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APRIL 1974

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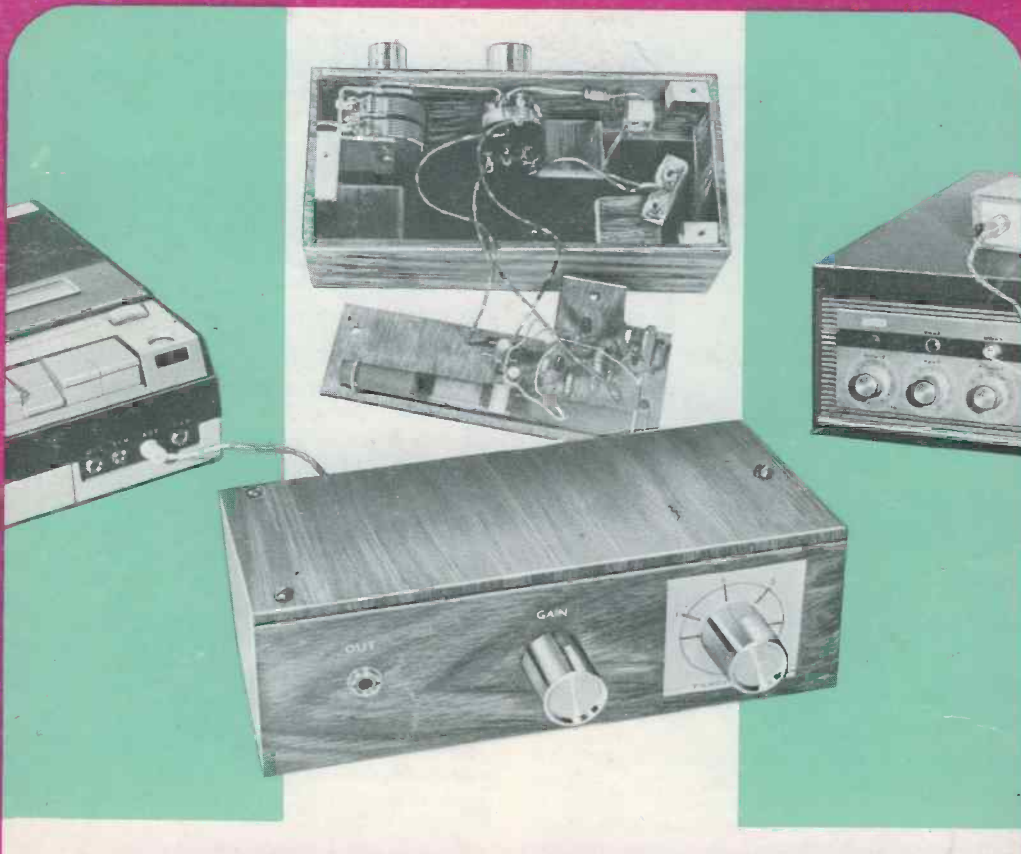

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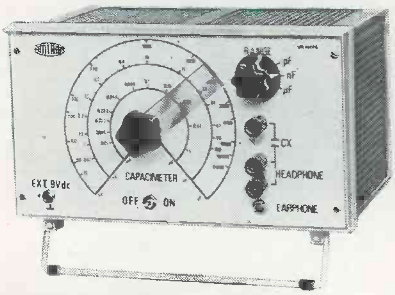

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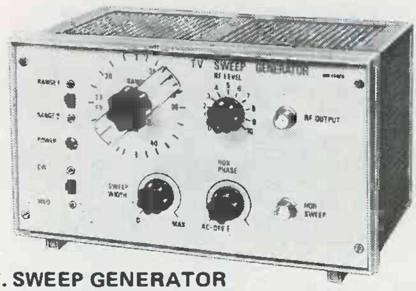

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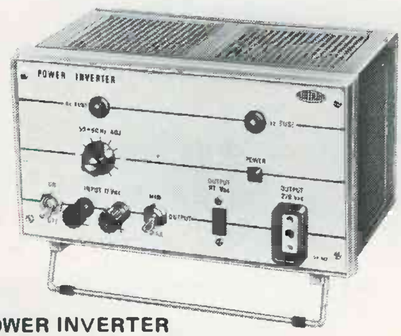

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C 4	75	⅛th W Resistors mixed preferred values	0.55
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PS42	Jack Stereo Switched	0.26
PS43	Phono Single	0.06
PS44	Phono Double	0.10
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PS15	Car Aerial	0.15
PS16	Co-Axial	0.10

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CP 3	Stereo Screened	0.08
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CP 5	Four Core individually Screened	0.30
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CP 9	Speaker Cable	0.04
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Log and Lin 4.7K. 10K. 22K. 47K. 100K. 220K. 470K. 1M. 2M.

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ACOS	GP91 1SC	200mV at 1.2cms/sec	£1.16
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The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S.

The versatility of their design makes them ideal for use in record players, tape-recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home.

PARAMETER	CONDITIONS	PERFORMANCE
HARMONIC DISTORTION	Po=3 WATTS f 1 KHz	0.25%
LOAD IMPEDANCE	—	8 - 16Ω
INPUT IMPEDANCE	f=1KHz	100 KΩ
FREQUENCY RESPONSE ±3 dB	Po=2 WATTS	50 Hz - 25 KHz
SENSITIVITY for RATED O/P	Vs 25V. RL 8Ω f 1KHz	75mV. RMS
DIMENSIONS	—	3"×2½"×1"

The above table relates to the AL10, AL20 and AL30 modules.
The following table outlines the differences in their working conditions.

PARAMETER	AL10	AL20	AL30
Maximum Supply Voltage	25	30	30
Power output for 2% T.H.D. (RL 8Ω f 1 KHz)	3 watts RMS Min.	5 watts RMS Min.	10 watts RMS Min.

AUDIO AMPLIFIER MODULES

AL10 3 Watts £2.19
AL20 5 Watts £2.59
AL30 10 Watts £3.01

PRE-AMPLIFIERS

PA 12 (Use with AL10 & AL20) .. £4.35
PA100 (Use with AL30 & AL50) .. £13.15

POWER SUPPLIES

PS12 (Use with AL10 & AL20) 88p
SPM80 (Use with AL30 & AL50) £3.25

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T461 (Use with AL10) p&p 15p .. £1.38
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BMT80 (Use with AL20 & AL50) p&p 25p £2.15

FRONT PANELS PA 12 With knobs £1.00

PA 12. PRE-AMPLIFIER SPECIFICATION

The PA12 pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL10, AL20 and AL30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with *Cramic cartridges while the auxiliary input will suit most †Magnetic cartridges. Full details are given in the specification table. The four controls are, from left to right: Volume and on/off switch, balance, bass and treble. Size 152mm × 84mm × 35mm.

Frequency response 20Hz–50KHz (–3dB)
Bass control ±12dB at 60Hz
Treble control ±14dB at 14 KHz
*Input 1.
Impedance 1 Meg. ohm.
Sensitivity 300 mV
†Input 2.
Impedance 30 K ohms
Sensitivity 4 mV

EA1000 AUDIO AMP MODULE

Module Tested and Guaranteed.
Full hook-up diagrams and complete technical data supplied free with each module or available separately at 10p each.

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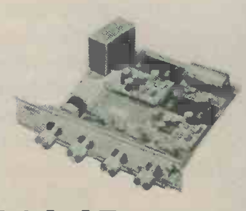
The STEREO 20

The 'Stereo 20' amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm x 14 cm x 5.5 cm. This compact unit comes complete with on/off switch, volume control, balance, bass and treble controls. Transformer, Power supply and Power Amps. Attractively printed front panel and matching control knobs. The 'Stereo 20' has been designed to fit into most turntable plinths without interfering with the mechanism or, alternatively, into a separate cabinet.

Output power 20w peak — Input 1 (cr.) 300mV into 1M
Freq. res. 25Hz–25kHz — Input 2 (Aux.) 4 mV into 30K
Harmonic distortion typically 0.25% at 1 watt — Bass control ±12bB at 60 Hz. Treble con. ±14bB at 14 kHz



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- Supply voltage 10-35 volts
- Thermal Feedback
- Latest Design Improvements
- Load - 3, 4, 8 or 16 ohms
- Signal to noise ratio 80dB
- Overall size 63mm x 105mm x 13mm

Especially designed to a strict specification. Only the finest components have been used and the latest solid state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F., enthusiast.

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STABILISED POWER MODULE SPM80

AP80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (rms) per channel, simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 62mm x 105mm x 30mm.

These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including: Disco Systems, Public Address, Intercom Units etc. Handbook available 10p.

PRICE £3.25

TRANSFORMER BMT80 £2.15 p. & p. 25p.

STEREO PRE-AMPLIFIER, TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques.

Designed for use with the AL60 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.

Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.

SPECIFICATION

Frequency Response	20Hz — 20KHz ± 1dB
Harmonic Distortion	better than 0.1%
Inputs: 1. Tape Head	1.25 mV into 50KΩ
2. Radio, Tuner	35 mV into 50KΩ
3. Magnetic P.U.	1.5 mV into 50KΩ

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB, from 20Hz to 20KHz.

Base Control ± 15dB @ 20Hz	Treble Control ±15dB @ 20KHz
Filters: Rumble (High Pass)	100Hz
Scratch (Low Pass)	8KHz
Signal/Noise Ratio	better than — 65dB
Input overload + 26dB	Supply + 35 volts @ 20mA
Dimensions	292mm x 82mm x 35mm

Price £13.15

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Printed circuit B9A – B7G	3p
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6 way **2p** Single **1p**

WRIST COMPASS
20p with Needle Lock

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Brand New Boxed 6K7G	25p

1¼ glass fuses— 250 m/a or 3 amp (box of 12)	12p
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FX2236 Ferrox Cores	5p
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All metal equipment Phono plug	2p
Bulgin, 5mm Jack plug and switched socket (pair)	20p
12 volt solenoid and plunger	40p
250 RPM 50 c/s locked frequency miniature mains motor	50p
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R.S. 12 way standard plug and shell	50p

ELECTROLYTICS

Mullard C426, TCC, CRL, CCL, Cullins, Hunts, STC Subminiature, etc
MFD/VOLT **2p** 100/6, 6/3, 8/6, 200/3, 25/3.
3p 25/6.4, 500/6, 250/6.
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9p 8/500, 100/200. 400/40, 100/250-275, 4/16 reversible.
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4p. 1500, 1800, 2200, 3000, 3300, 6800, 8200 PFD. .01/350, .013/350, .02/250, .05/125, .05/250, .25/350.
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All parts are supplied – all you need provide is a soldering iron and a pair of cutters. Complete step-by-step instructions are provided, and our service department will back you throughout if you've any queries or problems.

The cost? Just £27·45 !
The Sinclair Cambridge kit is supplied to you direct from the manufacturer. Ready assembled, it costs £32·95 – so you're saving £5·50 ! Of course we'll be happy to supply you with one ready-assembled if you prefer – it's still far and away the best calculator value on the market.

Features of the Sinclair Cambridge

- * Uniquely handy package. $4\frac{1}{2}$" x 2" x $\frac{11}{16}$", weight $3\frac{1}{2}$ oz.
- * Standard keyboard. All you need for complex calculations.
- * Clear-last-entry feature.
- * Fully-floating decimal point.
- * Algebraic logic.
- * Four operators (+, −, x, ÷), with constant on all four.
- * Constant acts as last entry in a calculation.
- * Constant and algebraic logic combine to act as a limited memory, allowing complex calculations on a calculator costing less than £30.
- * Calculates to 8 significant digits, with exponent range from 10^{-20} to 10^{79}.
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- * Operates for weeks on four U16-type batteries. (MN 2400 recommended.)

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2. Large-scale integrated circuit.
3. Interface chip.
4. Thick-film resistor pack.
5. Case mouldings, with buttons, window and light-up display in position.
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7. Keyboard panel.
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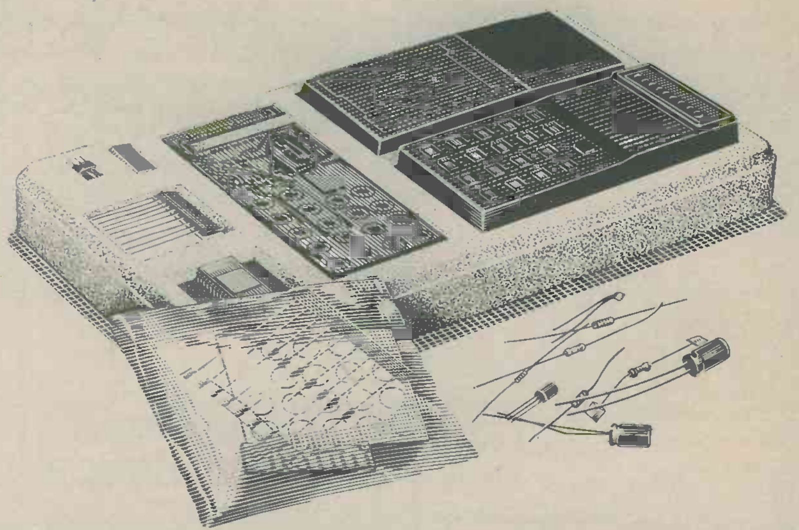
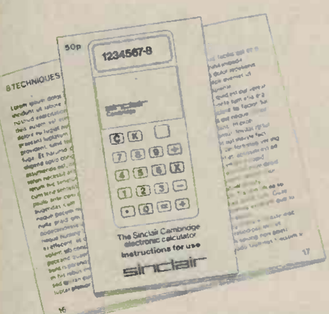


This valuable book – free!
If you just use your Sinclair Cambridge for routine arithmetic – for shopping, conversions, percentages, accounting, tallying, and so on – then you'll get more than your money's worth.

But if you want to get even more out of it, you can go one step further and learn how to unlock the full potential of this piece of electronic technology.



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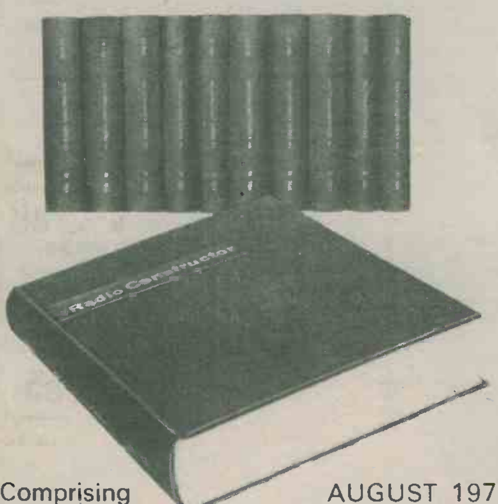

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MAY ISSUE WILL BE PUBLISHED ON 1st MAY

AUDIO TESTER

by A. P. Roberts

A low-cost battery operated test instrument for the checking of a.f. amplifiers which incorporates an a.f. oscillator with attenuator, and an a.f. output level indicator. It is mainly intended for checks on transistor equipment

THERE ARE SEVERAL TYPES OF SERVICING EQUIPMENT IN general use for testing audio circuits, and probably the most popular of these is the signal injector. As signal injectors are usually designed for small size and low cost, and also for r.f. as well as a.f. testing, they normally have an output waveshape which is either a sawtooth or a square wave. The output amplitude is usually fixed and rather high.

The output waveshape is often unimportant but if, for example, a fault has occurred in the biasing of one stage of an audio amplifier and the signal is being clipped, there would be little point in injecting a square wave and then trying to locate the faulty stage by listening for distortion. If, however, a sine wave were injected, checking for distortion would be a much simpler task.

The assembled audio tester. This is completely self-contained in an aluminium case having a sloping front panel

OUTPUT AMPLITUDE CONTROL

This brings us to the point about controlling the output amplitude, as there would be little point in injecting a signal of several volts peak-to-peak (as delivered by most signal injectors) since this would almost certainly cause clipping to occur, even in a faultless stage. Even in cases where the biasing has been seriously affected, and where under normal operating conditions virtually no output is obtained at all, injecting a strong signal could force the stage into linear operation on part of the signal. This would of course make it impossible to locate the faulty stage using an injector.

Another shortcoming of the signal injector is that it is only really easy to use when there is a serious loss of gain in the circuit being checked. If a fault in an emitter bypass capacitor or something similar is causing a partial loss of gain, locating the faulty stage using just a signal injector is obviously going to be extremely difficult. Some form of level detector to give an indication of the relative input and output signal levels would be an obvious advantage.

Bearing these points in mind the device which forms the subject of this article was designed. It has lost to a certain extent the main advantages of a conventional signal injector, which as stated earlier are small size and low cost. Nevertheless, the completed unit is still quite inexpensive. It is housed in an attractive ready-made aluminium case with a sloping front which measures only 5.75 by 2.75 by 2 in., and it is completely self-contained, with its own internal 9 volt battery.

PRACTICAL CIRCUIT

The unit consists of two sections, these being a sine wave generator with controlled output amplitude, and an a.f. level detector. The complete circuit is given in Fig. 1. Here, TR1 and TR2 form the oscillator section, whilst TR3, TR4, TR5 and the associated components constitute the level detector.

TR1 is operated in the emitter follower mode, with R5 giving the required biasing and R6 as the emitter load resistor. A coupling from the emitter to the base is made via the network given by R1 to R4 and C1 to C4, and oscillation takes place at the frequency at which the emitter and base are in phase. The circuit is unusual insofar that the transistor offers less than unity voltage

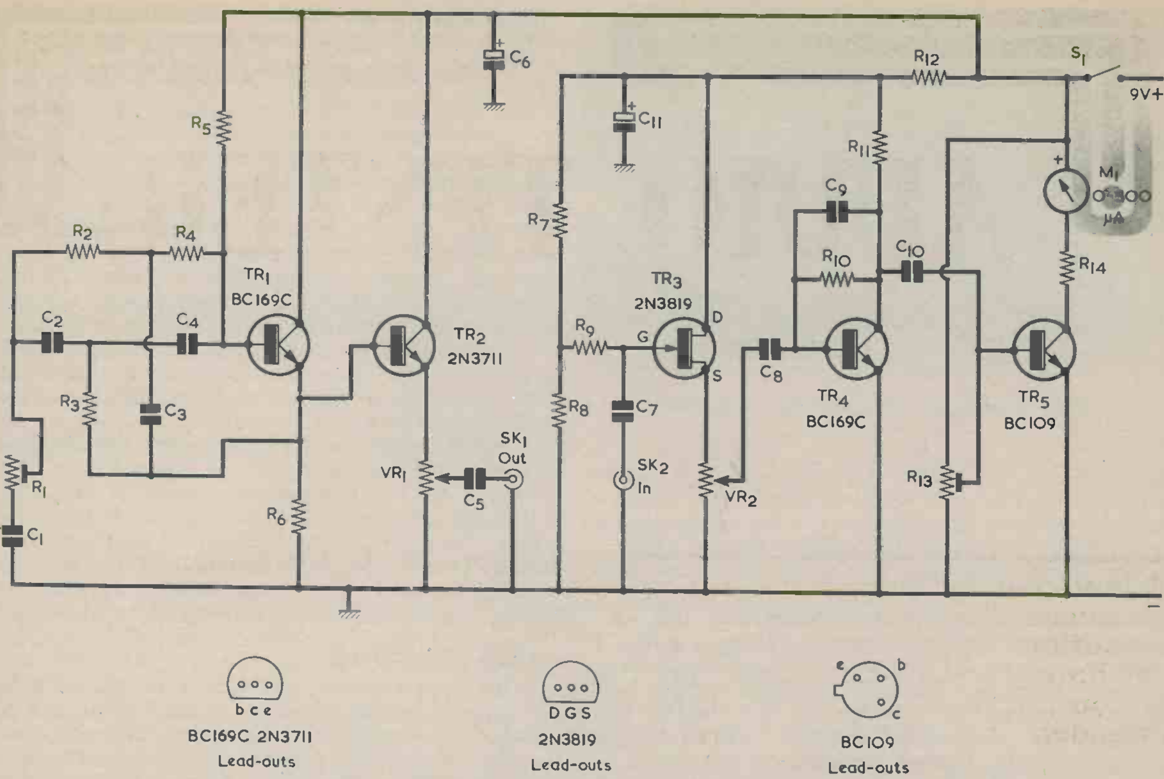


Fig. 1. The circuit of the audio tester. This has two sections, with TR1 and TR2 forming an audio signal source, and TR3, TR4 and TR5 functioning as a level detector

COMPONENTS

Resistors
(All fixed values ¼ watt 10%)

R1	50kΩ pre-set potentiometer, sub-miniature horizontal mounting
R2	5.6kΩ
R3	1.2kΩ
R4	5.6kΩ
R5	2.7MΩ
R6	4.7kΩ
R7	270kΩ
R8	150kΩ
R9	3.3MΩ
R10	1.5MΩ
R11	5.6kΩ
R12	1kΩ
R13	1MΩ pre-set potentiometer, sub-miniature vertical mounting
R14	10kΩ
VR1	1kΩ potentiometer, linear
VR2	5kΩ or 4.7kΩ potentiometer, linear, with switch S1

Capacitors

C1	0.022µF disc ceramic
C2	0.01µF polyester
C3	0.047µF Mullard type C280
C4	0.01µF polyester
C5	0.22µF Mullard type C280
C6	100µF electrolytic, 10 V.Wkg.
C7	0.022µF Mullard type C280
C8	0.22µF Mullard type C280
C9	0.01µF Mullard type C280
C10	0.22µF Mullard type C280
C11	100µF electrolytic, 10 V.Wkg.

