIT OPERATION

Referring to the circuit diagram Fig. 9, TR1 and TR2 form the master oscillator. TR1 is a Colpitts oscillator tuned to about 2·097MHz by L1 and C2. The output is



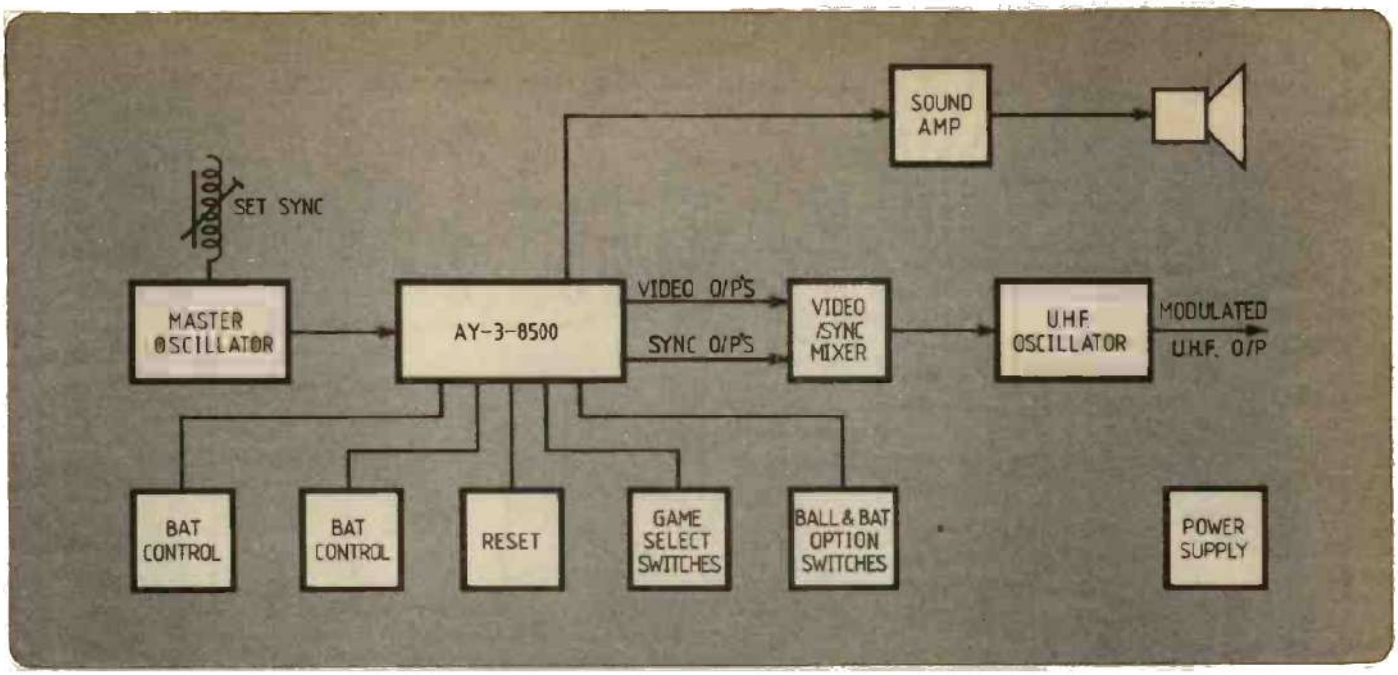


Fig. 8. Sportcentre block diagram

buffered by TR2 and feeds the clock pin of IC1. Variable resistors VR3 and VR4 are player controls for changing the bat positions. It was not found necessary to use screened lead to operate them remotely in the prototype. A 3m length of lightweight twin flex was used for each control. Preset controls VR1 and VR2 are for adjusting the bat displacement to cover the full height of the screen.

Transistor TR3 forms the video/sync mixer. The resistors connected to its base ensure that the video and sync levels are in the correct ratio. The composite video output is applied to the emitter of the u.h.f. oscillator TR5 to modulate it. The stripline inductors L2, L3 and L4 are part of the copper track of the printed circuit board. The frequency of the oscillator is set by C8.