Semiconductors

TR1	BC169C
TR2	2N3711
TR3	2N3819
TR4	BC169C
TR5	BC109

Sockets

SK1	3.5 mm. jack socket
SK2	3.5 mm. jack socket

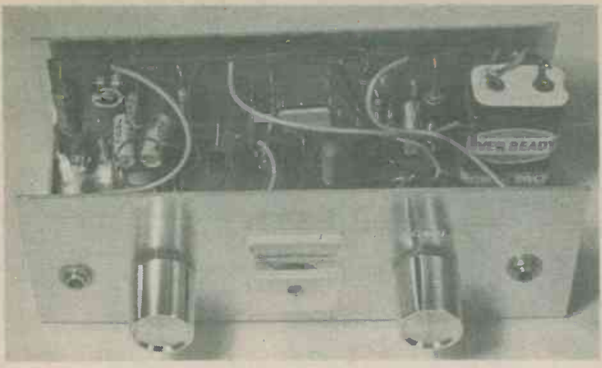
Meter

M1	0–500µA (see text)

Switch

S1	s.p.s.t., part of VR2

Miscellaneous
Battery type PP3 (Ever Ready)
Battery connector
Aluminium case (see text)
2 control knobs
Printed circuit board



A view inside the tester with the cover removed

gain although, of course, it produces a high current gain. There is, also, a 'hidden' coupling to C1 from the collector via the bypass capacitor C6. The oscillator runs satisfactorily in practice and offers a tone of approximately 2kHz. Adjusting R1 brings the circuit into oscillation and it is set up for a good compromise between waveshape purity and adequate amplitude.

The oscillator is liable to stop oscillating if a load is taken direct from the emitter of TR1. In consequence, the emitter follower, TR2, is interposed between TR1 and the output at SK1, thus ensuring that the latter is at a low impedance without excessive loading on the oscillator circuit. Output amplitude is controlled by VR1.

The input for the level detector is at SK2, and it is applied to the f.e.t., TR3. This is operated in the source follower mode with an input impedance of the order of 3.3MΩ. Very high input a.f. voltages could cause breakdown of the gate insulation and it is in consequence recommended that the unit be employed for checking transistor a.f. amplifiers only, in which a.f. voltages are not normally very large. It can be used with valve a.f. amplifiers provided that care is taken to keep the amplitude of a.f. input voltages to a reasonably low level.

The output from TR3 is applied to the potentiometer VR2, and thence to transistor TR4, which is a high gain common emitter voltage amplifier. The feedback capacitor, C9, gives top cut to the stage in order to aid stability.

The pre-set potentiometer R13 is adjusted such that, in the absence of input, TR5 is just conducting. When a signal is applied, negative half-cycles from TR4 will merely turn TR5 off, but positive half-cycles will cause it to conduct, thereby giving a deflection in the meter. The deflection is increased as input amplitude becomes larger. R14 is a current limiting resistor and ensures that the current in the meter circuit cannot rise above a level which is slightly less than 1mA.

In order to enable an inexpensive recording level type of meter to be employed, VR2 is adjusted to bring the needle of M1 to a predetermined point on the scale. It is then the setting of VR2 which indicates the level of the signal. The type of meter used here is usually sold as a tuning, battery level or recording level indicator, and should be about 1 in. by 1 in. at the front. A typical type is that retailed by Henry's Radio Ltd. as Model B81.

CONSTRUCTION

With the exception of C5 and R14, all the minor components are mounted on a small printed circuit board. C5 is wired between the appropriate tags of SK1 and VR1. R14 is fitted between the circuit board and the negative meter tag by initially soldering one lead of this resistor to the board and connecting the other lead to the meter after the board and meter have been finally mounted in position. Its leads are covered with sleeving and, if these happen to be too short, an extension length of wire can be soldered to the lead which connects to the meter. The decision to fit the resistor was made after the accompanying photographs had been taken.

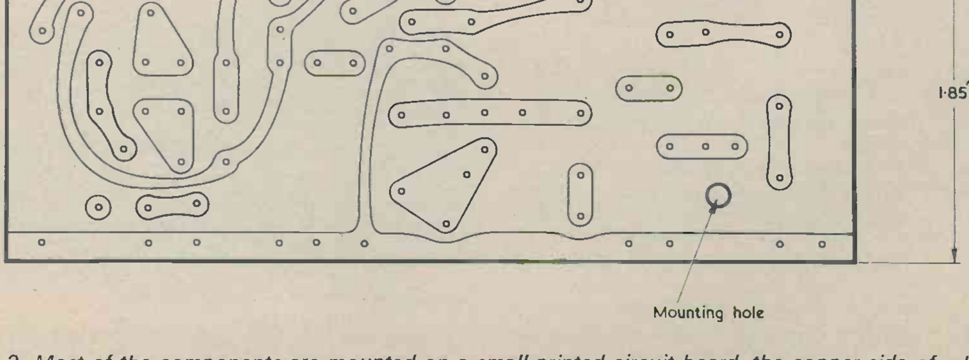
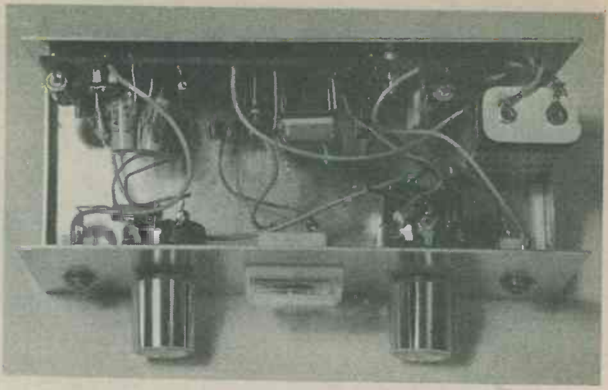


Fig. 2. Most of the components are mounted on a small printed circuit board, the copper side of which is shown here. This diagram is a full-size reproduction and may be traced

Fig. 2 shows the printed circuit board from the copper side. The board is reproduced full-size in this diagram, which may be traced. The hole positioning for component lead-outs should also be taken from Fig. 2. The two mounting holes are drilled 6BA clearance with a No. 31 twist drill. Fig. 3 shows the component side of the board.

Thin insulated wires about 3 to 4 in. long are soldered to the points on the printed circuit board which connect to controls and sockets, etc. The free ends of these are connected once all the components on the front panel and the completed printed circuit board are fitted. The board is mounted on the rear panel of the case over to the left, as viewed from the front of the case. It is secured by two ½ in. 6BA bolts, small insulated spacing washers being placed over the bolts between the board and the rear panel to space these apart slightly and to ensure that there is no risk of short-circuits between the underside connections on the board and the metal panel.



Looking directly down on the internal components

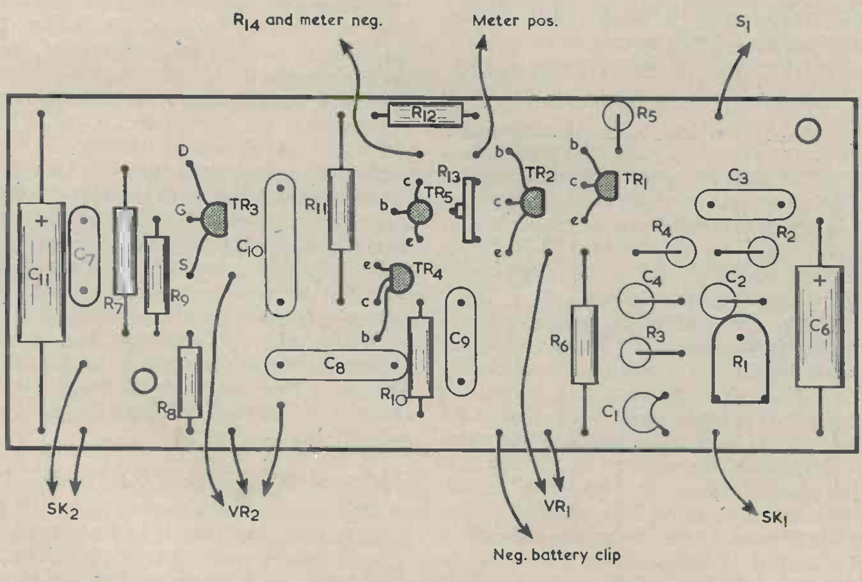


Fig. 3. The component side of the printed circuit board

Further protection against short-circuits could, if desired, be given by fitting a thin sheet of Paxolin, or similar, to the rear panel, this having the same outside dimensions and mounting hole positioning as the printed circuit board. The 6BA mounting bolts would then pass through the rear panel, the thin Paxolin sheet, the spacing washers and the printed circuit board in that order.

The connection between the negative supply rail and the metal case is made by way of the appropriate tags of the two sockets. These tags are those which correspond with the sleeve of the jack plug and the mounting bush of the socket.

Fig. 4 shows the layout of the front panel. The size and shape of the cut-out for the meter depends upon the type used. The meter is positioned centrally between VR1 and VR2. Some meters of the type used here do not have mounting screws, whereupon it will be necessary to either make the meter a tight fit in the front panel cut-out, fix it with adhesive, or devise a simple clamp from thin metal sheet.

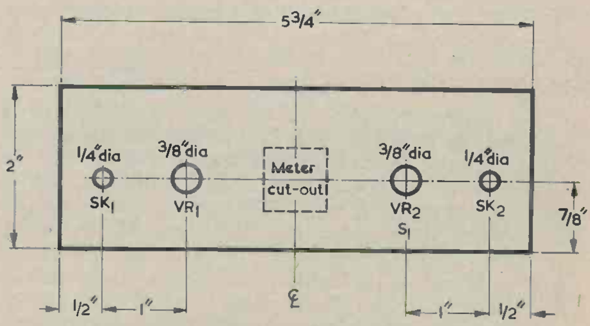
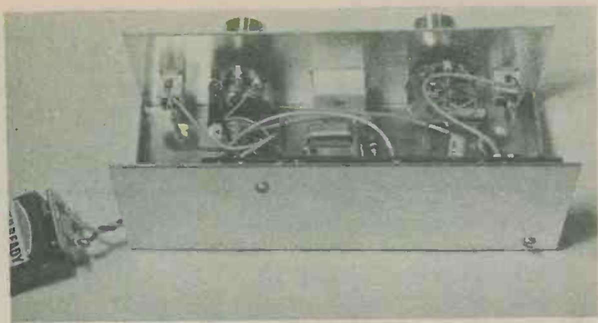


Fig. 4. Drilling details for the front panel. The dimensions of the meter cut-out depend upon the particular movement employed



Wiring and components behind the front panel

There is plenty of space for the battery on the right-hand side of the case. This is mounted vertically and is held firmly in place by being trapped between the top and base of the case. A piece of foam rubber or plastic is fitted to the underside of the top, this pressing against the battery. The case, it should be added, is available from Chromasonic Electronics, 56 Fortis Green Road, London, N10 3HN, and it is listed as Ref. No. SF1.

SETTING UP

R1 and R3 must be adjusted before the unit is brought into use. It is most important to note that the battery must *not* be connected and the tester switched on until R13 has been adjusted so that its slider is at the negative end of its track. It is worth checking with an ohmmeter that the slider has been turned fully in the correct direction. R1 should be adjusted for zero resistance between C1 and the junction of R2 and C2.

A battery may now be connected and the tester switched on. If a current reading meter is inserted in the positive supply lead this should indicate a consumption of about 5mA. A high impedance earphone or pair of headphones should be plugged into SK1 and VR1 adjusted as required. A loud and rather harsh note should be heard. Increasing the resistance inserted into circuit by R1 will reduce the volume of the note but will increase its purity, and a point will be reached where oscillation ceases. It should be possible to find a setting where the output is quite strong and a clean-sounding note is obtained. This is the correct setting for R1.

Next, R13, should be slowly and carefully adjusted so as to increase the resistance between TR5 base and the negative supply rail, a continual watch being maintained on meter M1. A point will be reached where there is a slight forward deflection of the needle. The final setting of R13 is that which causes a barely perceptible meter deflection.

USING THE TESTER

For many tests only the a.f. oscillator section of the unit will be required. This can be used as an ordinary signal injector when testing a dead amplifier. The first test is made at the output of the amplifier and the subsequent tests are made at the inputs and outputs of the earlier stages, working back towards the input. When no output is obtained from the amplifier the fault will be found to lie between the points where the last and penultimate tests were made.

A similar method can be used when testing for the cause of severe distortion. In this case it is necessary to listen for the distortion rather than check for absence of signal. The distortion should be clearly audible when located, providing R1 has been properly adjusted for a sufficiently pure tone. Care should be taken not to set the output level too high.

The level detector is only required when testing for the cause of a loss of gain. It would be feasible to calibrate the tester to show exact voltage gain, but this would require some advanced test gear for calibration, and the supply of the tester would need to be stablized. The following method is, in the author's opinion, in some ways more practical.

The sensitivity control of the level detector is advanced to maximum, and the output of the oscillator reduced to minimum. The output of the oscillator is connected to the input of the level detector, and the oscillator output level is adjusted to give a deflection to a pre-determined point on the scale of the meter. The scale of this type of meter is usually divided into two or three coloured areas. Where two of these areas meet gives a convenient reference point.

Now connect the oscillator to the input of an amplifier which is in good working order. Reduce the sensitivity of the level detector and connect its input to the output of the amplifier. Adjust the level detector sensitivity control to position the meter needle at the reference point. A mental note should be made of the position of the sensitivity control. A random scale can be marked on the panel around VR2 spindle if it is thought that it will prove helpful. If this procedure is repeated a few times on the various stages of audio amplifiers, or the audio stages of radio receivers, the user will soon begin to know what kind of setting of VR2 is to be expected for various types of amplifying circuit. When it comes to testing a faulty piece of equipment it is usually immediately obvious when a stage being checked is working properly or not.

It may be necessary to gain a little experience with the tester before its full worth can be taken advantage of, but once this has been achieved the device will prove helpful in locating very many types of fault in audio amplifying equipment.

NON-SINUSOIDAL OUTPUT

The author's instrument is only required for a.f testing and therefore it has not been designed to produce a square wave type of output for r.f. and i.f. tests. However, the simple modification shown in Fig. 5 will enable the unit to generate a non-sinusoidal waveform which is sufficiently rich in harmonics for r.f. and i.f.

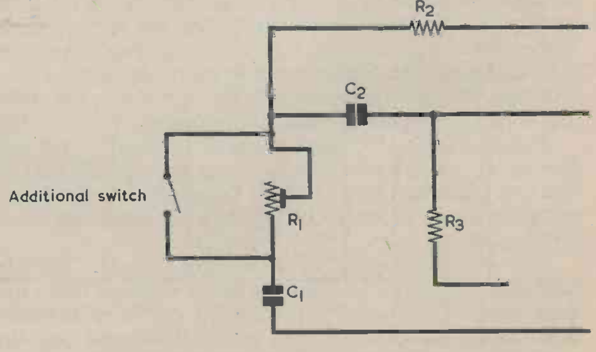


Fig. 5. A simple modification which allows the signal source section to produce a non-sinusoidal oscillation which is rich in harmonics

testing of medium and long wave broadcast receivers.

The modification merely consists of a switch wired across R1. When this switch is open the circuit operates as before. When the switch is closed the feedback is no longer subject to any limitation, and the circuit oscillates violently, producing the required harmonics of the fundamental signal.

There is little space for the added switch on the front panel, but as it would only be required occasionally it could conveniently be mounted on the rear panel immediately behind the battery. Any miniature s.p.s.t. switch should be suitable.

CLEARING NOISY VOLUME CONTROLS

by James Kerrick

Adding an emitter follower stage not only removes the cause of noisy volume controls in a.m. transistor radios but also improves quality

Often the volume control in an a.m. transistor radio becomes noisy, and this is frequently due to charging currents in the coupling capacitor arising from d.c. across the volume control when this is used as the diode load. These conditions may be readily circumvented by the inclusion of an emitter follower after the volume control, so that a smaller capacitor can be used and the time constant reduced.

An added advantage is that the a.c.–d.c. diode load ratio is improved, with noticeable results on the quality of the sound reproduced.

MODIFICATION

A receiver recently modified had the circuit shown in Fig. 1, in which the detector feeds the volume control directly. This control was noisy on switch-on. After modification there was no noise from the control and the quality was improved.

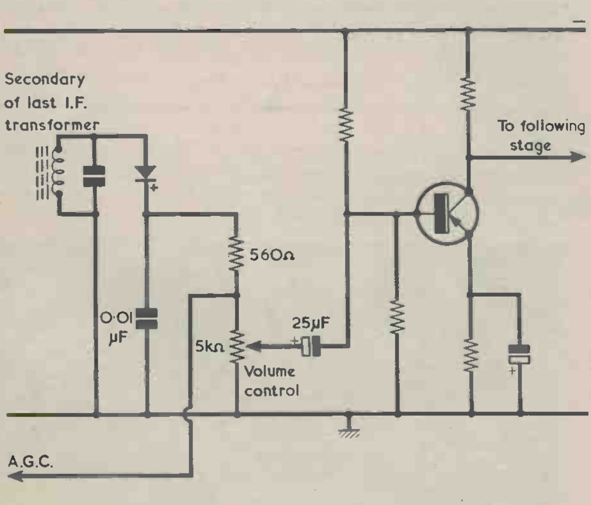


Fig. 1. A familiar a.m. detector and volume control circuit

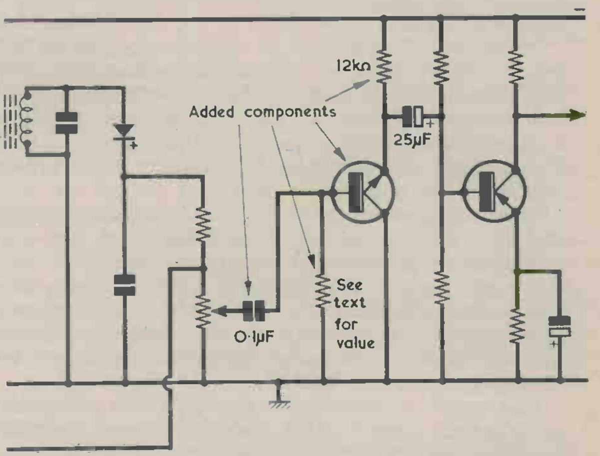


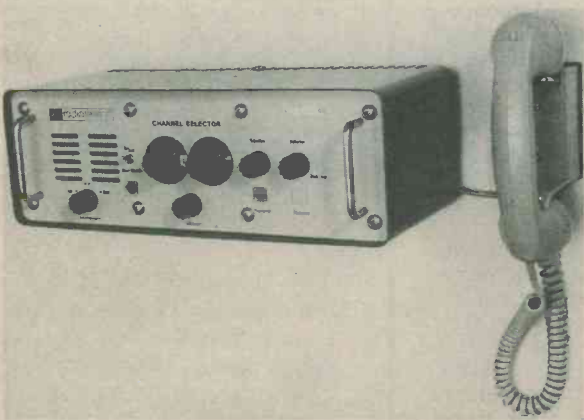
Fig. 2. Four components are added to insert an emitter follower stage immediately after the volume control

The modified circuit is shown in Fig. 2 and it will be seen that four extra components are added, these being two resistors, a capacitor and a transistor. The electrolytic capacitor previously connected to the volume control slider now couples the output of the added emitter follower stage to the base of the existing common emitter a.f. amplifier transistor.

The added transistor may be any high gain general purpose type, and the base resistor is adjusted *in situ* to provide about 2 volts across the 12kΩ emitter resistor. Room should be found in all but the smallest receivers for the additional components required, and the circuit may of course use a p.n.p. emitter follower if the set has a positive supply line.

NEWS . . . AND .

MARINE RADIO TELEPHONE WITH INTERNATIONAL COVERAGE



Already well established in the popular boating field for its wide range of electronic navigational aids, EMI Marine of Cramptons Road, Sevenoaks, Kent, has introduced a compact new marine radio telephone to the British market which incorporates all 57 VHF international channels with the addition of 10 private channels when required.

This international capability, coupled with a rugged and fully environmentally tested system is not only eminently suitable for the serious yachtsman cruising in foreign waters, but represents EMI Marine's entry into communications for the commercial shipping field. Naval and military communications are also covered by this very versatile system which has full Post Office approval.

This new international marine radio telephone features data controlled frequency selection, a method of digital frequency synthesis needing only four crystals aided by a miniature computer to control the 134 frequencies required. A technique, which previously has been limited to satellite and military communications.

The AP.759, offering full duplex, semi-duplex and simplex operation, is manufactured by A.P. Radiotelephone, Copenhagen.

The radio telephone units are compactly designed and well styled, measuring 132 mm × 380 mm × 165 mm and having facilities for two extra handsets, and two extension speakers. Distances between individual stations can be up to 200 feet and operating supplies are either 12 or 24 V d.c. (completely isolated) or ships voltages of 110 d.c. or 230 a.c.

This highly advanced communication transceiver is competitively priced at £695 for a complete single system. Prices for 2, 3 or 4 – station versions will be quoted on request.

With the facilities stated it gives the skipper of an ocean-going commercial or passenger vessel, or the skipper of a yacht, confidence in his ability to contact any international port, shorestation or any other ship at sea. The AP.759 operates in the VHF band with immediate access to the distress frequency coverage on channel 16.

OSCAR NEWS

Pat Gowen, G3IOR and Tony Bailey, G3WPO, are producing a newsletter for OSCAR enthusiasts, two very informative editions have been produced.

The first issue gives much useful information on operating techniques; orbit times; aerial design; some interesting news of some of the more unusual stations to be heard using OSCAR; an explanation of some of the control problems and irregular appearances of OSCAR; useful Satellite Orbit terminology etc.

From a Stop Press report to the first edition, we learn that OSCAR 7 is not likely to be launched before July 1974. To quote:– "With the successful launch of the ITOS-F Satellite by NASA on November 6th, 1973, it is now expected that ITOS-G, the mission we expect OSCAR 7 to fly on, will probably not be called out for launch until around July 1974."

"Originally it was expected that a launch opportunity for OSCAR 7 would exist around the beginning of 1974. The loss of ITOS-E during launch on July 16, 1973 caused a reshuffling of the launch schedules, with the result that we find ourselves with several months available for additional spacecraft testing".

The second edition of the "Newsletter", has an article from VE2BYG, one of the OSCAR control stations, giving details of some of the control problems being currently experienced. There is also a useful Table of Predictions up to April 21st. The issue also contains much other very interesting material, including a quite detailed account of some of the experiments AMSAT has been conducting with OSCAR 6.

If these Newsletters continue at the high level of interest set by the first two, OSCAR users will be provided with a most useful service. Further information on the Newsletter may be obtained from Tony Bailey, G3WPO, 5 Erin Way, Burgess Hill, SUSSEX, RH15 9PN.

Pictured below is disc jockey Dave Cash in Capital Radio's main control room in which Rediffusion Industrial Services carried out the technical installation for London's latest independent radio station.

. . . COMMENT

"FATHER OF WIRELESS" – CENTENARY YEAR OF BIRTH

One hundred years ago (April 25th, 1874) Guglielmo Marconi was born in Bologna, the younger son of a wealthy Italian landowner, Giuseppe Marconi, and his Irish wife Annie, the daughter of Andrew Jameson, the whiskey distiller from County Wexford in Ireland.

To Guglielmo Marconi must go the credit for seeing the wider possibilities of wireless, of taking it out of the laboratory where pure science had shackled it, and developing practical systems for the benefit of mankind. His work and that of the brilliant men with whom he surrounded himself in the company he formed, laid the foundations of the electronics industry as we know it today.

From an early age he was interested in science and by his late teens, at his home the Villa Grifone, he was experimenting with electromagnetic waves as a communication medium. By the summer of 1895 he had succeeded in transmitting signals over a few yards of space and in August, using an earth and an elevated aerial at both transmitter and receiver, he was able to pass Morse code over 1¾ miles.

The Italian Government was not greatly interested in Marconi's invention, so in 1896 he came to England where he filed the world's first patent for a system of telegraphy using Hertzian waves. A letter of introduction to William Preece, Engineer in Chief of the GPO, led to a series of demonstrations culminating in 1897 in a record transmission across 8.7 miles of the Bristol Channel, where Preece himself was experimenting with inductive methods, with far less success.

The potential of wireless telegraphy was becoming clear and in 1897 the world's first radio company was formed to develop Marconi's apparatus commercially. First called the Wireless Telegraph and Signal Company, it was later renamed Marconi's Wireless Telegraph Company and in 1963, The Marconi Company.

By the end of the century, wireless had been adopted by the British and the Italian Navies, it had spanned the English Channel, it had proved its worth to the mercantile navy as a life saver and Marconi had introduced his system to the USA, where he registered The Marconi Wireless Telegraph Company of America – later to become the Radio Corporation of America (RCA)

PYE KEPT SOLDERING ON

Pye at Lowestoft found one way of maintaining production on 'power ban' days.

A number of their work force is employed in soldering operations. So, to keep busy on days when the use of electricity was forbidden, they switched to Ronson Blowtorches which are small, lightweight and powered by butane gas.

Photograph shows three girls in the factory using the Ronson torch in inspecting television set chassis. The copper soldering tips – packed with Ronson Blowtorch Kits, or available as optional extras – are particularly useful for this detailed work.

Ronson Blowtorches, priced from £2.95 to £4.95, are available from Halfords and most other good hardware stores.

NORTH MIDLANDS MOBILE RALLY

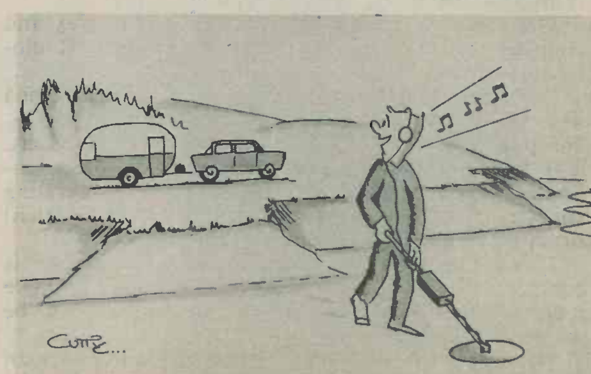
The 1974 Rally will take place on Sunday 21st April, at Drayton Manor Park, Near Tamworth, Staffs. Drayton Manor Park is open to the public from 10 a.m. till dusk. Location – on A4091 road – AA signposted one mile from A5 – which links the M1 and M6. 15 miles from the M5 and within 12 miles of intersection 4 on the M6 at Coleshill. A complete day out for the whole family, Zoo, Amusement Park, full catering etc.

Further details from Hon. Sec. Alf Walton G3ZKQ, 243 Barnes Hill, Birmingham 29.

NORTHERN RADIO SOCIETIES ASSOCIATION

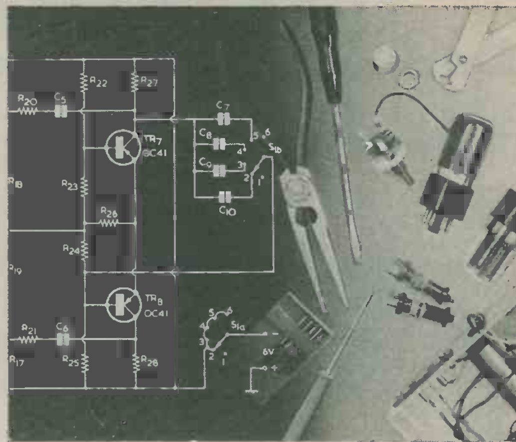
The Annual Convention is to be held at the Exhibition Hall, Belleview Manchester, on the 12th of May at 11 a.m. Items include – Club Stands, Trade Stands, Raffle, Inter Club Quiz, S S T V, Construction Contest.

Please note that the entrance to the Convention is not on Hyde Road, but at the rear of Belleview.



"Heh! I think I've found that transistor radio you lost last week."

ELECTRONIC COMBINATION LOCK



by G. A. FRENCH

THE CONCEPT OF ELECTRICAL OR electronic combination locks is an attractive one for the home-constructor and the experimenter. Whilst mechanical combination locks employ complex operating systems requiring carefully made parts, an electronic combination lock can be made with standard components coupled up in a relatively simple circuit. Further, electronic combination lock design offers the fascinating feature that much ingenuity can be employed to make the lock really thief-proof.

Home-constructed electronic combination locks cannot, of course, be made to the robust standards inherent in the type of lock fitted to large safes. Nevertheless, they can be readily employed for such applications as the locking of chests, desks and similar items.

BASIC APPROACH

The simplest form of electronic combination lock has a circuit of the type shown in Fig. 1. Here, three 12-way rotary switches and a push-button are mounted so that they can be operated from outside the protected object. The switch bodies, a battery and a solenoid are fitted inside. When energised, the solenoid draws in a bolt and thereby releases the lock.

To operate the lock the switches are set to the requisite combination and the push-button is pressed. If the correct combination, which in Fig. 1 is 4, 8 and 10, has been selected the solenoid will operate when the push-button is pressed, and the lock will open. The lock will remain closed for all other settings of the switches. The protective strength of the lock rests in the fact that there are 1,728 possible settings of the three switches, of which only one can open the lock. If another 12-way switch were added the total number of possible settings becomes 20,736 (i.e. 12 × 12 × 12 × 12) of which only one can cause the lock to release.

The circuit of Fig. 1 offers a perfectly feasible combination lock but it suffers from one serious disadvantage. Provided that sufficient time is available it can be opened by the simple process of going through all the switch positions successively. The first and second switches could be left at 1 and the third switch taken rapidly through all its positions with the push-button pressed. The second switch could then be set at 2, the third switch once more taken rapidly through all its positions, and so on. Given luck and patience, the lock could under these circumstances be opened in a relatively short period of time.

It is evident that a more sophisticated approach is needed if the lock is to be more effective against illicit operation, and the circuit which forms the basis of this month's article in the 'Suggested Circuits' series provides an arrangement which gives an exceptionally high degree of protection. If desired, it can also incorporate a warning circuit which sounds a continual alarm when an incorrect combination has been selected.

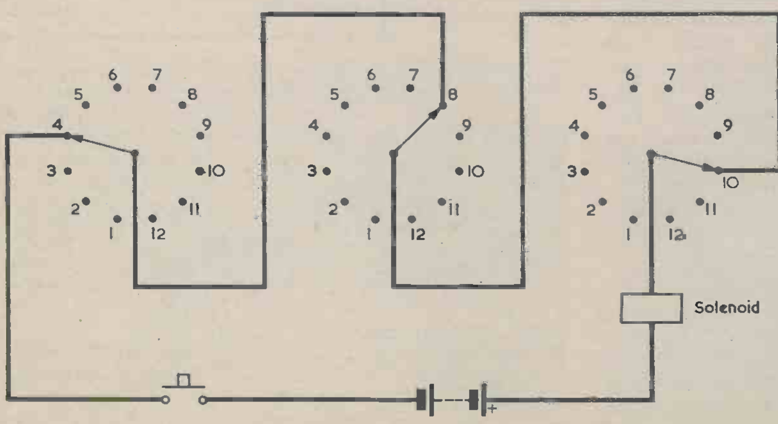


Fig. 1. Basic circuit for a switched combination lock. The solenoid operates the release bolt

LOCK CIRCUIT

The circuit of the combination lock, without the warning facility, appears in Fig. 2. As with Fig. 1 the combination is selected by way of three 12-way rotary switches and, again, a fourth switch could be added if it was required to reduce still further the risk of fortuitous opening of the lock. In Fig. 2 the required combination is 5, 8 and 11. As in Fig. 1 there is a push-

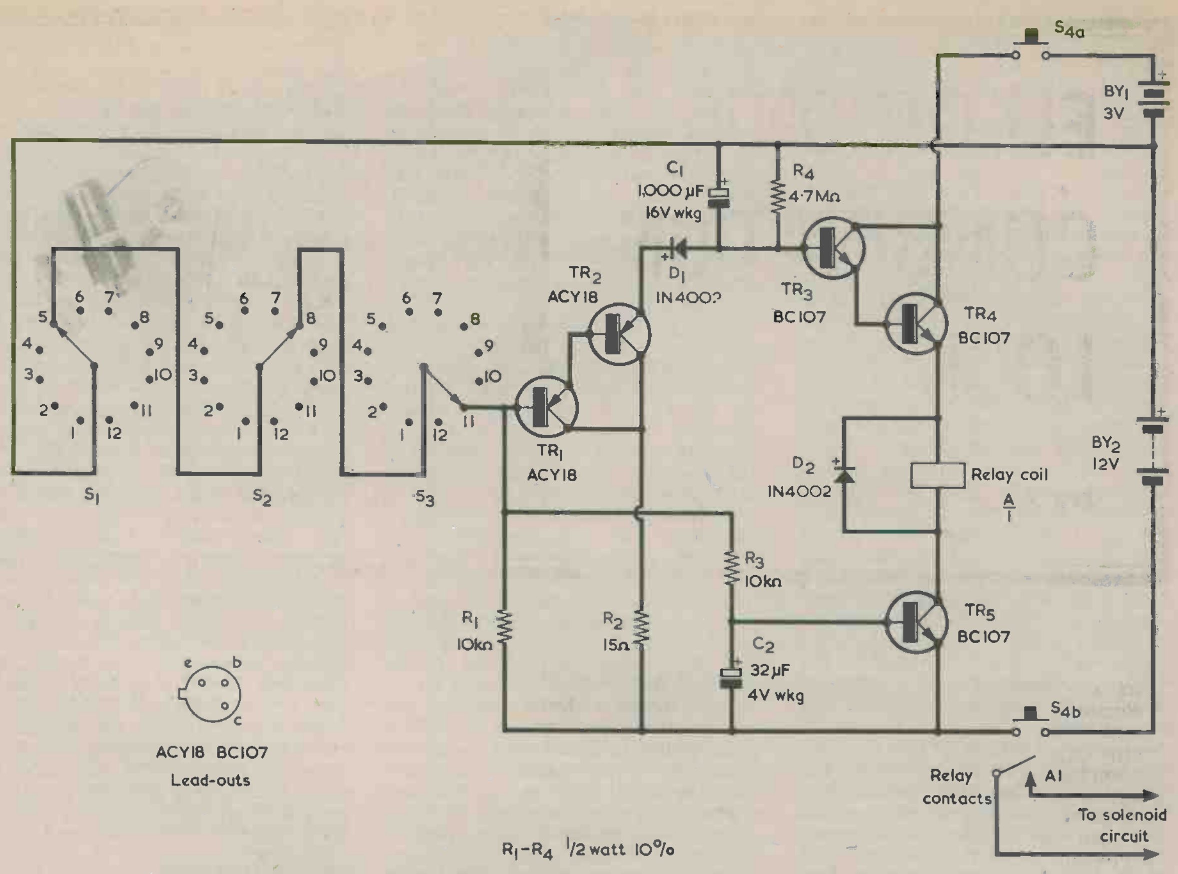


Fig. 2. A comprehensive electronic combination lock. S1, S2 and S3 can, of course, be wired for any combination of three numbers other than that shown here

button to actuate the lock after the combination has been set up, and this is provided in the present circuit by the double-pole push-button, S4(a)(b). When this button is pressed, both its sets of contacts close at the same instant. In Fig. 2, the solenoid is not connected directly into the circuit but is operated by way of a relay. This is relay A, and its coil is represented by the rectangle designated A/1. The relay has one set of contacts, which close when the relay energises. These are contacts A1 and they couple to the solenoid and a suitable solenoid-actuating battery in series.

The supply in Fig. 2 is provided by BY1 and BY2, and is essentially a 15 volt battery having a 12 volt tap. The current drawn from the 12 volt tap when the push-button is closed is relatively low compared with that drawn from the total 15 volt battery, with the result that the 12 volt section does not discharge significantly faster than the overall 15 volt supply and the whole battery can be made up from, say, five similar 3 volt batteries in series. No current is drawn from any section of the battery when the push-button is not depressed.

There are two capacitors in the circuit, these being C1 and C2. Both are normally in the discharged condition.

As already stated, the required combination in the three 12-way switches is 5, 8 and 11, and when this combination is set up a circuit is completed from the 12 volt battery tap to fixed contact 11 of S3. If, now, push-button S4(a)(b) is pressed, the 12 volt positive supply is applied to the input base of the Darlington pair TR1, TR2. Since the output emitter of this pair is coupled via D1 to the negative plate of C1, which is also at the potential of the 12 volt positive tap, TR1 and TR2 do not conduct and have no effect on circuit operation. The 12 volt positive supply from contact 11 of S3 is also applied to R1, and this merely allows a current of approximately 1.2mA to flow through it without any further effect in the circuit. Finally, the 12 volt positive supply from S3 is passed to R3 whereupon, after a very short delay due to the presence of C2, TR5 becomes fully conductive.

The upper terminal of the relay coil is connected to the output emitter of a second Darlington pair, TR3, TR4, the input base of which is held at the positive 12 volt potential by the discharged capacitor, C1. In consequence, as soon as TR5 becomes conductive, TR4 allows current to flow from the 15 volt supply through the relay coil to the collector of TR5; the relay energises and its contacts complete the circuit which actuates the solenoid. Under these conditions, the voltage on the upper terminal of the relay coil is that on the 12 volt battery tap less about 1.2 volts due to the forward voltage drops in the base-emitter junctions of TR3 and TR4. The input base current required by TR3 and TR4 to keep the relay energised is negligibly low, and capacitor C1 continues to remain in the discharged condition. Thus, the relay stays energised and the solenoid is actuated all the time that push-button S4(a)(b) is pressed.

INCORRECT COMBINATION

Let us next see what occurs if S1, S2 and S3 are set up to an incorrect combination before the push-button is pressed. Selecting an incorrect combination results in contact 11 of S3 being isolated from the 12 volt battery tap and from any other part of the overall circuit. When, now, S4(a)(b) is pressed, the negative supply line is applied via R1 to the input base of the TR1, TR2 pair, whereupon these cause a charging current to be applied via D1 to C1. C1 rapidly becomes charged to 12 volts less the small voltage dropped across TR2 and D1. Resistor R2 limits the initial charging current to slightly less than 1 amp. At the instant of closing S4(a)(b) the base of TR1 assumes a momentary positive potential which is lower than that on the negative plate of C1 by the forward voltage drop across D1 and the emitter base junctions of TR2 and TR1, and this voltage is applied to R3. However, the time delay given by C2 prevents the momentary positive voltage from taking TR5 into conduction.

To sum up the situation so far, pressing S4(a)(b) after an incorrect combination has been set up results in the very rapid charging of C1 and a lack of conduction in TR5, whereupon the relay cannot energise. What is the most important feature is that, once charged, C1 discharges, into the parallel resistor R4, very slowly. Thus, the input base of the Darlington pair TR3, TR4, is initially held at a potential which is only slightly higher than that on the negative supply rail, and the voltage on the emitter of TR4 will only become sufficiently high to permit the relay to energise again when C1 is nearly fully discharged. *As a result, selecting the incorrect combination and pressing the push-button causes the circuit to be completely disabled for a long period.* The lock will not operate, even when the correct combination has been set up, until C1 is nearly completely discharged.