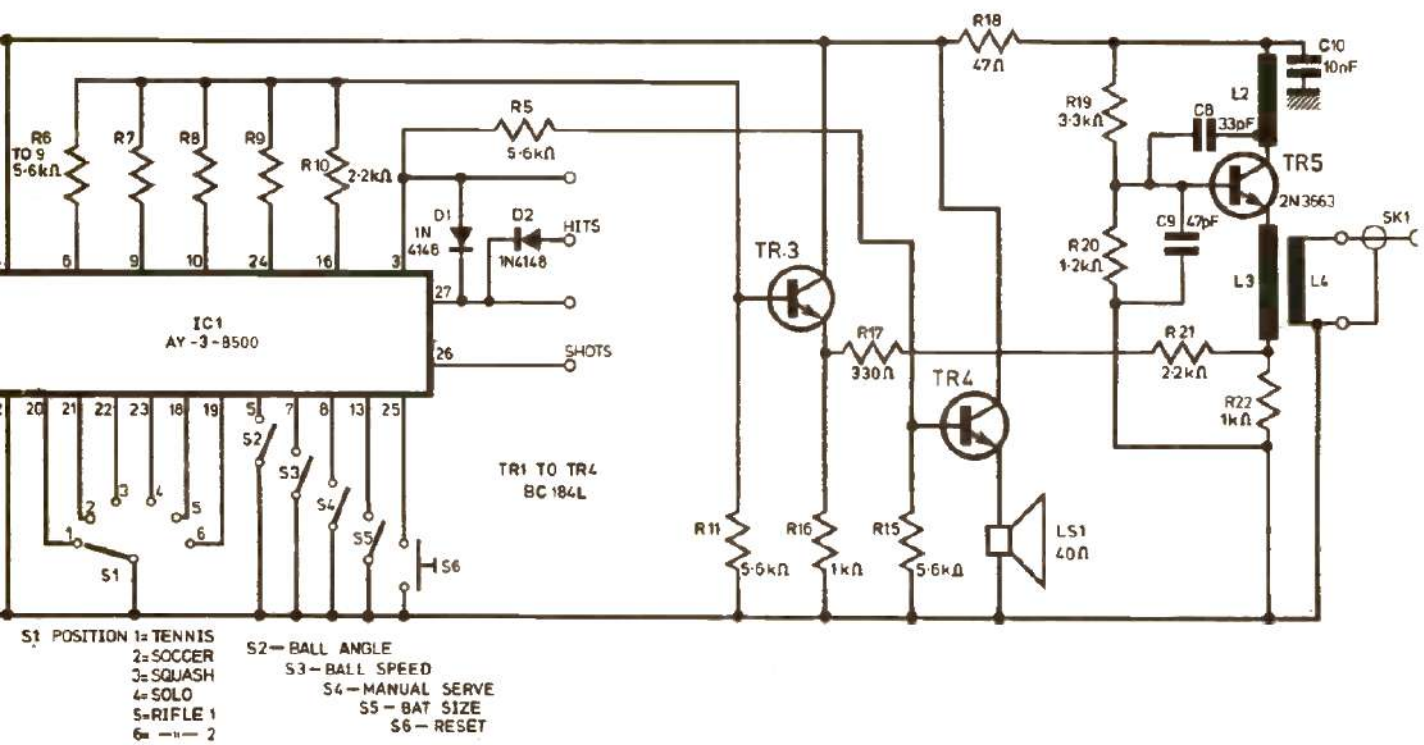


Fig. 9. Circuit diagram of the Sportcentre

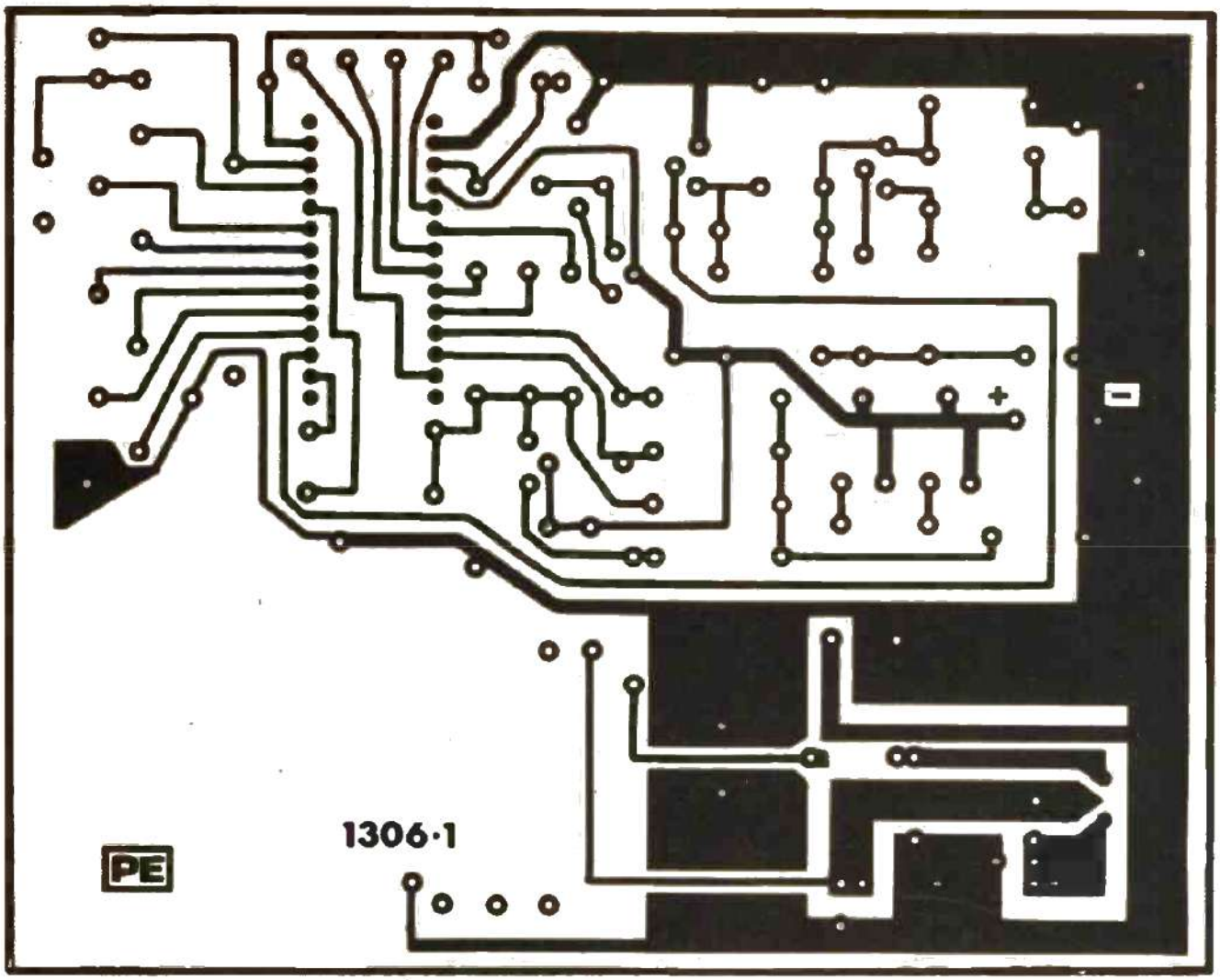


Fig. 10. Printed board track pattern, shown full size. Blank area at bottom left is reserved for rifle circuitry

COMPONENTS . . .

Resistors

R1	82kΩ	R15	5·6kΩ
R2	1kΩ	R16	1kΩ
R3	22Ω	R17	330Ω
R4	2·2kΩ	R18	47Ω
R5–R9	5·6kΩ (5 off)	R19	3·3kΩ
R10	2·2kΩ	R20	1·2kΩ
R11	5·6kΩ	R21	2·2kΩ
R12	1kΩ	R22	1kΩ
R13	10kΩ	R23	56Ω 1W
R14	270Ω		

All ¼ watt 5% carbon film except R23

Potentiometers

VR1, VR2	100kΩ miniature horizontal presets
VR3, VR4	100kΩ linear moulded track

Capacitors

C1	47μF 16V	Tantalum bead type
C2	100pF	Polystyrene
C3	1nF	"
C4	1nF	"
C5	100pF	"
C6	0·33μF	MKM polycarbonate
C7	0·33μF	MKM polycarbonate
C8	33pF	sub-miniature plate ceramic
C9	47pF	sub-miniature plate ceramic
C10	10nF	disc ceramic
C11	220μF 25V	tubular electrolytic
C12	220μF 25V	tubular electrolytic

Semiconductors

TR1–TR4	BC184L (4 off)
TR5	2N3663
IC1	AY-3-8500 (GIM)
D1, D2	1N4148
D3–D6	1N4001 (4 off) or silicon bridge
D7	9·1V 400mW Zener diode

Miscellaneous

LS1 35/40Ω 2·5in loudspeaker
T1 Min. mains transformer, 12V 6VA sec.
LP1 Neon indicator 240V a.c.
FS1 200mA 20mm with holder
S1 1-pole, 6-way rotary switch
S2–S5 S.P.D.T. min. toggle switch (4 off)*
S6 Min. push-to-make push-button switch
S7 D.P.S.T. min. toggle switch
Printed circuit board. Aluminium box 200 × 150 × 75mm.
Plastic moulded boxes 110 × 71 × 50mm (2 off).
Coil former, 6mm diameter, with tuning slug. 36s.w.g. enamelled copper wire. Knobs. Coaxial socket.
Miniature group board.
*See text regarding S4

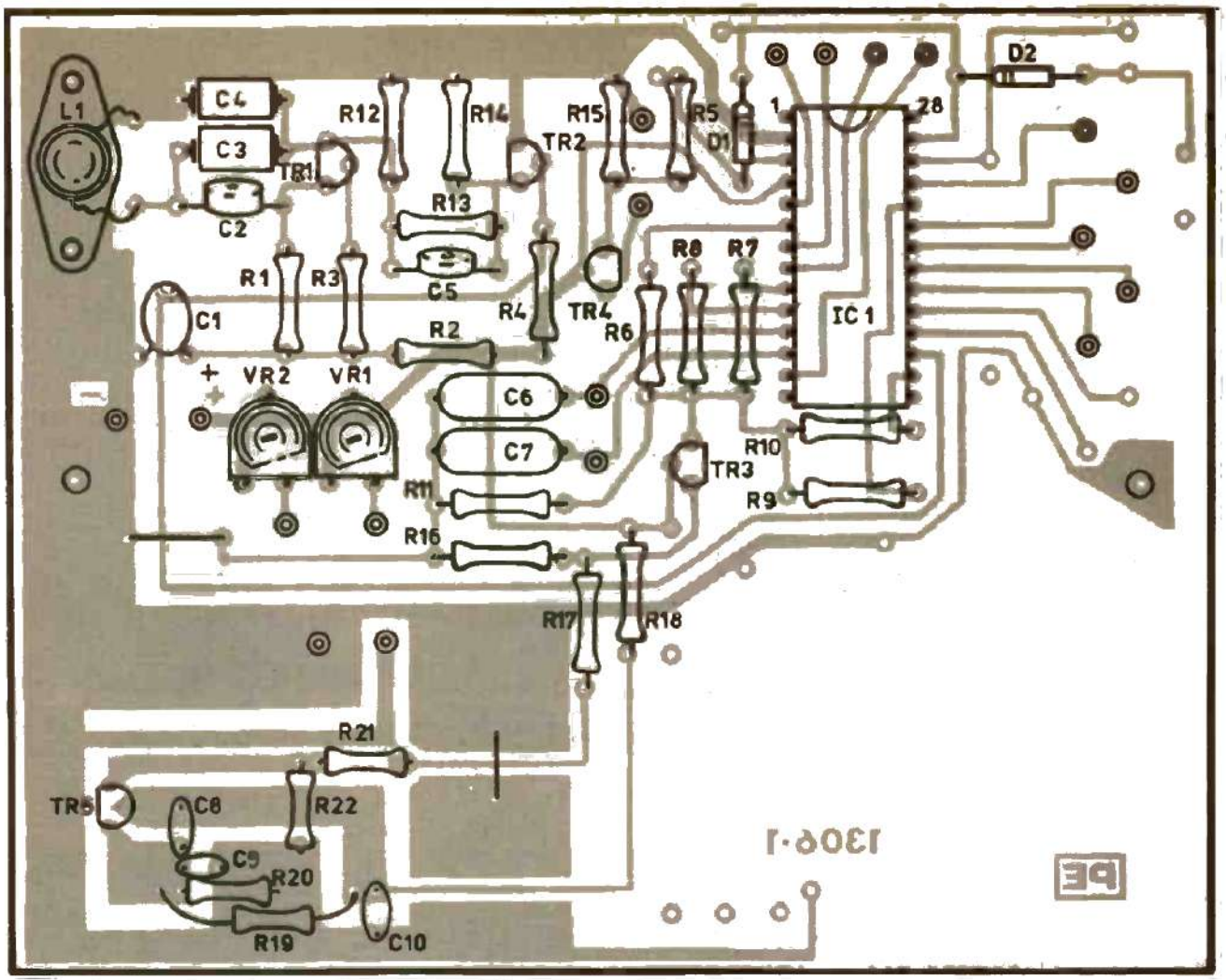
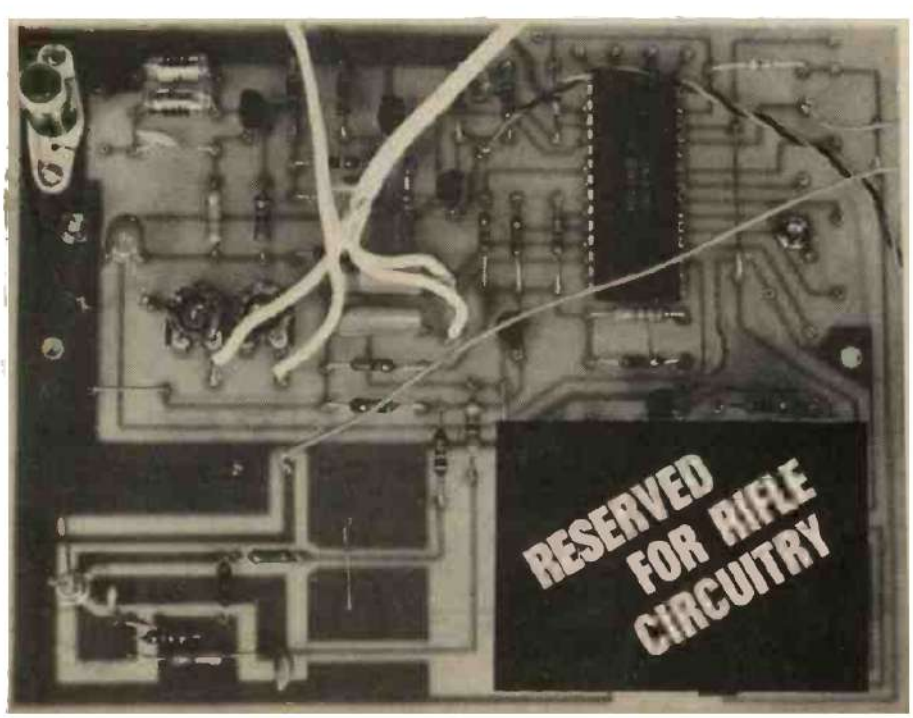