The length of the period during which the circuit is disabled depends on leakage current in C1, D1 and the base-emitter junctions of TR3 and TR4, the actual value within tolerance of C1 and the lowest energising voltage required by the relay. To give a rough idea of what is to be expected, the time constant of C1 and R4 is of the order of 4,700 seconds, or 1 hour and 18 minutes. In practice, a delay during which the circuit is inoperative of about 1 hour can be assumed, and this is what was given with the prototype circuit. When C1 is charged, and assuming the push-button is not pressed, silicon diode D1 isolates its negative plate from the remainder of the circuit. Should the correct combination be set up whilst C1 is charged, a second discharge circuit is set up (when the push-button is released) through S1, S2, S3, R3, the forward biased base-collector junction of TR5, the relay coil and the reverse-biased emitter-base junctions of TR3 and TR4 to the negative plate of C1. The leakage current in the last two junctions should be negligibly low. Also, reverse base-emitter voltage ratings in TR3 and TR4 cannot be exceeded as the maximum reverse base-emitter voltage rating for the BC107 is 6 volts.

FURTHER POINTS

There are some points in the circuit which require a little further explanation.

Care has been taken to keep the current drain from the 15 volt supply to a low level apart from the times when the push-button is pressed with the correct combination selected, whereupon the relay energising current is drawn from the total 15 volt source. The inclusion of TR1 and TR2 means that the current drawn from the 12 volt tap by the charging circuit when the correct combination is set up and S4(a)(b) is pressed is only 1.2mA through R1. When the incorrect combination is set up, the only demand on the 12 volt section is the initial charging current surge to C1. A separate battery is recommended for the solenoid, which may require a relatively high current.

It is essential that S4(a)(b) be a push-button in which both contacts make at the same instant. If S4(b) closes before S4(a) no collector voltage is available for TR3 and TR4, and a charge current for C1 can flow by way of the base-emitter junctions of TR3 and TR4, through the relay coil and the conducting TR5. This can cause C1 to become partly charged, thereby reducing the voltage available at TR4 base for energising the relay. A second reason for providing the time delay given by C2 at TR5 base is that this ensures that TR5 does not become conductive immediately after closure in S4(b) and thereby allows the closure of S4(a) to be fractionally later, as it could in practice be. The best choice for S4(a)(b) would be a push-button that operated a double-pole toggle mechanism. Alternatively S4(a)(b) could be a spring-loaded toggle switch biased to the open position.

TR1 and TR2 are germanium transistors. These are chosen because they are small robust devices capable of passing collector currents up to 2 amps. TR3, TR4 and TR5 are small silicon devices. It is necessary for TR3 and TR4 to be silicon transistors in order to ensure that leakage currents in the C1 circuit are kept to a minimum. The two diodes, D1 and D2 are small silicon rectifiers, and the purpose of D2 is to prevent the appearance of high reverse voltages across the relay coil when its energising current is removed.

The minimum relay coil resistance is limited by the maximum power dissipation rating of 300mW in TR5. Since this transistor turns on a little slowly, due to the presence of C2, its dissipation passes through a peak when half the available supply voltage appears across it. Assuming a half supply voltage of 6 volts, the minimum permissible relay coil resistance calculates as 120Ω. However, there is little point in taking the transistor right up to maximum power rating and a suitable choice for the relay would be any type having a coil resistance of 150Ω or more which is capable of energising at coil voltages of 10 volts or less. This offers a very wide range of relays. The relay employed by the author for checking the circuit was a P.O. 3000 type with a 500Ω coil.

ALARM CIRCUIT

The circuit of Fig. 2 represents a combination lock which, as soon as an incorrect combination has been set up,

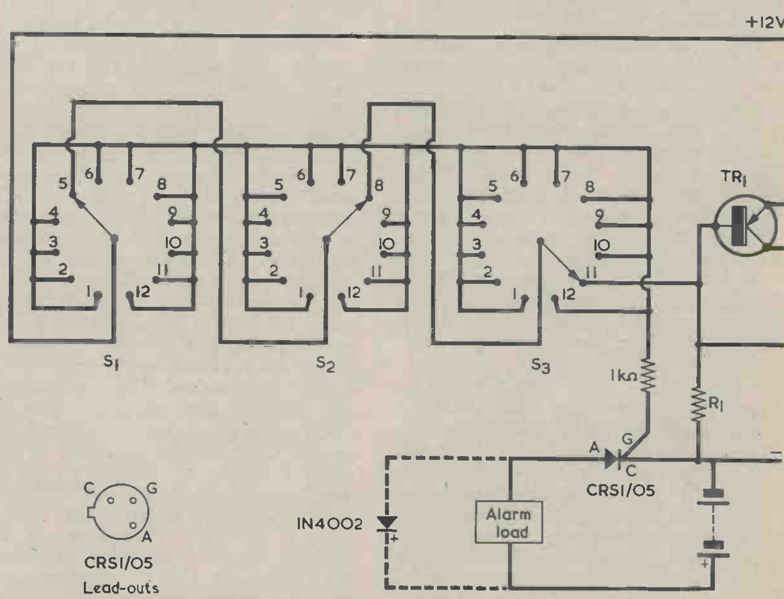


Fig. 3. Adding an alarm facility. All the contacts of S1, S2 and S3 which are not in the combination are connected together and coupled to the gate of the thyristor via a 1kΩ resistor

disables itself for about an hour. Longer disabling periods can be provided, incidentally, by increasing the value of C1. Even further protection can be given by adding an alarm facility, this being actuated by the selection of an incorrect combination.

The additional alarm circuitry appears in Fig. 3. In this diagram the combination switch circuit is the same as in Fig. 2. but all the unused contacts of S1, S2 and S3 are coupled together and taken, via a 1kΩ resistor, to the gate of a thyristor type CRS1/05. If, after an incorrect combination is set up, push-button S4(a)(b) is pressed, the 12 volt supply is applied to the 1kΩ resistor and the thyristor cathode. This causes the thyristor to trigger on, and it remains conductive even when the gate current is removed.

The CRS1/05 is a small thyristor in a TO5 can and it can pass anode-to-cathode currents up to 1 amp in magnitude. The anode-cathode voltage should not exceed 50 volts when the device is turned off, but it is anticipated that only low voltages will be required in the present application. Normally, the alarm will be given by an electric bell, whereupon this can be actuated by a relay whose coil is in the anode circuit of the thyristor. A disadvantage with the alarm system is that it requires a separate battery (or batteries) for the relay and the bell. It would, however, be undesirable for the alarm circuit to use the same batteries as are employed for the solenoid and the circuit of Fig. 2 because of the risk of running them down. When the alarm sounds, it is necessary to wait until C1 of Fig. 2 becomes sufficiently discharged for the combination lock to be actuated. The protected object can then be opened and the alarm disabled by disconnecting the battery in the thyristor circuit, or by momentarily short-circuiting together the anode and cathode of the thyristor.

A protective diode across the thyristor load can be added if this load is a relay coil, although it is not as essential as it would be in a transistor circuit. The diode is shown connected to the load in broken line in Fig. 3. The battery in Fig. 3 has a voltage suitable for the load.

To conclude, it may be of assistance to discuss the solenoid which operates the bolt of the combination lock. Experienced constructors should be able to assemble a suitable solenoid, but it may be mentioned that two small solenoids are listed in the Henry's Radio catalogue. One of these has a coil resistance of 55Ω and operates at 15 to 28 volts, whilst the other has a coil resistance of 15Ω and operates at 4.5 to 9 volts. This second solenoid has a maximum stroke of 3/8 in. The author has not checked circuit operation with either of these solenoids and he mentions them merely to advise readers of their availability. ■

LETTERS...

The Editor,
Readers' Letters,
Radio & Electronics Constructor,
57 Maida Vale,
London, W9 1SN.

Dear Sir,

With reference to the letter from K. W. Warn – Bristol in the January issue of "R. & E. C." although I have no first hand knowledge of the crystal set he mentions you might care to forward to him the enclosed note on crystal detectors of 1922.

The crystals used in the crystal sets of 1922, in conjunction with a "cat's whisker", were silicon, copper pyrites, iron pyrites and galena. In addition, galena treated to improve its crystalline structure was sold under such trade names as Hertzite, Lionite, Permanite, Electronite and Markonite. The crystals were held in brass cups fitted with three set screws or embedded in Woods Metal.

The "cat's whisker" was a fine wire, usually wound into a small spiral, one point resting on the crystal. Copper wire was often used but the point soon became tarnished with a consequent loss of sensitivity. This meant snipping a piece off the point to regain sensitivity. More usually 9 carat gold wire (cost 6d to 1/–) was used because it did not tarnish.

There were two other crystal detectors, (1) "PERIKON" in which a crystal of bornite was in contact with one of zincite, and (2) a strip of spring steel in contact with carborundum with or without a battery across them.

A. Edmonds – Bromley.

Dear Sir,

May I through the courtesy of your columns bring to the attention of Component Retailers the way we are attempting to deal with an urgent problem which affects all of us. I refer to the shortage of Electronic Components.

There are many buying Groups operating successfully in commodities ranging from Groceries to Television Sets but we believe we are the first (and perhaps the only one) dealing in Electronic Components. We are the poor relation of this Industry and it is the manufacturer who can buy bigger quantity who comes first. "Group One" has been functioning for about 3 years during which time it has prevented the total disappearance of many vital components by large purchases. To give us more buying power we would like to recruit more members. Would any Electronic Component Retailer who is interested, please contact the writer.

A. Sproxton (Director) – Home Radio (Components) Ltd., 234–240 London Road, Mitcham, Surrey, CR4 3HD.

STEREO LOUDSPEAKER ARRAYS

by R. N. Soar

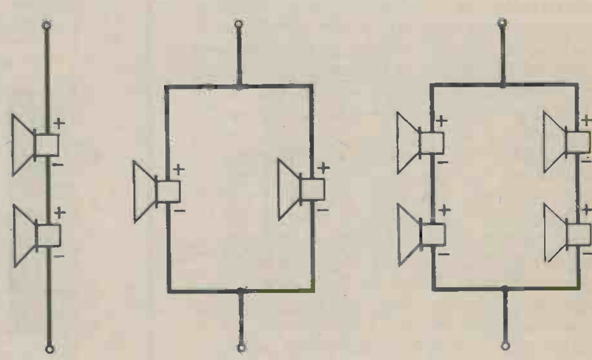
The use of inexpensive loudspeaker networks for improved spatial effects in stereo sound reproduction

THE ARRAYS DESCRIBED IN THIS ARTICLE REQUIRE THE use of a number of 3Ω loudspeakers. In the author's case these were ex-TV loudspeakers obtained at a cost of 25p each. The three most common sizes are 6 by 4 in. elliptical, 7 by 4 in. elliptical and 5 in. round, the impedance in all cases being 3Ω. For ease of construction, identical sizes should be used for a network, although this is not essential. Long years of service in a television set tend to loosen up the cone suspension, and the bass response of these speakers is usually quite good. Readers wishing to buy low cost surplus speakers in quantity may see these advertised occasionally in the technical press or offered at component retailers. It will probably be better, however, to contact a local service engineer, as these speakers will usually be available from unwanted part-exchange models.

PHASE

It is most important that the speakers used in the arrays be connected together in phase. The phasing of the speakers can be checked with a 3 volt cycle lamp battery, such as the Ever Ready No. 800. The negative terminal of this type of battery is the brass strip soldered to one of the cell walls and the positive terminal is the brass strip at the top. The battery is connected to the speaker momentarily. When this causes an outward movement of the cone, the speaker tag to which the positive terminal of the battery connects is marked with red paint. For the purposes of this article we shall say that speaker tags marked red are 'positive' and that unmarked speaker tags are 'negative'. Also, in the diagrams we shall use a plus sign to indicate a speaker positive tag and a minus sign to indicate a speaker negative tag.

When speakers are connected in series they should be wired up as in Fig. 1(a). Fig. 1(b) shows two speakers in parallel, and Fig. 1(c) four speakers in series-parallel. In these diagrams all the speakers are wired up with correct phase.



(a) (b) (c)

Fig. 1. Connecting speakers together with correct phasing. In (a) two speakers are in series and in (b) they are in parallel. Four speakers in series-parallel appear in (c). The significance of the plus and minus signs is explained in the text

8 SPEAKER ARRAY

The first array was developed for use with a stereo amplifier having 3Ω outputs. The array uses eight 3Ω loudspeakers, four to each channel, as illustrated in Fig. 2. The two sets of four loudspeakers are connected in series-parallel to give an overall impedance of 3Ω per channel.

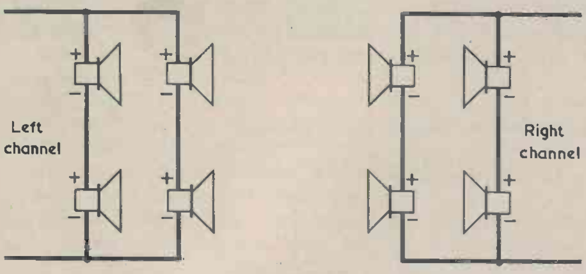


Fig. 2. How the speakers are connected for an eight speaker array

The loudspeakers are built into three cabinets, these being at left, centre and right. The left hand cabinet contains three loudspeakers connected to the left channel, the centre cabinet houses one loudspeaker connected to the left channel and one loudspeaker connected to the right channel, and the right hand cabinet contains three loudspeakers connected to the right channel. The idea is shown in Fig. 3, in which diagram the letters 'L' and 'R' indicate the channels to which each loudspeaker is connected.

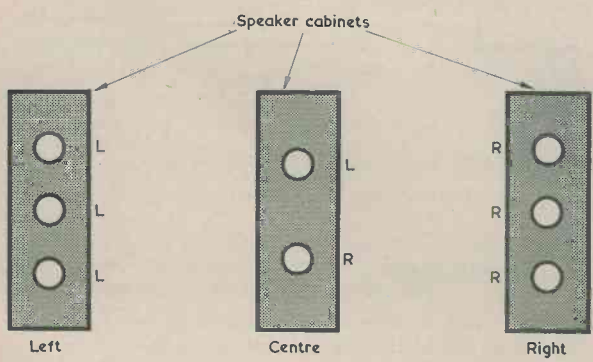


Fig. 3. The eight loudspeakers in their cabinets

Fig. 4 illustrates the layout as seen from above. The left and right hand cabinets should be positioned about 10 ft. apart. The centre cabinet should be moved back

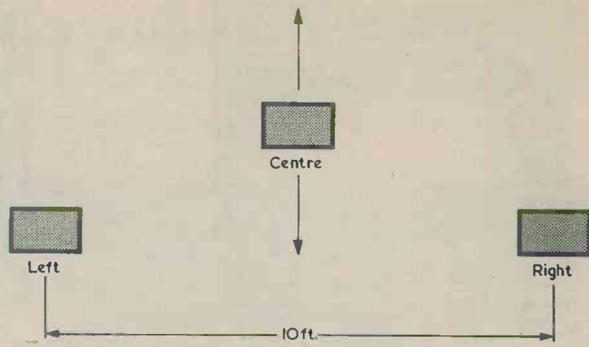


Fig. 4. Top view of the eight speaker array. The centre cabinet is moved forwards and backwards along the centre line to find the best position

and forth on the centre line, whilst listening to a stereo record, until the best position is obtained. To the author's ear, the use of the centre loudspeaker cabinet gives the subjective impression of a definite centre positioning of sound, with the intermediate sound positions improved in definition.

20 SPEAKER ARRAY

A more extensive array can be employed with amplifiers having 8Ω outputs. Twenty loudspeakers are required, giving ten for each channel. The ten speakers can be connected in series-parallel, as in Fig. 5, to give an overall impedance of 7.5Ω per channel.

Five identical cabinets are required, each housing four speakers. These are left (with four L speakers), half left (three L, one R), centre (two L, two R), half right (one L, three R) and right (four R). The layout is

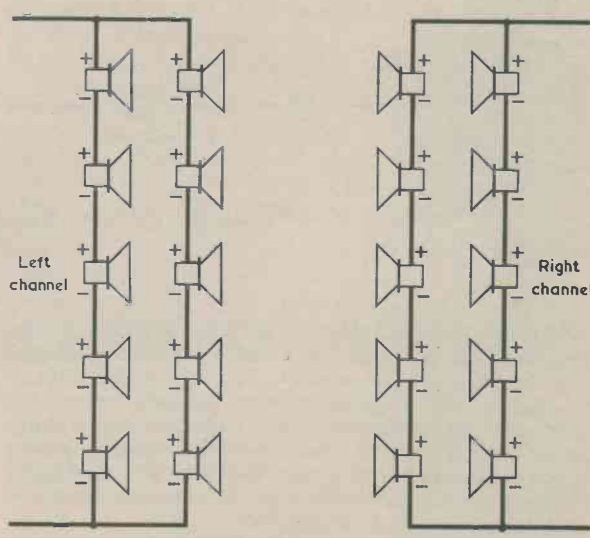


Fig. 5. Connecting up the speakers for a twenty speaker system

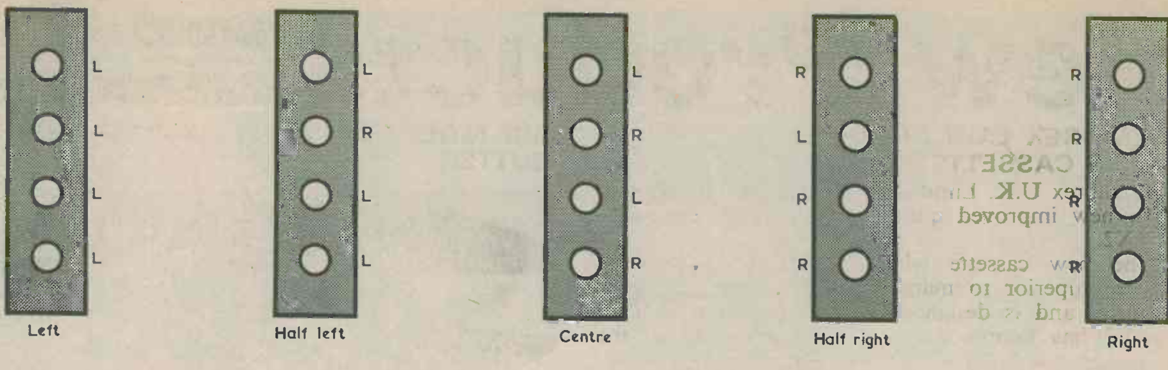


Fig. 6. The manner in which the twenty speakers are fitted in their cabinets.

illustrated in Fig. 6, whilst Fig. 7 gives a view from above.

The left and right hand cabinets are positioned about 12 ft. apart. The centre cabinet is at the exact centre, being moved forward and backward along the centre line for best results. The half left and half right cabinets should be placed at the three-quarter positions to start with and then moved in any direction for best results.

With this array a pseudo-quadraphonic effect can be obtained by adding a back loudspeaker or loudspeakers. The back loudspeaker is connected to the left and right non-earthy output terminals of the amplifier in series with a low value wire-wound potentiometer. In most cases the potentiometer will require a wattage rating of 3 watts and its value may be between 50 and 100Ω. See Fig. 8. The 18Ω series resistor is included to prevent the possibility of overloading transistor output stages. It may be rated at 1 watt. The back loudspeaker is positioned behind the listener, preferably mounted on a wall and as high as possible. For amplifiers having 8Ω outputs, a single 8Ω speaker or three 3Ω speakers connected in series should be used, and the potentiometer is adjusted until a suitable 'surround sound' effect is obtained.

The cabinets can be made with 1 in. thick board for the fronts, with suitable holes cut for speakers. The sides of the cabinets can be 5-ply and the backs hardboard with holes at suitable points to prevent the formation of an infinite baffle. Wiring between the cabinets and the amplifiers may be carried out with flexible 3-core mains cable of at least 5 amp rating, and it is helpful to employ a colour code such as green/yellow for the earthy side for all speakers, brown for right hand channel speakers and blue for left channel speakers.

It must not be forgotten that the left and right loudspeaker *networks* must be correctly phased with respect to one another, as in a stereo system using only two loudspeakers.