Fig. 11. Printed board component layout



Prototype printed circuit board

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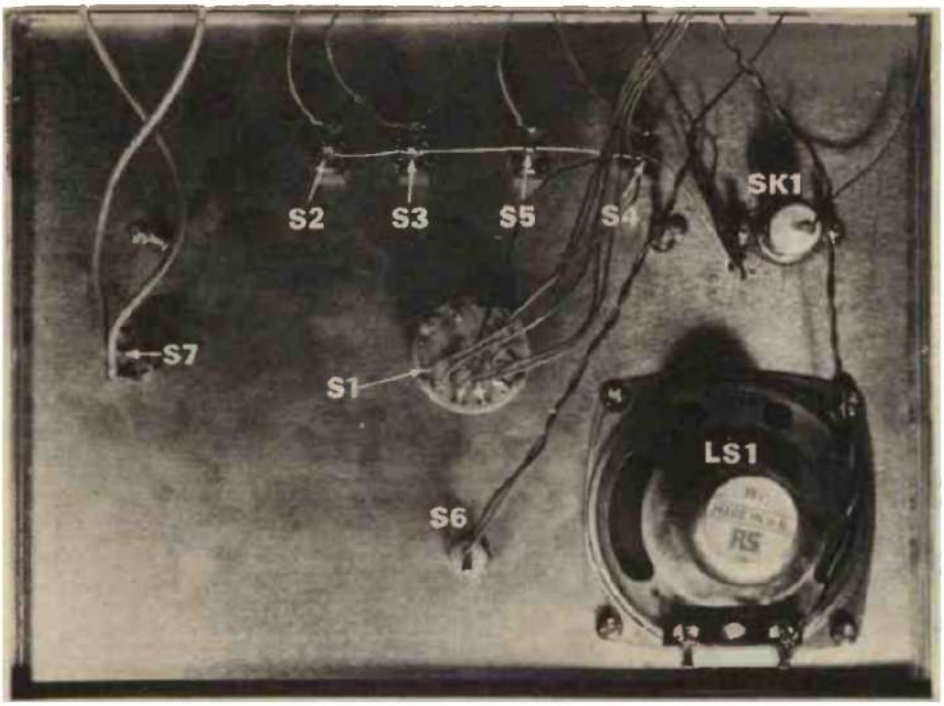