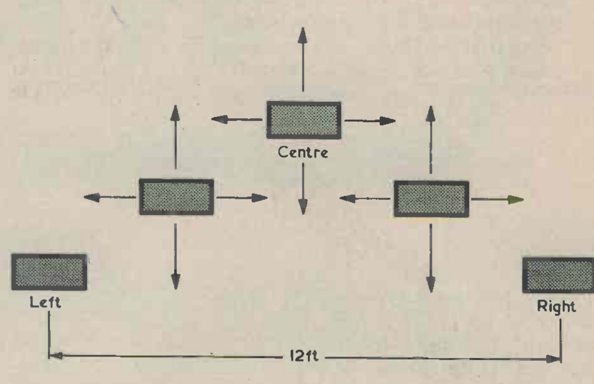


Fig. 7. The twenty speaker array viewed from above

Fig. 8. One or more speakers at the back can increase the apparent spatial effect of the sound source

Editor's Note

Since the loudspeakers employed in the arrays described in this article are surplus television receiver types, the results given cannot of course enter the true high fidelity category. Also, the fact that the impedance of a speaker varies with frequency may result in an uneven frequency response from the back speaker (or speakers) when the circuit of Fig. 8 is employed, although the effect, if present, should not be too troublesome when the back speaker is operated at a low volume level. The main purpose of the arrays is to achieve spaciousness with inexpensive reproducers. ■

New Products

MEMOREX LAUNCH MRX2 OXIDE CASSETTE

Memorex U.K. Limited, announce the introduction of a new improved quality, blank audio cassette – MRX2.

The new cassette with MRX2 Oxide provides fidelity superior to many low noise or high energy cassettes and is designed for use on all equipment. MRX2 has improved quality and reliability in the following specific areas:

1. Frequency Response – shows performance of tape over entire audible range with emphasis on low and high frequencies. New MRX2 oxide has a distinct 2dB advantage over many competitive brands, particularly at the important high frequencies.

2. Signal/Noise Ratio – determines the dynamic range at which you can record. New MRX2 has the smallest possible particle volume yet the highest possible oxide volume loading characteristics.

Result: a more magnetically dense coating with greater signal holding character (Memorex put more particles into a given length of tape than many of their competitors).

3. Distortion – lack of clarity at a constant input. New MRX2 oxide has the lowest distortion levels while having a greater output.

4. Compression – the output lost when recording at extremely high levels. The New MRX2 oxide has an output advantage at high frequencies.

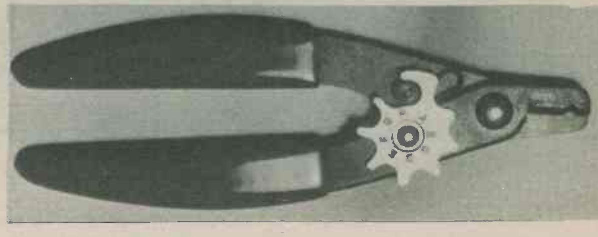
The following indicates the improvements made by MRX2 Oxide:

Output for 2% Distortion, 500 Hz $1\frac{7}{8}$ ips dB + 3.5.; Frequency Response 6.3 kHz, $1\frac{7}{8}$ ips dB + 4.5; Frequency Response 12.5 kHz, $1\frac{7}{8}$ ips dB + 5.5; Uniformity 500 Hz, $1\frac{7}{8}$ ips, dB ± 0.25; Relative Signal/Noise Ratio, dB + 3.5; Uniformity 10KHz, $1\frac{7}{8}$ ips, dB ± 1.0.

The new MRX2 Oxide cassette will be available in 30, 45, 60, 90 and 120 minute forms and retail prices will be as follows:

MRX2	C30	£0.62	+ V.A.T.
MRX2	C45	£0.75	
MRX2	C60	£0.90	
MRX2	C90	£1.20	
MRX2	C120	£1.60	

BIB MODEL 8A WIRE STRIPPER AND CUTTER



The BIB Division of Multicore Solders Limited announce the introduction of another new Wire Stripper and Cutter. This is a modified and improved version of their well-known Model 8 Wire Stripper.

This new Wire Stripper strips insulation from most sizes of flex and cable. Adjustment of the cam ensures correct setting of the jaws for quick and accurate wire stripping. A particular feature of this tool is that for repetitive wire stripping it is fitted with a self-opening spring which can be simply locked when the tool is not in use.

The Wire Stripper is attractively finished in black with easy-grip red plastic covered handles. The selector gauge is nickel plated. Attractively bubble packed on a colourful display card with full instructions for use.

Recommended Retail Price is 70p each, excluding VAT, and should be available from most Electrical, Hardware and Garage Accessory Shops.

'SAFEBLOC' FROM R.S.

R.S. Components Limited, have introduced to their range the 'Safebloc' designed to provide a safe yet simple method of connecting flexible leads to a.c. mains. The unit incorporates three nickel-plated clips for the output connections which are automatically isolated when the cover is raised, while the input cable is internally connected and includes a cable clamp.

Priced at £2.95, the 'Safebloc' may be used up to 13A., and is made from tough thermosetting plastic with a glass-filled nylon lid.

Further information may be obtained from R.S. Components Limited, 13–17 Epworth Street, London E.C.2.

SHORT WAVE NEWS
FOR DX LISTENERS

By Frank A. Baldwin

Times=GMT *Frequencies*=kHz

Clandestine stations have often been mentioned in these columns and it is known that some readers draw up lists from the information supplied here in order that they may listen on the channels and at the times stated. We now present news of three more clandestine transmitters, the first being –

"Voice of the Middle East People" which operates from 1430 to 1550 in Persian, Arabic, Kurdish and Turkish on **7200**. To provide assistance in logging this one, we suggest readers try the Arabic transmission which commences at 1450 and ends at 1510; identification in Arabic is "Sawt Shu'ub ash-Sharq al-Awsat". Secondly we have –

"Voice of Palestine, Voice of the Palestine Revolution" operates from 0900 to 1000 on **6662** in Arabic and Hebrew. This one is anti-Israel and pro-Palestine and the identification in Arabic is "Sawt al-Filistiniyah, Sawt Ath Thowrah al Filistiniyah". For the third clandestine, listen for –

"Radio Korush" is a Persian (Farsi) language station operating from 0230 to 0330 and from 1930 to 2030 on **7098.5** (as measured by us) although the actual frequency used at any one time could possibly vary slightly. Logged here recently at 1940, the format was as follows – OM in Farsi, military music at 1950 to 1952, more talk, light music European style at 2001 after clear identification, more light music, a further identification at 2009. Sign-off was at 2026 after slogans and more light music. Korush translated into English = Clamour.

All the above information is correct at the time of writing but some clandestines are not noted for stability of operation with respect both to times and frequencies.

CURRENT SCHEDULES

● AFGHANISTAN

Radio Afghanistan, Kabul, has an External Service, in English to Europe, from 1130 to 1200 daily on **15195**. Kabul also radiates in English to South Asia, on **4775** from 1400 to 1430.

● MONGOLIA

Radio Ulan Bator provides an External Service in English as follows – from 1220 to 1250 weekdays on **8890, 15445** and on **17785**; from 2200 to 2230 on **9545** and on **11810**, both transmissions being directed to South-east Asia and the Far East.

● CHINA

Foochow operates an External Service in Standard Chinese to Quemoy and Matsu on **4975** and **5050** from 2100 to 2130, from 0001 to 0030, from 0500 to 0530 and from 1400 to 1430. In Amoy from 1500 to 1530 on the same channels.

● ALBANIA

Radio Tirana maintains a service in English to Europe on **7065** and **9500** from 0630 to 0700. On **9480** and **7065** from 1630 to 1700, from 1830 to 1900, from 2030 to 2100 and from 2200 to 2230.

● HUNGARY

Radio Budapest broadcasts in English to Europe as follows – Dx programme on Tuesday and Friday from 1615 to 1630 on **6110, 7220, 9833, 11910, 15160, 17890** and on **21505**; from 2245 to 2300 on **5980, 7220, 9833, 11910, 15415, 17710** and on **21685**. Feature programme from 1745 to 1800 on **6100, 7220, 9833, 11910, 15415, 17795** and on **21505**; from 1945 to 2000 on the same channels; from 2130 to 2200 when the **6110** and **17795** channels are substituted for **6020 and 17890.**

● CUBA

Radio Havana presents an English programme to Europe from 2010 to 2140 on **15140** and to the Americas from 2050 to 2150 on **15285** and **15425.**

● ITALY

RAI Rome radiates a programme in English to the U.K. from 1935 to 1955 on **6050, 7275** and on **9710;** to the Near East from 2025 to 2045 on **6050, 7235** and on **9575.**

● AUSTRALIA

Radio Australia offers a service in English to Europe and Pacific Islands from 1900 to 2000 on **7290, 9540, 9580, 11840** and on **15355**. In English to the U.K. from 0645 to 0745 on **11765** (also on **9570** from 0700); from 0815 to 0830 on **9570** and **11765.**

● JORDAN

Radio Amman "The Broadcasting Service of the Hashemite Kingdom of Jordan" does not now operate an external service as such but does beam an English service to Europe on **7155** and **9560** as follows – from 1100 to 1230 on **7155** and from 1600 to 1730 on **9560.** Radio Amman also operates a Home Service in Arabic on **11810** from 0330 to 2310 which is beamed to North Africa, this service also operating on **7155** and **9530** at various time-slots throughout this period.

● VATICAN CITY
"Vatican Radio" provides a service in English directed to the U.K. and Eire from 1500 to 1515 on **7250**, **9645** and on **11740** and from 2045 to 2100 on **6190**, **7250** and on **9645**.

NEWS FOR DXERS

● CHILE
Radio Nacional de Chile has been reported with the new External Service on **15150** from 2045 to 2324 in various languages, the entire programme being repeated until sign-off at 0450. The schedule in English is from 2223 until 2240.

● NORTH VIETNAM
The Tay Bac regional Service operates from 0928 to 1115 and from 1155 to 1430 on **4770**, **6335** and on **9495**; also from 0155 to 0400 on **6335** and **9495**, language being Vietnamese and minority dialects.
The Viet Bac regional Service is from 0225 to 0430 on **6750** and on **8635** and from 1125 to 1400 on **3995** and **6780**.

● AROUND THE DIAL
A few interesting stations have been logged recently on the HF bands, details of these being –

● AUSTRALIA
R. Australia at 1600 on **7150** with identification, the world news until 1611 then "Australian Scene", all in English.

● CYPRUS
BBC Limassol at 2115 on **6050** with identification then programme about space probes in English.

● SOUTH AFRICA
Radio South Africa at 1600 on **11900** with identification and a newscast in English followed by "World Affairs" at 1609 to Kenya, Uganda and Tanzania.

● PORTUGAL
Radio Portugal at 0740 on **17880** with "Press Roundup", identification by YL at 0743 then "Portugal Today", all in English.

● PAKISTAN – 1
Radio Pakistan at 1532 on **11672** with a newscast of local events in English read at slow speed. Radio Pakistan can also be heard in English on **7082.5** with identification at 2000.

● PHILIPPINES
AFRTS Tinang at 1034 on **15110** with programme in English about U.S.A. sports and domestic affairs. Identification, time check and world news at 1100.

● JAPAN
NHK Tokyo at 0800 on **17825** with station identification and a newscast of world events in English after the French transmission. Also heard in parallel on **17710**, the former channel providing the best reception here in the U.K.

● ECUADOR
HCJB Quito at 0815 in English to Europe, identification and sign-off at 0830, **9760**.

● AFGHANISTAN
Kabul at 1130 on **15195** with identification, local music, a newscast, pops, then programme about the export of carpets. More local music at 1143 until the end of the English programme, with a further identification at 1155.

● PAKISTAN – 2
Karachi at 1250 on **15520**, identification by YL, local music and songs, 6 pips at 1300 (6 p.m. local time) further identification then news in English.

QSX
For the Dxer, the following may prove of some interest –

● SINGAPORE
Radio Singapore on **5010** at 2238 with light classical music European-style.

● MALAYSIA
Penang on **4985** at 2346 with Malaysian by Radio programme, YL providing English translations.

● INDONESIA
YDK Palembang on **4855** at 2319, OM with Arabic-type song till 2323 then YL announcer, local music.
YDR3 Banda Acheh on **4955** at 2316 with Arabic-like chants till 2322 then YL announcer followed by Arabic-type music.

● CHINA
Kunming on **4759.5** at 2256, Chinese music, YL in Chinese, teletype QRM LF makes things rather difficult here.

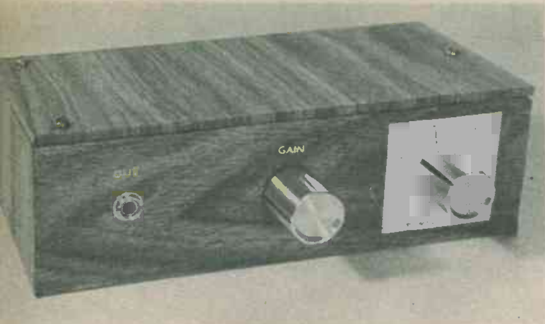
● MONGOLIA
Blagoveshensk on **4975** at 0002 with Chinese-type music, identification at 0004, OM and YL alternate in dialect.

● BOLIVIA
CP70 R. Grigota on **4830** at 0002, LA music with OM announcer, several identifications by YL at intervals, full identification by YL at 0015.

● VENEZUELA
YVMI R. Voz de la Fe on **3375** at 0103, OM with sports commentary; YVOA R. Tachira on **4830** at 2325, LA music, songs by OM, identification at 2330 and YVMG R. Popular on **4810** at 2303, OM and YL in Spanish, LA music ads and jingles etc.

● FEEDER SERVICE?
BBC on **4769** in SSB mode (LSB) at 2300 with news in English in the World Service, heard many times recently.

● CLANDESTINE
We end as we began, with news about clandestines.
"Voice of the National United Front of Cambodia" broadcasts in Cambodian from 0001 to 0200, 0400 to 0500, 1100 to 1200 and from 1300 to 1400 on **4675**, **7015**, **9985**, **10080** and **12006**. According to recent information, has also now added **10120**.



The tuner-receiver is housed in a case which gives it an attractive appearance

MEDIUM
TUNER-R

by R. Pe

Employing threene sistors, this receir to an external arli corder, or it can bise receiver in conjurio or high impedancea

THIS PROJECT IS A SIMPLE 3-TRANSISTOR MEDIUM WAVE tuner-receiver which is self-contained with its own internal ferrite aerial and battery supply. The a.f. output is at low impedance and has a fairly high amplitude, this being as much as 2 volts peak-to-peak with strong signals. The unit is therefore capable of driving virtually any amplifier. Alternatively, it can be used to feed a crystal or high impedance magnetic earphone of 1,000Ω or more, whereupon it makes a very useful personal portable receiver.

For simplicity a t.r.f. circuit has been employed, with the result that the unit is both inexpensive and easy to construct. It is reasonably compact and its case measures 6¼ by 3 by 2 in.

THE CIRCUIT

The circuit of the tuner-receiver is shown in Fig. 1. TR1 is in a reflex stage with pre-set regeneration, TR2 is a high gain common emitter amplifier and TR3 is an emitter follower with the volume control in its emitter circuit. All three stages are directly coupled to each other.

Describing the circuit in greater detail, L1 is the tuned aerial coil and is wound on a ferrite rod. Signals selected by L1 and the tuning capacitor VC1 are induced into the low impedance coupling winding, L2. One end of this winding is bypassed to the lower supply rail via C2 whilst the other end connects to the base of TR1. This transistor now functions as an r.f. amplifier and the signal appears, greatly amplified, at its collector.

Resistor R2 presents a relatively high impedance to the r.f. signal and a much lower impedance is offered by C3. In consequence, most of the amplified r.f. signal passes through C3 to D1 and thence to the base of TR1. Despite the lack of a resistive return for D1 cathode the whole circuit offers, in practice, detection of the amplified r.f. signal and C2 bypasses the r.f. content of the detected signal. TR1 then carries out its secondary function of a.f. amplifier and the detected signal undergoes further amplification, to appear at TR1 collector.

A small amount of the amplified r.f. signal at TR1 collector is fed back to the aerial tuned circuit via C1, and this gives the stage a certain amount of regeneration. It would seem better, theoretically, to use an r.f. choke rather than resistor R2. However, a choke here causes the circuit to become over-sensitive and rather difficult to control.

The tuner-receiver cled cassettee r

M WAVE
RECEIVER

★★★

. Penfold

inexpensive tran-
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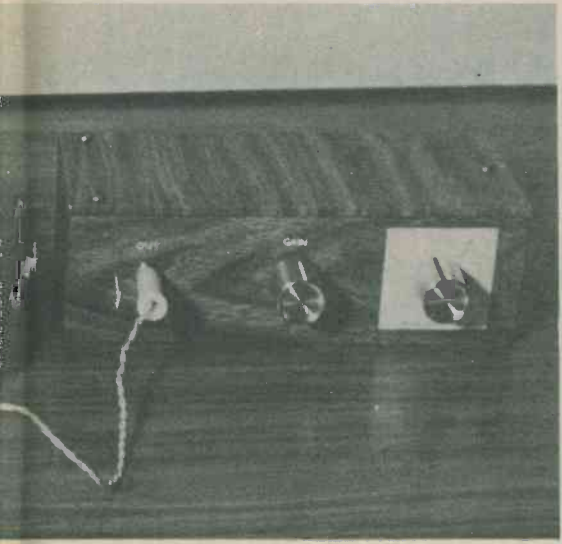
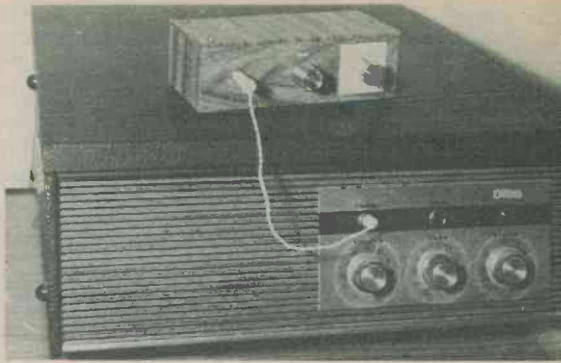
e magnetic earphone



oupled to the input of a
tape recorder



Here the tuner-receiver is feeding into an external amplifier

TR2 operates as a straightforward common emitter audio amplifier. R4 is the collector load resistor and R3 the emitter bias resistor. R5 stabilizes the bias conditions for both TR2 and TR1. Since the base of TR1 is 180° out of phase with the emitter of TR2 the circuit provides negative feedback but, due to the presence of C4, the feedback is of a d.c. nature only. Capacitor C6, connected between the collector and base of TR2, reduces its high frequency response. It also fully attenuates any r.f. signals which may find their way to TR2 base via R2.

TR3 is an emitter follower and gives no voltage amplification, merely ensuring a low output impedance. This may seem a little unnecessary, but it is just as easy to use this circuit as it would be to couple TR2 collector to VR1 by way of a capacitor. There is very little difference in cost, either. VR1 is the volume control and it also forms the emitter load for TR3. The output is taken from VR1 slider via the d.c. blocking capacitor, C5.

Current consumption from the battery is very small and there is no need for any supply decoupling components. S1 is the on-off switch, and it is ganged with VR1.

COMPONENTS

In the prototype, VC1 was one section of a 2-gang 250+250pF air-spaced variable capacitor. However, any reasonably small component of 250 to 300pF maximum capacitance may be employed, the main proviso being that it fits into the $1\frac{3}{4}$ in. depth of the case and does not project backwards from the front panel by more than $1\frac{1}{8}$ in. There are many variable capacitors which meet these requirements and a suitable type could be, say, a 192+78pF capacitor with both sections in parallel or a single gang 300pF Jackson Brothers 'Dilemin' capacitor.

Miniature disc ceramic capacitors are ideal for C2, C3 and C6, but there are other types available which could also be used provided they are miniature types. Construction will be much easier if these alternatives have side wire lead-outs, as for printed circuit board mounting. C1 is not a physical capacitor and is given by two lengths of insulated wire twisted together.

The ferrite aerial is a ready-made component incorporating a $4\frac{1}{2}$ in. rod complete with windings L1 and L2, and is available from Amatronix Ltd., 396 Selsdon Road, South Croydon, Surrey, CR2 0DE. The

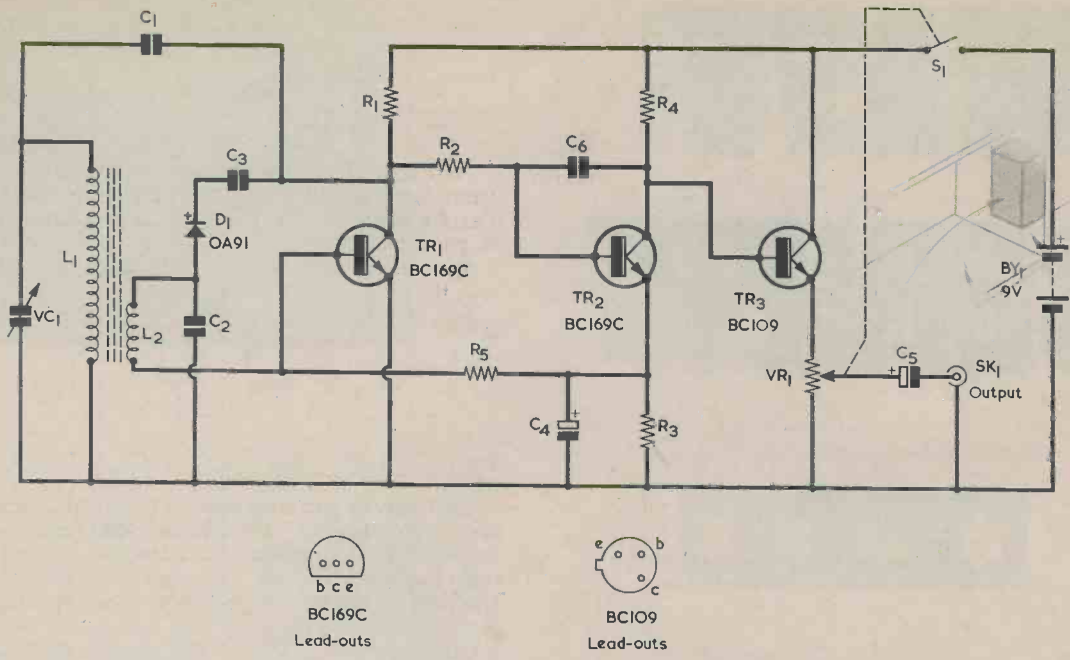


Fig. 1. Circuit diagram of the tuner-receiver. Current consumption from the 9 volt battery is of the order of 2.5 mA only

COMPONENTS

Resistors
(All fixed values ¼ watt 10%)
- R1 4.7kΩ
- R2 2.7kΩ
- R3 1.5kΩ
- R4 5.6kΩ
- R5 270kΩ
- VR1 5kΩ log, with switch S1.

Capacitors
- C1 Twisted pair (see text)
- C2 4,700 or 5,000pF disc ceramic
- C3 1,000pF disc ceramic
- C4 30μF miniature electrolytic, 10 V.Wkg.
- C5 10μF miniature electrolytic, 10 V.Wkg.
- C6 470 or 500pF disc ceramic
- VC1 250 or 300pF variable (see text)

Inductors
- L1, L2 Medium wave ferrite aerial (see text)

Semiconductors
- TR1 BC169C
- TR2 BC169C
- TR3 BC109
- D1 OA91

Socket
- SK1 3.5mm. jack socket

Battery
- BY1 9 volt battery type PP3 (Ever Ready)

Switch
- S1 Part of VR1

Miscellaneous
- 2 control knobs
- Battery connector
- Connecting lead with plugs (tuner to amplifier), if required
- Crystal or high impedance magnetic earphone, if required
- Materials for case
- Paxolin for component panel

larger coil is L1 and the smaller coil L2. The lead-out from L1 which is closer to L2 is that which connects to the negative supply rail, and the lead-out of L1 which is further from L2 is that which connects to the junction of C1 and VC1. The connections to L2 are found by trial and error; initially, L2 lead-outs are connected into circuit temporarily as it may be necessary to transpose them to obtain the correct phase relationship for regeneration.

The potentiometer used for VR1/S1 should be a small component whose switch tags do not project more than 1⅛ in. behind the panel on which it is mounted.

The socket SK1 is a 3.5 mm. jack socket. This type of socket usually has an additional contact which breaks when the jack plug is inserted. The additional contact is ignored here.

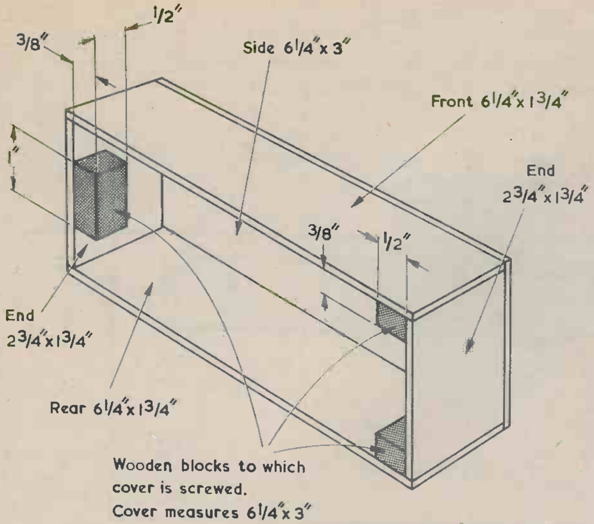


Fig. 2. Illustrating the assembly of the case

THE CASE

The case is home-made and, as mentioned earlier, measures $6\frac{1}{4}$ by 3 by 2 in. It is made from material $\frac{1}{8}$ in. thick, and this may be hardboard, plywood or Paxolin. Fig. 2 shows the method of assembly. In this diagram the panel on which are mounted VR1, VC1 and the output jack socket is referred to as the front panel. The panel not shown is the cover. The front, rear, end and side panels of Fig. 2 are secured together with a strong adhesive such as Araldite. Fig. 3 shows the holes required in the front panel. Mounting requirements for variable capacitors vary considerably, and the hole or holes required for fitting VC1 must be made to suit the particular component employed.

The cover is removable and is held in position by three wood screws passing into the wooden blocks shown in Fig. 2. The two smaller blocks in the corners are approximately $\frac{1}{2}$ in. by $\frac{3}{8}$ in., and the larger block is approximately 1 in by $\frac{3}{8}$ in. All three blocks are $\frac{1}{2}$ in. deep only, and they are glued in position with adhesive.

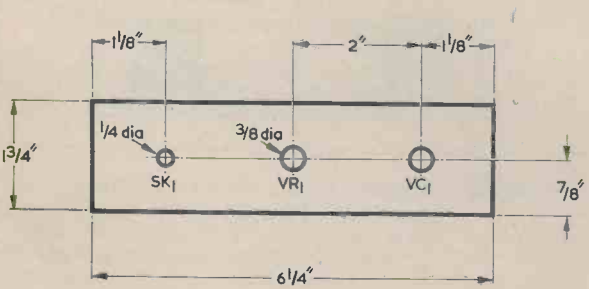


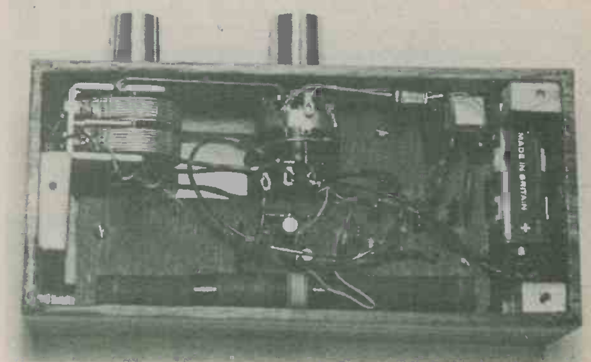
Fig. 3. Component positioning on the front panel.

The case of the prototype unit was finished by being covered with a plastic veneer having a wood grain effect, but any other desired finish can be given according to individual taste.

CONSTRUCTION

Apart from the battery and the parts fitted to the front panel, all the components are mounted on a plain Paxolin panel of $\frac{1}{16}$ in. thickness, as illustrated in Fig. 4. A panel measuring 5 by $2\frac{5}{8}$ in. is first cut out from a larger piece, and then two pieces are cut from this to give the shape shown in the diagram.

Fig. 4 is reproduced actual size, and the positioning of the component mounting holes can easily be traced from this onto the panel. All holes for component lead-outs and the four holes for the ferrite rod aerial mounting are $\frac{1}{16}$ in. or $\frac{3}{64}$ in. diameter. The ferrite rod is held in place by two loops of thin single core insulated wire passed over the rod and through the appropriate holes. The two ends of each loop are twisted together on the reverse side of the board so that the rod is held down firmly. It is essential that the wire used here be insulated and that the core ends of each loop do not touch each other, as this will then constitute a 'shorted turn' and will prevent the ferrite aerial from working correctly.



A view of the components inside the case

Components on the panel are mounted by passing their lead-out wires through the holes indicated in Fig. 4, the wires then being bent over at right angles on the reverse side. These are then soldered together as represented by the broken lines in the diagram. There are three external connections from the panel to the positive battery terminal, to the high volume end of VR1 track and to the negative supply rail. A flexible insulated lead about 3 to 4 in. long can be used for each of these connections. A further single core lead of about the same length is connected to the collector of TR1 on the reverse side of the board. This is one of the leads which form C1 and it is not shown in Fig. 4. The non-earthy lead-out of L1 (the lead-out further away from L2) will also connect, later, to the fixed vanes of VC1.

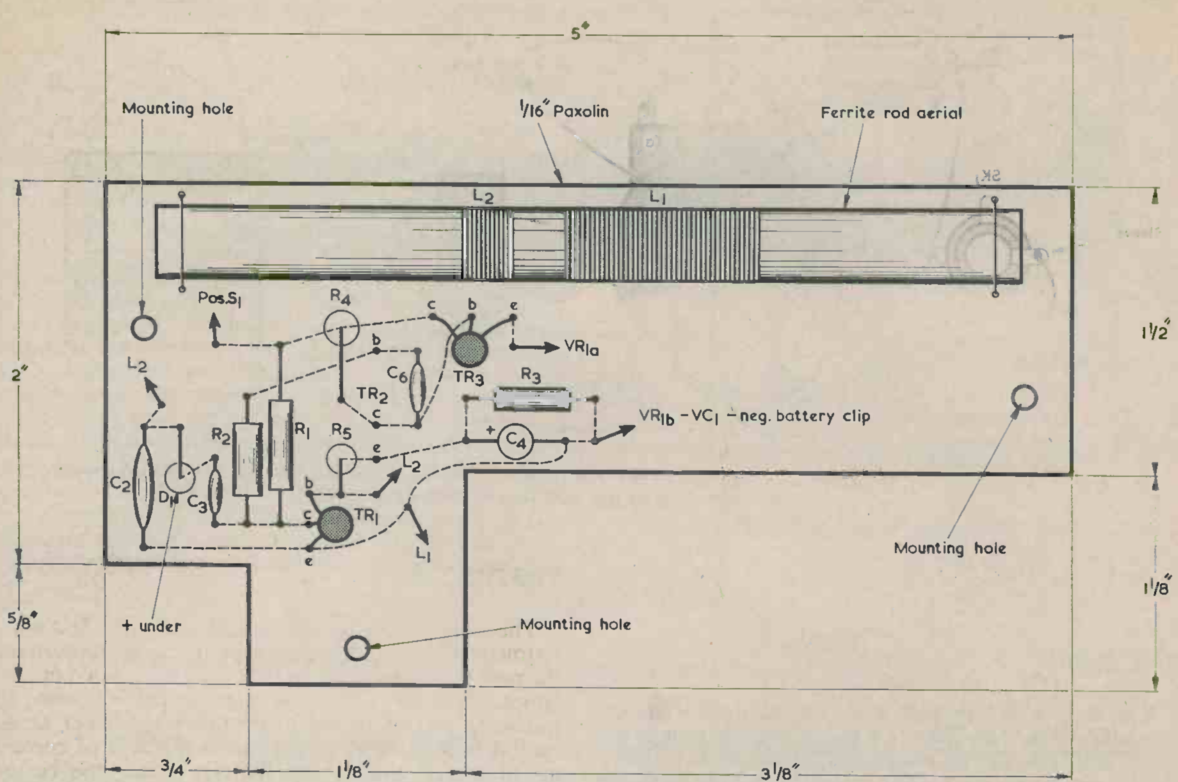


Fig. 4. The wiring layout on the component panel. For clarity the body of TR2 is omitted. The panel is reproduced full size fof tracing

Three blocks of wood, each 1 in. by 1 in. and ⅜ in. thick are next secured to the inside surface of the case side, as shown in Fig. 5. They are positioned such that they take wood screws passed through the three large holes in the component panel, thereby allowing the panel to be mounted in the case. Positioning need not be precise but the dimension marked 'X' should be such as to allow the PP3 battery to be gripped, on its side, between the block of wood and the adjacent case end. The blocks are secured in position with adhesive. The panel should fit quite neatly into place, the large 3⅛ by 1⅛ in. cut-out allowing space for VC1 and VR1, when these are fitted, and the small cut-out allowing space for the output jack socket. The component panel is not finally fitted yet.

The components on the front panel are next mounted, and these are then wired up as illustrated in Fig. 6. The leads to the battery connector should be sufficiently long to reach the battery when the latter is fitted later. The positions of the tags for S1 may differ, with some components, from those shown in the diagram. It will save possible trouble later if the requisite tags are traced through with an ohmmeter or continuity tester before wiring up. The jack socket should be wired such that the sleeve of the plug, when inserted, is connected to the negative supply rail. An ohmmeter or continuity tester

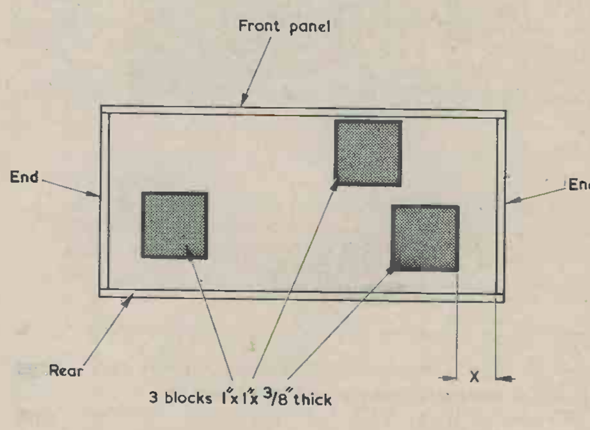


Fig. 5. The three wood blocks to which the component panel is secured take up the positions shown here. Again for clarity the wooden blocks of Fig. 2 are omitted here

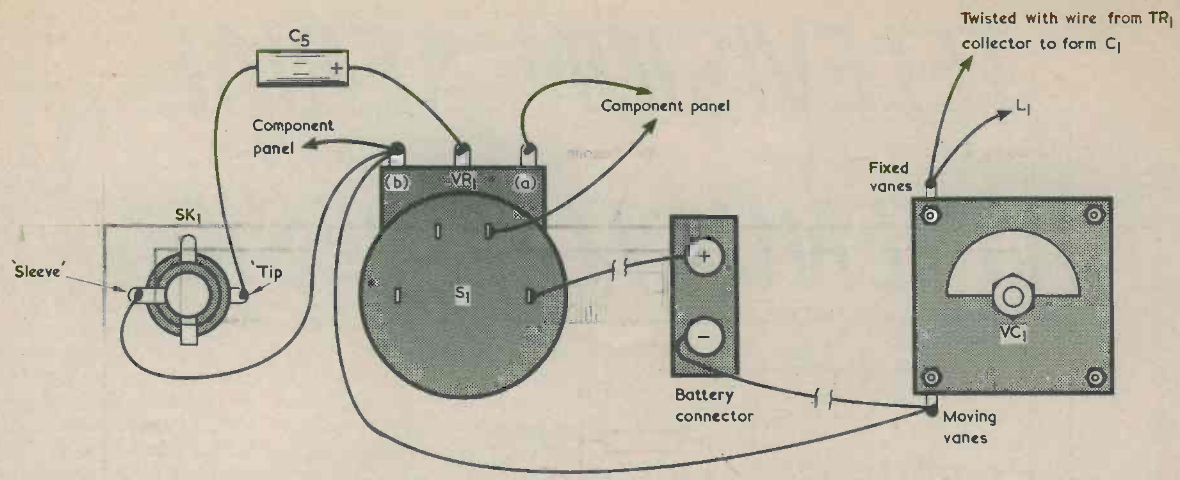
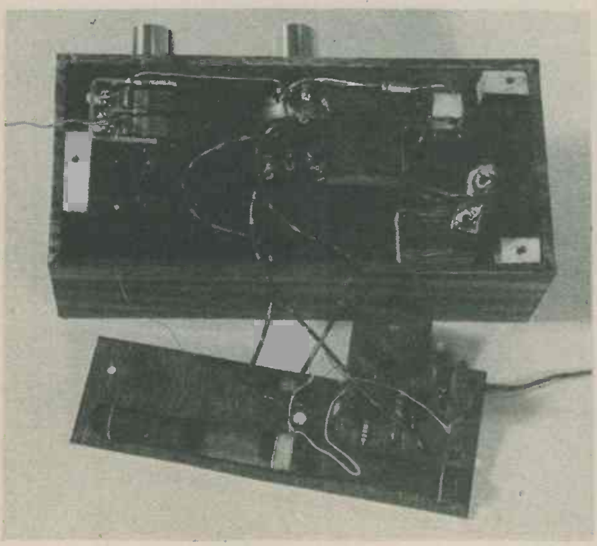


Fig. 6. Wiring of the components at the front panel. The terms 'sleeve' and 'tip' at SK1 refer to the corresponding sleeve and tip of the jack plug which fits into it



The unit with the component board and battery removed from the case. The three square blocks to which the board is screwed can be seen on the inside surface of the case side

may be helpful here also in determining the socket tags to which connections should be made.

The wire from VC1 fixed vanes which forms one section of C1 should be single core insulated.

The component panel may next be screwed in position and the interconnections between this panel and the components of Fig. 6 completed. The two insulated wires which form C1 are twisted together very loosely at this stage.

TESTING

The unit is now complete and ready for testing. A testmeter switched to a high current range is inserted in the positive supply lead and the unit is switched on. If it appears that no excessively high current is flowing the testmeter should be set to progressively lower ranges until it is capable of giving useful readings of currents up to 5mA. With a new battery fitted, the current consumption of the unit should be roughly of the order of 2.5mA. If the current reading is considerably different from this figure the unit should be switched off immediately and checked for wiring faults. If a correct current reading is given, a crystal earphone, a high impedance magnetic earphone or an amplifier can be connected to the output. Adjusting VC1 should permit a few stations to be received.

The effect of twisting the two wires which form C1 more closely together can then be checked. If the constructor is lucky this will cause the received stations to increase in volume and number. Should the opposite occur the connections from L2 must be reversed. The two wires which form C1 should be twisted together as tightly as possible without the set breaking into oscillation at any setting of VC1. Oscillation is evident as a loud 'pop' followed by a hissing noise. With the unit adjusted in this way it should be possible in the daytime to receive B.B.C. Radios 1, 3 and 4 in most parts of the U.K. plus two or three Continental stations. After dark many more stations will appear.

If the unit is to be used as a tuner for an amplifier or tape recorder it will be necessary to provide a lead to connect the two items of equipment together. If this lead is short it will probably not need to be screened, but if it is more than a foot or so in length it will be essential to use screened wire. The outer braiding of this lead connects, of course, to the jack plug sleeve at the tuner and, thence, to its negative supply rail. It may be found that using the unit close to a mains powered amplifier will cause an excessive mains hum to be heard. This is due to magnetic pick-up of the field around the amplifier mains transformer by the ferrite rod aerial. If trouble of this nature is experienced the tuner should be sited a few feet away from the amplifier.

TELEVISION AERIAL ATTENUATOR DESIGN

by L. Simpson

Calculating the values needed for a 75Ω television aerial attenuator

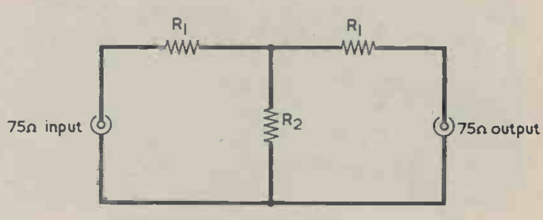
Television viewers living in areas which are close to the transmitter are liable to receive signals of excessive amplitude. Such signals can cause cross-modulation between the sound and vision channels in the television receiver, this being due to non-linearity in the r.f. or i.f. stages as a result of overloading or the formation of an excessively high a.g.c. voltage. The cross-modulation results in sound on vision, in which the picture content varies in sympathy with the sound and line lock may be lost on high sound levels, or in vision on sound, in which the sound is accompanied by a raucous field buzz.