Rear view of control panel with components identified

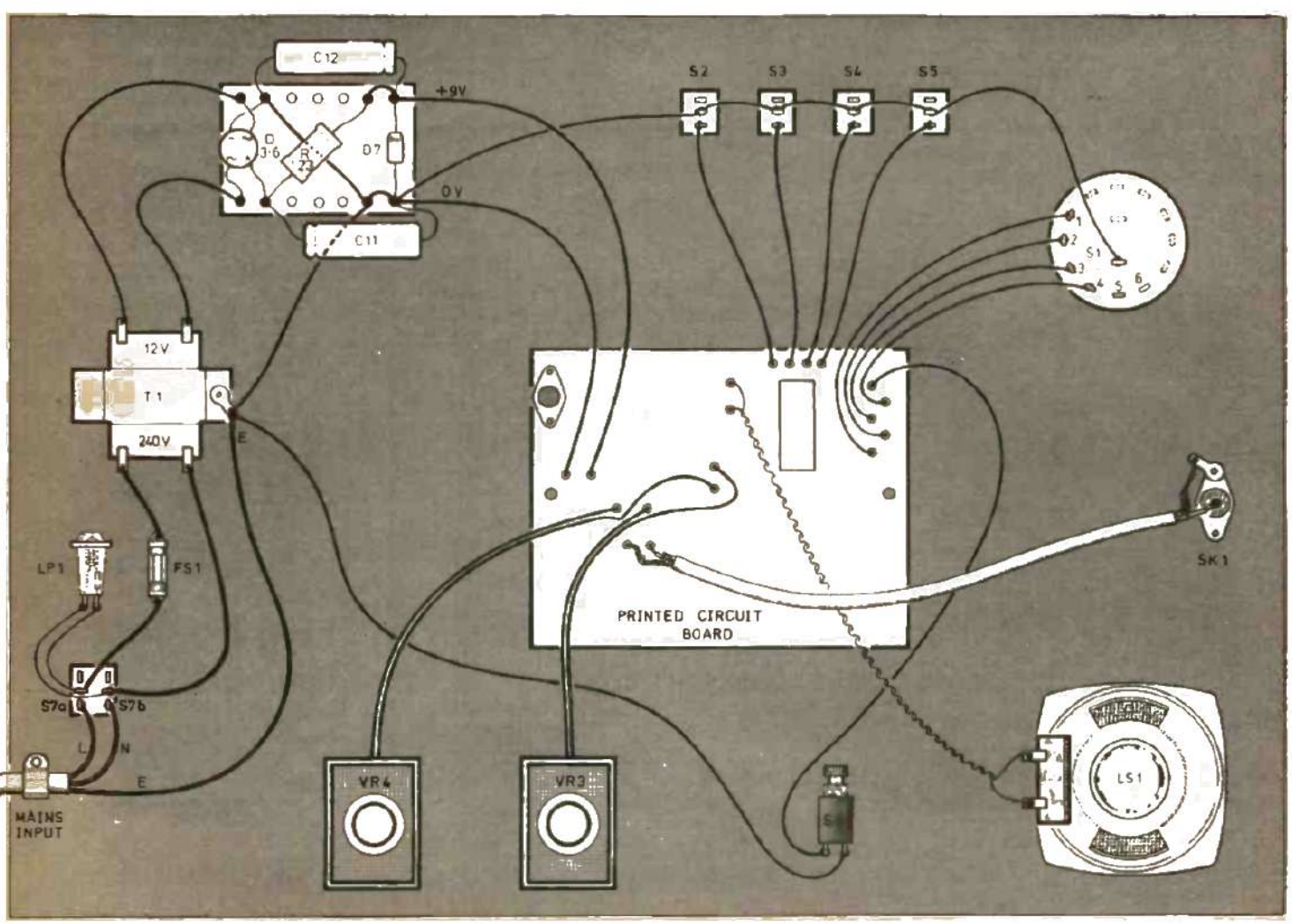
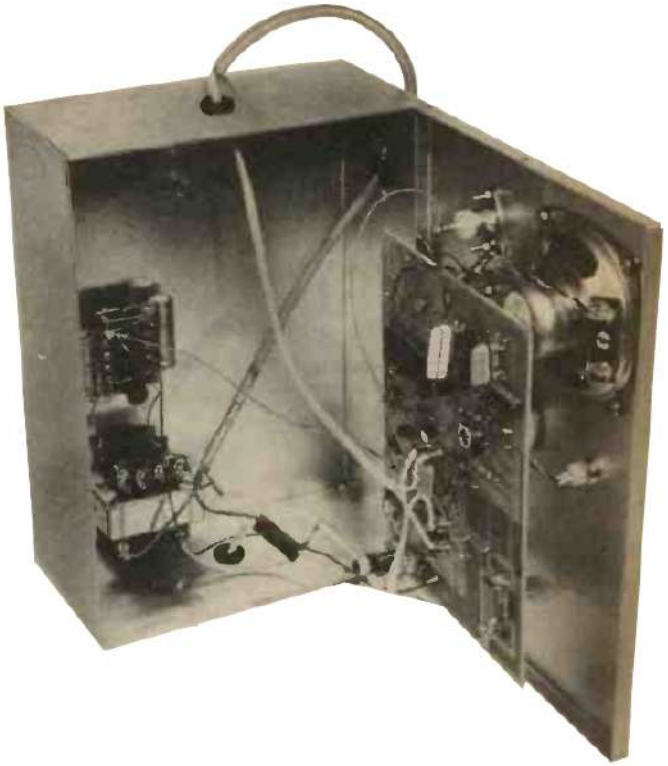