Unless some form of r.f. gain control is fitted in the receiver, the cure is to insert an attenuator between the aerial and the input socket of the receiver. Attenuators for 75Ω aerial inputs can be obtained ready-made but, since they consist merely of a few resistors, many home-constructors would prefer to assemble their own.

The only problem that then remains is to select resistor values which give the desired attenuation and which also present an impedance of 75Ω at both the input and output sockets of the attenuator. It is essential, of course, to ensure that the correct impedance is given at both the input and output of the attenuator, as otherwise there will be a mismatch to the aerial.

ATTENUATOR VALUES

A suitable attenuator circuit is given in Fig. 1, and it will be seen that this incorporates three resistors. Of these, the two series resistors, R1, both have equal values, whilst the shunt resistor R2 has a different value. The resistors require values which ensure that, provided a 75Ω load is presented to the output socket, the impedance 'looking into' the input socket will similarly be 75Ω.



Attenuation factor = n

$$R_1 = \frac{75(n-1)}{n+1}$$

$$R_2 = \frac{R_1+75}{n-1}$$

Fig. 1. Circuit of the attenuator described in this article, together with equations for resistor values for different attenuation factors

Any level of voltage attenuation within reason can be provided by giving the resistors values which are determined by the equations which appear in Fig. 1 below the circuit. It is first of all necessary to choose the attenuation factor desired, whereupon letter n is then made equal to this number. If it is desired to attenuate the signal by 5 times, i.e. make the output one-fifth of the input, n is made equal to 5. The next step consists of working out the value required for R1 from the second equation and then the value required for R2 from the third equation.

The manner in which these equations are derived requires a treatment that is a little too cumbersome and lengthy for an article of this nature. They were developed from an equation for 75Ω distribution boxes given by the author in an earlier issue of this journal.*

To illustrate the operation of the equations and to prove their truth, let us take a few simple examples. To commence, let us say that we want the attenuator output to be half the input, so that n becomes equal to 2. From the second equation, R1 is shown to be 75 multiplied by 1 and divided by 3, or 25Ω. R2 is then 100 divided by 1, or 100Ω.

Fig. 2(a) shows the attenuator with these values, and includes the 75Ω load presented by the receiver to the output terminals. The right-hand 25Ω resistor and the 75Ω load give a resistance of 100Ω in parallel with the upright 100Ω resistor, so that these three resistances have a total value of 50Ω. The left-hand 25Ω resistor is in series with this, and it can be seen that the desired impedance of 75Ω is presented at the input terminals. The effective arrangement is as in Fig. 2(b).

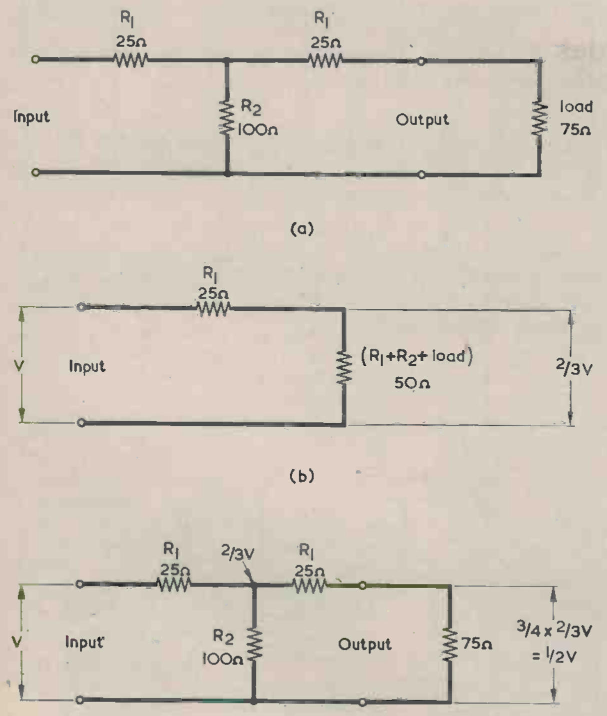


Fig. 2 (a). An attenuator capable of offering an output equal to half the input voltage
(b). The effect of combining the right-hand 25 Ω resistor, R2 and the load resistance
(c). Demonstrating that the output voltage is half the input voltage

* L. Simpson, 'Balanced Distribution Boxes', *The Radio Constructor*, July 1972.

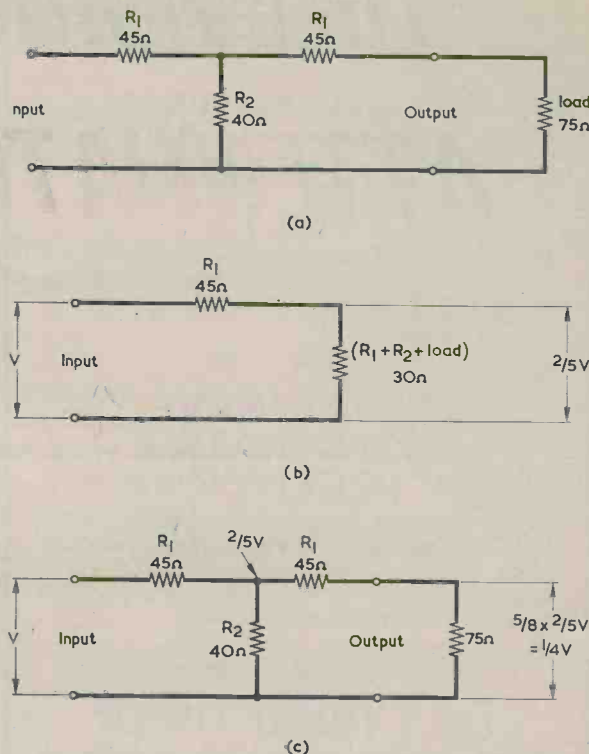


Fig. 3 (a). A circuit having resistor values which give an attenuation of 4 times
(b). The right-hand 45 Ω resistor, R2 and the load have a combined value of 30Ω
(c). The voltage across the output is one quarter of the input voltage

If a voltage, V, is applied to the two input terminals in Fig. 2(b), two-thirds of this will appear across the resistance of 50Ω. If we now split this 50Ω resistance back into its original three resistances, we will see that the 25Ω and 75Ω resistances allow three-quarters of the two-thirds voltage to appear across the 75Ω load. Thus, the voltage across the load is three-quarters of two-thirds of the input voltage, and this works out at half the input voltage.

Let us repeat the process, saying that this time we want an attenuation of 4 times. From the second equation in Fig. 1, R1 is now 75Ω multiplied by 3 and divided by 5. R1 is thus 45Ω. From the third equation we find that R2 is 120 divided by 3, or 40Ω. This is shown in Fig. 3(a). The combination of the right-hand 45Ω resistor, the 75Ω load and the upright 40Ω resistor gives a total of 30Ω, as in Fig. 3(b). So, the circuit again presents an input impedance of 75Ω. Two-fifths of the input voltage appears across this 30Ω resistance, and as illustrated in Fig. 3(c), five-eighths of this fraction appears across the 75Ω load. Five-eighths of two-fifths is one quarter, and so the attenuation has been 4 times.

TABLE

Readers may care to check the equations for other levels of attenuation. However, most other attenuation factors do not produce resistance figures that are as readily calculable as those for 2 and 4 times.

The accompanying Table gives calculated values for R1 and R2 for a range of attenuation factors ranging from 2 times to 20 times. In practice it should be satisfactory to use the nearest 5% preferred value, and these are also shown in the Table. The second column shows decibel figures corresponding to the attenuation factors obtained.

TABLE

Attenuation Factor (n)	Attenuation (db)	R1 calculated (ohms)	R1 nearest preferred value (ohms)	R2 calculated (ohms)	R2 nearest preferred value (ohms)
2	6	25	24	100	100
4	12	45	43, 47	40	39
7	17	56	56	22	22
10	20	61	62	15	15
15	23.5	66	68	10	10
20	26	68	68	7.5	7.5

The aerial attenuator can be made up in practical form using ¼ watt carbon composition resistors. Wirewound types should not be employed because of their inherent inductance.

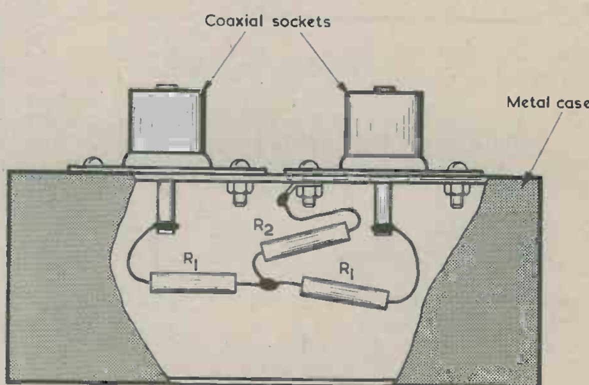


Fig. 4. The attenuator may be assembled in a small metal case. Wiring should be kept as short as possible

A suitable construction is shown in Fig. 4, in which the components are housed in a small metal case fitted with two coaxial sockets. There is no need to mark these as input and output sockets since, due to the symmetrical nature of the attenuator circuit, either socket can be used for input with the other providing the output. ■

THE QUASISTER
A Quasi–Stereo V.H.F. Tuner

by Sir Douglas Hall, K.C.M.G., M.A. (Oxon)

This unusual design provides reception over the v.h.f. f.m. band and gives two outputs, one with treble accentuation and one with bass accentuation

In an earlier issue of this journal, the author described a piece of apparatus which he called the 'Stereosim', and which combined a record deck, a 2-channel stereo amplifier and an a.m. tuning head which, in conjunction with the amplifier, gave quasi-stereo results from local mono stations.* In the 'Stereosim' one detector and amplifier handled middle and low audio frequencies whilst a second detector and amplifier handled middle and high audio frequencies. The subjective effect given by these two channels is similar to that obtained from 'enhanced' recordings cut from an original mono source.

It has been suggested to the author that it would be worth-while designing a v.h.f. tuner which would give similar results, but with the even better quality that frequency modulation and the accompanying wide audio frequency range makes possible.

QUASI-STEREO

The 'Quasister' is the result. This is a v.h.f. tuner offering two outputs with the same type of frequency colouration as was given in the earlier design, and these outputs may be applied to any 2-channel stereo amplifier which has high impedance inputs offering a sensitivity of not less than about 100mV. Most stereo amplifiers have high impedance inputs for crystal or ceramic cartridges, and these should be suitable. The tuner may also be employed with the 'Stereosim' amplifier and some brief notes on the coupling arrangements required here are given at the end of this article. These are for the benefit of readers who have built the earlier equipment. It must be pointed out that a testmeter offering voltage ranges with a sensitivity of 20kΩ per volt is necessary for finally setting up the present design.

For best results, the 'Quasister' tuner has to be used in a fairly good reception area. It is not at its best in fringe areas. A factor which must also be stressed from the outset is that the quasi-stereo effect given by the 'Quasister' is *not* the same as true stereo, with separate and discrete left and right channels, as is obtained from a superhet v.h.f. receiver and a stereo decoder.

The circuit of the tuner is given in Fig. 1. The signal from a swivel based telescopic aerial is applied to the emitter of TR1 which functions, at r.f., as a common base amplifier. R1 is the input load resistor, and the amplified r.f. signal at TR1 collector is applied via C1 to the base of TR2 and the tuned circuit given by VC1 and L1. TR2 functions as a common collector current amplifier at r.f. and the signal at its emitter is passed to the diode D1 for demodulation, after which the resultant a.f. signal is returned to the emitter of TR2. This transistor functions as a common base amplifier for audio frequencies. The stage incorporating TR2 and D1 is an example of the author's 'Spontaflex' reflex circuit.

The a.f. signal, considerably amplified by TR2, is built up across R5 and is fed back to TR1 base. TR1 now functions as a common collector amplifier for a.f. and its output is passed via R6 to TR3. In company with the input capacitance of TR3, R6 prevents any remanent r.f. signal appearing at the base of this transistor. TR3 gives a high level of amplification as a common emitter amplifier and its output is fed by way of the low value capacitor C11 to volume control VR3. Another low value capacitor, C18, couples the slider of VR3 to R15 and thence to one of the output terminals of the tuner. R15 provides further filtering of any v.h.f. signal voltage which may be present. The relatively low values of C11 and C18 cause a marked attenuation of base frequencies, whilst the treble register comes through strongly. This output represents one of the quasi-stereo 'channels', and may be coupled to the right hand input of the following stereo amplifier.

SECOND DIODE

Returning to the demodulation process at D1, a second diode, D2, forms a voltage doubler or 'pump' circuit in configuration with D1, whereupon a further rectified signal appears across C8. This is fed through C9 and VR2 to the base of TR4. R9, VR2 and the two diodes form a potential divider which sets the base of TR4 at a suitable level to allow a collector current of about 500μA to flow in R10. The small forward direct current passing through D2 brings this diode to a sensitive condition. There is already a small forward current in D1, which is given by TR2 emitter current. The additional current which passes through this diode via D2 does not upset circuit conditions.

TR4 acts as a common emitter amplifier. Because of the bypass capacitor C14, and the negative feed-

*Sir Douglas Hall, 'The Stereosim', *The Radio Constructor*, July 1971. An alternative source for two of the potentiometers employed was noted on page 95 of the September 1971 issue.

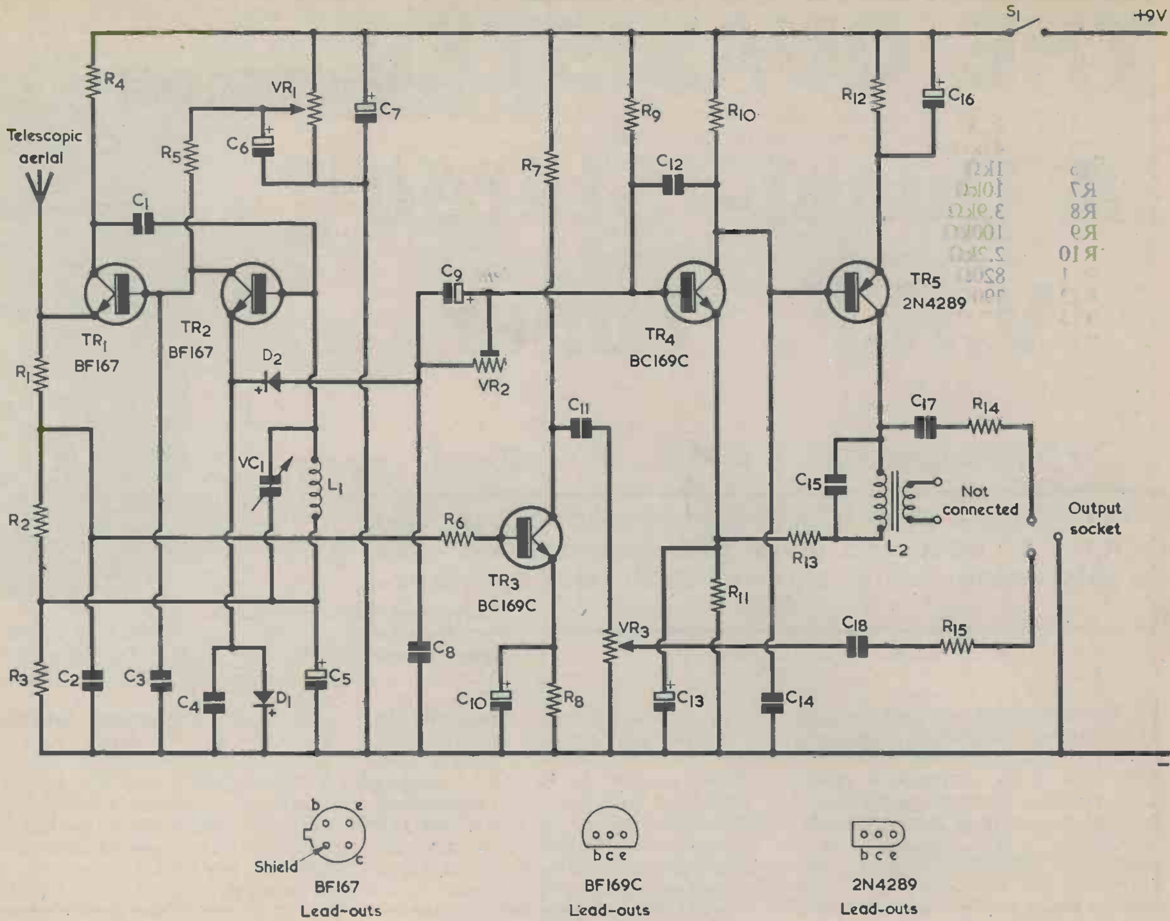


Fig. 1. The circuit of the v.h.f. tuner

back of higher audio frequencies given by C12, the signal at TR4 collector has strong emphasis in the bass register. Further amplification of signal is given by TR5, another common emitter device. The output passes through C17 and R14. R13 forms the main output load for TR5 but the inductor, L2, shunted by C15, gives increased bass amplification, this rising to a maximum at a frequency between 50 and 100Hz where these two components form a broadly tuned resonant circuit. L2 is the large winding of a Repanco microphone transformer type TT53. The output given via R14 represents the second 'channel' and may be coupled to the left hand input of the stereo amplifier.

There are, in consequence, two outputs from the tuner, one of which favours the treble register whilst the other gives more prominence to bass frequencies. The tuner amplifier providing the treble output is capable of offering a greater voltage level, but it is fitted with a volume control which can therefore be made to function as a 'balance' control. After the two outputs have been coupled to a stereo amplifier, VR3 is adjusted so that the bass appears to come from the left, the treble from the right, and the middle register, as given in particular by the human voice, from a point towards the centre. With properly positioned speakers, and with VR3 correctly adjusted, results are extremely pleasing and a considerable improvement on the normal mono output.

Dealing further with the r.f. section of the circuit, TR2 is kept in a state of gentle oscillation, the capacitor C4 providing an effective tap into the tuned circuit to give oscillation in the Colpitts mode. The degree of oscillation is controlled by VR1. C6 provides decoupling and also overcomes any tendency towards noise in VR1 as the latter is adjusted. Synchronous demodulation of the incoming f.m. signal is provided and the author has employed this type of circuit in previous designs.

Bias current for the base of TR1 is fed via R5 and VR1, whilst that for TR2 is set by R3. There is a high level of d.c. negative feedback, and this stabilizes operating conditions for the two transistors.

Some points need to be made next with respect to components. It is essential to employ the transistors and diodes that are specified and to avoid using so-called 'substitutes' or unmarked devices. The two diodes are R.S. Components parts and may be obtained from suppliers handling this company's products, such as Elekon Enterprises, 224a St. Paul's Road, Highbury Corner, London, N.1. The group board is also an R.S. Components part, and is described as an 18-way 'standard group panel'. This may be similarly obtained from suppliers of R.S. Components parts. The board is also available from Home Radio under Cat. No. BTS10. The two potentiometers VR1 and VR3 were Clarostat type 37 in the author's tuner. These have a body diameter of 1⅛in. If potentiometers made by an alternative manufacturer are used, the body diameter should be reasonably close to, but not greater than 1⅛in.

The telescopic aerial is an Eagle type TA632 which has an extended

COMPONENTS

Resistors
(All fixed values ¼ watt 10%)

R1	390Ω
R2	3.9kΩ
R3	2.2kΩ
R4	2.2kΩ
R5	47kΩ
R6	1kΩ
R7	10kΩ
R8	3.9kΩ
R9	100kΩ
R10	2.2kΩ
R11	820Ω
R12	390Ω
R13	22kΩ
R14	100kΩ
R15	100kΩ
VR1	25kΩ potentiometer, linear (see text)
VR2	25kΩ pre-set potentiometer, skeleton
VR3	2MΩ potentiometer, log, with switch S1 (see text)

Capacitors

C1	1pF silvered mica or ceramic
C2	0.01μF plastic foil
C3	470pF silvered mica or ceramic
C4	4.7pF silvered mica or ceramic
C5	25μF electrolytic, 2.5 V.Wkg
C6	2μF electrolytic, 10 V.Wkg.
C7	1,000μF electrolytic, 10 V.Wkg.
C8	470pF silvered mica or ceramic
C9	25μF electrolytic, 4 V.Wkg.
C10	25μF electrolytic, 4 V.Wkg.
C11	470pF silvered mica or ceramic
C12	4,700pF silvered mica or ceramic
C13	500μF electrolytic, 4 V.Wkg.
C14	0.22 μF plastic foil
C15	0.047μF plastic foil
C16	500μF electrolytic, 4 V.Wkg.
C17	0.01μF plastic foil
C18	470pF silvered mica or ceramic
VC1	10pF variable, type C804 (Jackson Bros.)