Fig. 12. Wiring diagram including power supply

Remote controls



Interior view of prototype

CONSTRUCTION

The inductor L1 consists of 55 turns of 36 s.w.g. enamelled copper wire close wound on a 6mm (0·25in) diameter former. Two small holes (1mm dia.) should first be drilled in each side of the base of the former for anchoring the ends of the winding. A small amount of quick-setting adhesive should finally be applied to fix the turns of the coil.

The board (Figs. 10 & 11) can be assembled by fitting and soldering the links (tinned copper wire), resistors, diodes, capacitors, transistors, presets and coil. Carefully check the orientation of the transistors, diodes and electrolytics. The last component to be inserted is the integrated circuit, which should be retained in its packaging until required. This is an MOS i.c. and is thus susceptible to damage from static electricity until it has been soldered into the p.c.b. A properly earthed soldering iron must be used. If this precaution is observed it is not necessary to use a 28-pin i.c. socket, or Soldercon sockets.

The board is mounted behind the lid of the box, spaced off on long 6BA screws and nuts. Before attaching it, wires must be soldered to it for the switches, loudspeaker and power supply. The connection from the modulator to the coaxial socket can be made with a short length of screened lead.

The internal layout of the unit is shown in Fig. 12. The power supply components are mounted on a miniature group board which is fixed to the bottom of the main box by two 6BA screws and spacers. For D3–D6 use either four separate diodes or a bridge as preferred.

TESTING AND SETTING UP

Before switching on, carefully check the polarity of the connections to the power supply. Set the game selector switch to TENNIS and the serve switch to AUTOMATIC. After switching on, the tones for boundary reflections and scoring should be heard coming from the loudspeaker.

Connect a coaxial lead from the games unit to the aerial socket of a television receiver. A signal should be received at around channel 50. The core of L1 should now be adjusted for proper locking of the pattern. Fine adjustment of this core should stop any slow undulations in the pattern.

The capacitor C8 in the u.h.f. oscillator may have to be increased or decreased in value by 5 or 10pF if the signal does not tune in conveniently. Finally, the presets VR1 and VR2 should be adjusted so that the bats traverse the full height of the screen. ★