Inductors

L1	See text
L2	Primary of microphone transformer type TT53 (Repanco)

Semiconductors

TR1	BF167
TR2	BF167
TR3	BC169C
TR4	BC169C
TR5	2N4289
D1	1GP5 (R.S. Components)
D2	1GP5 (R.S. Components)

Switch

S1	s.p.s.t., part of VR3

Battery
9-volt battery type PP4 (Ever Ready)

Aerial
Swivel base telescopic aerial (see text)

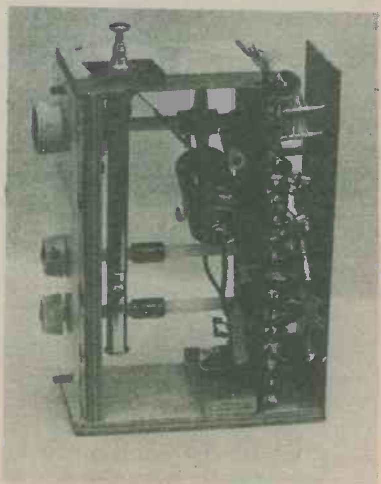
Miscellaneous
3 knobs
18 way group board (see text)
Epicyclic drive with flange, type 4511/F (Jackson Bros.)
Battery connectors
Flexible spindle coupler
2 brass spindle couplers
1in. spring clip
¼in. insulated spindle
Stereo jack socket and plug (see text)
Plywood, Paxolin, Perspex, etc.

length of 80cm. (or 31.5in.) and a closed length of 15cm. (or 5.9in.) This is a swivel based aerial with the added facility that it is a 'disappearing' type, insofar that the aerial, when closed, can be passed down through its mounting bush. Other swivel based aerials of around the same dimensions can be employed but these may not have the 'disappearing' facility. Some small items of hardware are required for the controls. These include a small flexible spindle coupler and two brass spindle couplers. The latter are available from Home Radio under Cat. No. DL60. Three lengths of insulated ¼in. diameter rod are also needed. In the author's case these were pieces cut from the spindles of potentiometers used in other projects. A spring clip is required to take the PP4 battery, which has a diameter of 1in. This clip is of the 'tool-clip' variety and is available from most hardware stores. Further essential hardware it. ms are two ⅜in. 4BA bolts and one 1½in. countersunk 4BA bolt.

As a final point concerning the components, the output socket is a ¼in. stereo jack socket of the type having an open construction.

CONSTRUCTION

All the components, apart from the aerial, are mounted on the 18-way group board. See Figs. 2(a), (b) and (c). Note that the tags and holes in the board are numbered in Fig. 2(a). This enables reference to be made to individual holes and tags in this article; the group board does not itself, of course, carry any numbers. Before carrying out any work on the group board a piece of ¼in. plywood should be cut to the outside dimensions shown in Fig. 3(a). The 18-way group board should be laid on the plywood panel so that the bottom of the board is level with the bottom of the plywood. (This is the bottom as in the view given in Fig. 3(a).) Mark out hole centres on the plywood through holes H3, H10 and H13. Drill out the three holes in the plywood, the two lower holes being ¼in. diameter for control spindles, and the top one slightly in excess of ⅜in. to take the epicyclic drive flange. Next drill out the two 4BA clear holes in the plywood panel. The plywood panel may now be ste aside for the time being. Next cut out a piece of Paxolin to the dimensions shown in Fig. 3(d). Lay the group board on it so that the top of the board is level with the top of the Paxolin (top as in the diagram), and mark out hole centres through the group board



Side view of the receiver, with its case removed

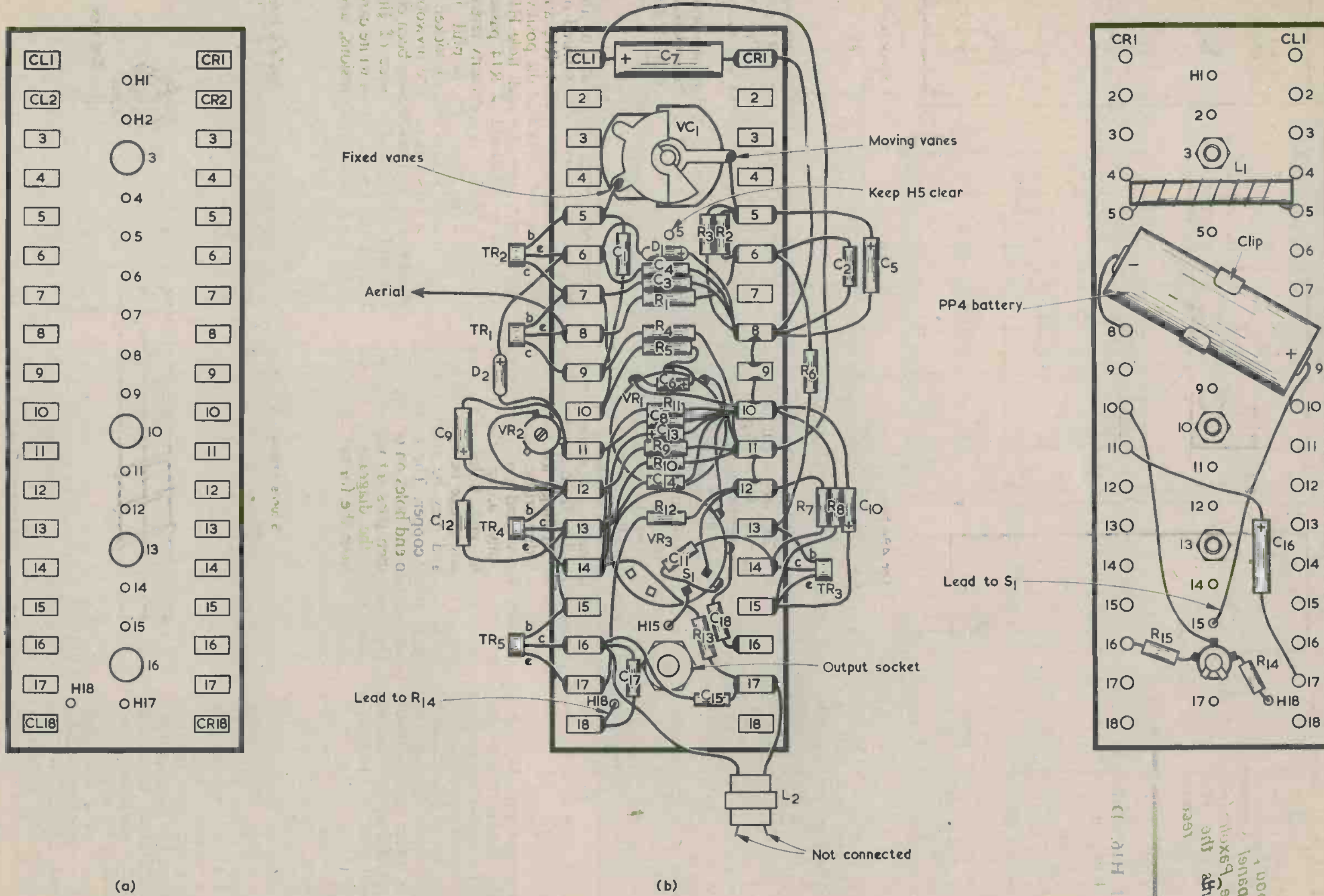
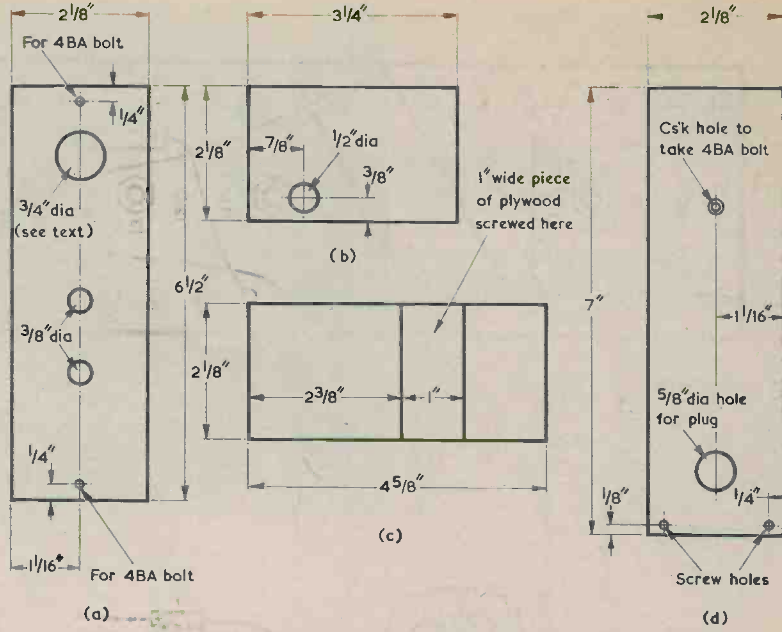


Fig. 2 (a). All the components are mounted on an 18 way group board. The tags and holes are numbered here for reference
(b). The parts mounted on the tag side of the board
(c). Components and wiring on the board underside

Fig. 3 (a). The plywood panel which appears at the front of the receiver
(b). The plywood panel at the top
(c). The base consists of a plywood panel with a second panel screwed to it
(d). The Paxolin panel which forms the rear of the receiver



holes H5 and H16. Drill out the corresponding holes in the Paxolin panel, the upper one being 4BA clear and the lower one 5/8in. diameter. The 4BA clear hole should be lightly countersunk on one side. Drill out also the two holes at the bottom intended for woodscrews. These woodscrews, when they are later fitted, should have a small diameter. A suitable size is 3/8in. No. 1.

Next take up the group board and drill out the four holes H3, H10, H13 and H16 to 3/8in. diameter, and also drill out the extra small hole indicated as H18. The last hole need only be large enough to take a resistor lead-out. Break off the inside arms of tags CL3 and CL4 to avoid fouling VC1, and the inside arms of tags CR13 and CR14. The bases of these tags should be covered with a layer or two of insulating tape to avoid short-circuits to the tags of VR3.

Next fit and wire up the components, as shown in Fig. 2(b). For clarity, some of the components are not drawn to scale. Also, some components appear outside the board edges in the diagram. In practice, leads should be as short as is reasonably possible, and all components should be within the width of the board and should not extend away from the board surface (i.e. towards the reader in the view of Fig. 2(b)) by a greater distance than the fixed vane lugs of VC1. Be careful to avoid short-circuits between leads. Insulated sleeving may be used, but it is better to do without and to rely on careful positioning, as this approach will result in low inter-lead capacitance which is quite a problem in v.h.f. designs. If sleeving is relied on, there is a tendency for leads to lie closer together!

When potentiometers of the same body diameter as those used by the author are employed, their bodies will be very close to each other and may even touch. In the latter case a layer of thin tape may be interposed between the bodies to prevent what may later become an intermittent connection which could affect receiver operation. L2 is left hanging on its leads for the time being. The high inductance winding is that which connects into circuit.

The shield lead-outs of TR1 and TR2 are left unconnected. These lead-outs should be shortened, if necessary, and positioned so that they do not make contact with any other wire or any tag.

Now make coil L1. The former of this coil is a 2in. length cut from the outside body of a 'Bic' ball-point pen. Even if a new pen has to be bought the former will not prove to be expensive! 'Bic' pens are available with transparent or yellow bodies, and either is satisfactory for use here. Do not cut the former from the body of another make of pen as the dimensions may be different. The coil is shown in Fig. 4. Two 1/16in. holes are drilled in the former, each 1/8in. from the end. Take care whilst drilling, as the plastic material is rather brittle. Next, 8 turns of wire are wound on, these being spaced equally along the former between the end holes. The wire should be any gauge between 24 and 28 s.w.g., and may be enamelled or bare tinned copper. The 8 turns are between two end holes on one surface. The leads then pass through the end holes, as in the diagram. The leads projecting from the former should be about 1/2in. long, and they are soldered direct at the holes of tags CR5 and CL5, as shown in Fig. 2(c). The coil body should be close to the group board surface.

Also shown in Fig. 2(c) are the other parts fitted, or wired, on the underside of the group board. The clip for the battery is mounted at hole H7, and is oriented so that the battery is at a slant, as illustrated. This keeps its connectors within the width of the board. Further components wired on the underside are C16, R14, R15 and the jack socket. Note that the positive battery lead passes through hole H15 and that one lead-out of R14 passes through hole H18. A continuity tester, or ohmmeter may be helpful in identifying the tags of the jack socket.

Turn to Fig. 3 again. The plywood panel in Fig. 3(a) has already been cut out and drilled. Cut a piece of 1/8in. Perspex and a piece of thin white card to the same outside dimensions, and

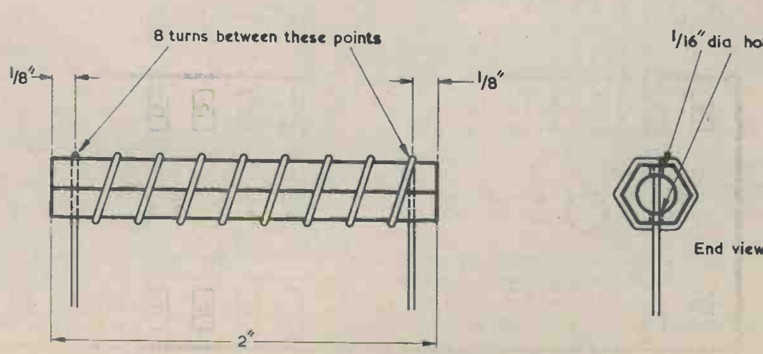
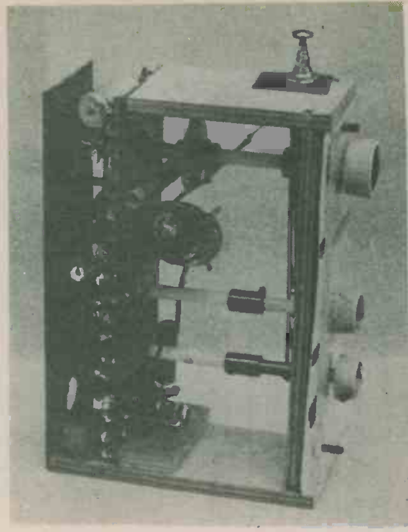


Fig. 4. The coil L1 is wound on a section cut from the body of an inexpensive ball-point pen



Another illustration of the receiver components

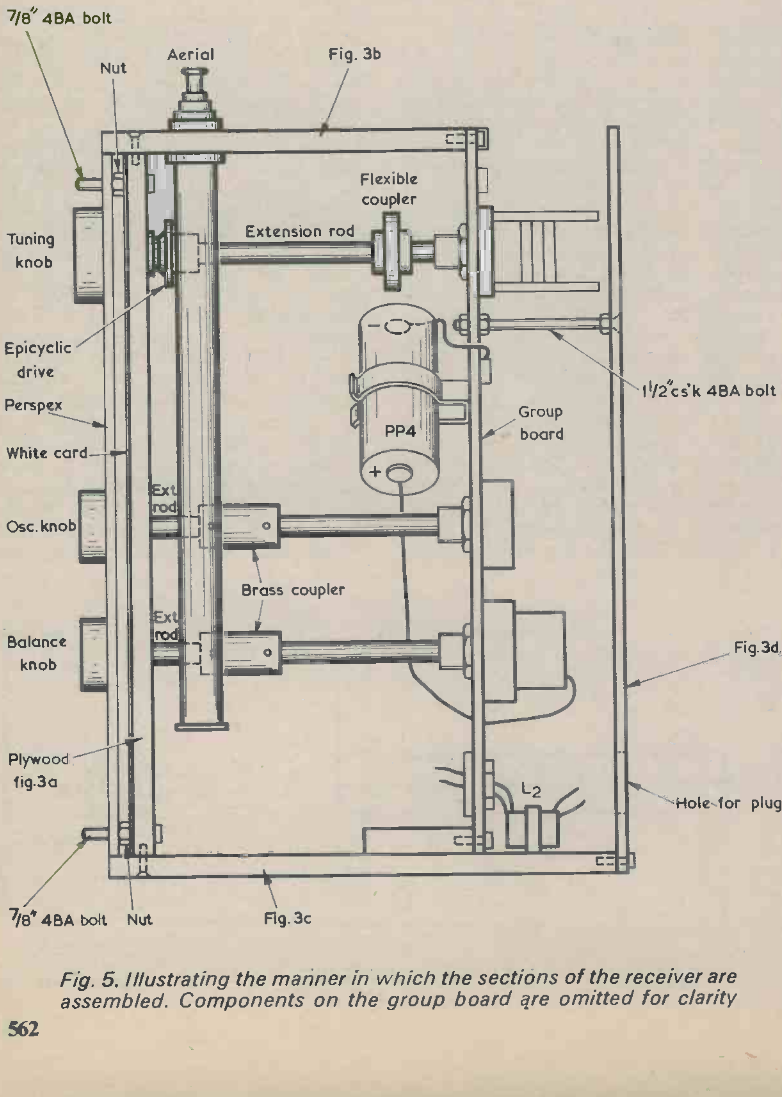


Fig. 5. Illustrating the manner in which the sections of the receiver are assembled. Components on the group board are omitted for clarity

drill or cut out holes in these to agree with those in Fig. 3(a), using the plywood panel as a template.

Cut out the ¼in. plywood panel shown in Fig. 3(b). The ½in. hole here is intended for the telescopic aerial employed in the prototype. Other aerials may require a hole of different diameter. Then cut out a further ¼in. plywood panel measuring 2¼ by 4⅝in., as in Fig. 3(c). Screwed to this, in the position shown in the diagram, is a further piece of ¼in. plywood measuring 2¼ by 1in.

Assemble the group board and the pieces of Fig. 3 in the manner shown in Fig. 5. Note that the white card is placed immediately over the plywood panel of Fig. 3(a) after which a nut is fitted over each ⅞in. 4BA bolts to act as a spacer. The Perspex panel is then fitted on the outside. There is no nut over the Perspex as yet, because another piece is later fitted over this. When the receiver has been finally completed the Perspex panel may be removed and a wire pointer fitted to the flange of the epicyclic tuning drive. The white card may then be marked up in terms of the local v.h.f. transmissions. The Paxolin panel at the rear is held off from the group board by the 1½in. 4BA bolt, three nuts being fitted, as indicated. The group panel and Paxolin panel are secured with thin woodscrews of the type already mentioned. The epicyclic drive has its anchor lug suitably screwed down and a short length of insulated ¼in. spindle appears between it and the flexible coupler on the spindle of VC1. Two brass couplers and lengths of ¼in. insulated rod are fitted to the spindles of VR1 and VR3. The inductor L2 is secured to the baseboard with adhesive in a position which leaves full access to the jack socket.

The aerial is next fitted and wired to tag CL8.

SETTING UP

The receiver is now ready for setting up. Set up a testmeter with a resistance of 20kΩ per volt or better to a volts range which allows a clear reading of 3.5 volts. Clip this across R13 with positive to tag CR17. Set the slider of VR2 so that it inserts zero resistance into circuit. Switch on and adjust VR2 until a reading of 3.5 volts is given.

Now, plug in a stereo amplifier, turn VR3 to a central setting and advance VR1 until the existing low hiss suddenly becomes louder. This will probably happen when VR1 is around three-quarters of full clockwise rotation. Adjust VC1 slowly, keeping the louder hiss in being by adjusting VR1 as necessary. The three main B.B.C. stations and the local station, if there is one, should then come in clearly, the hiss tending to diminish as the transmissions are tuned in. The station will probably appear when the vanes of VC1 are rather more than half en-

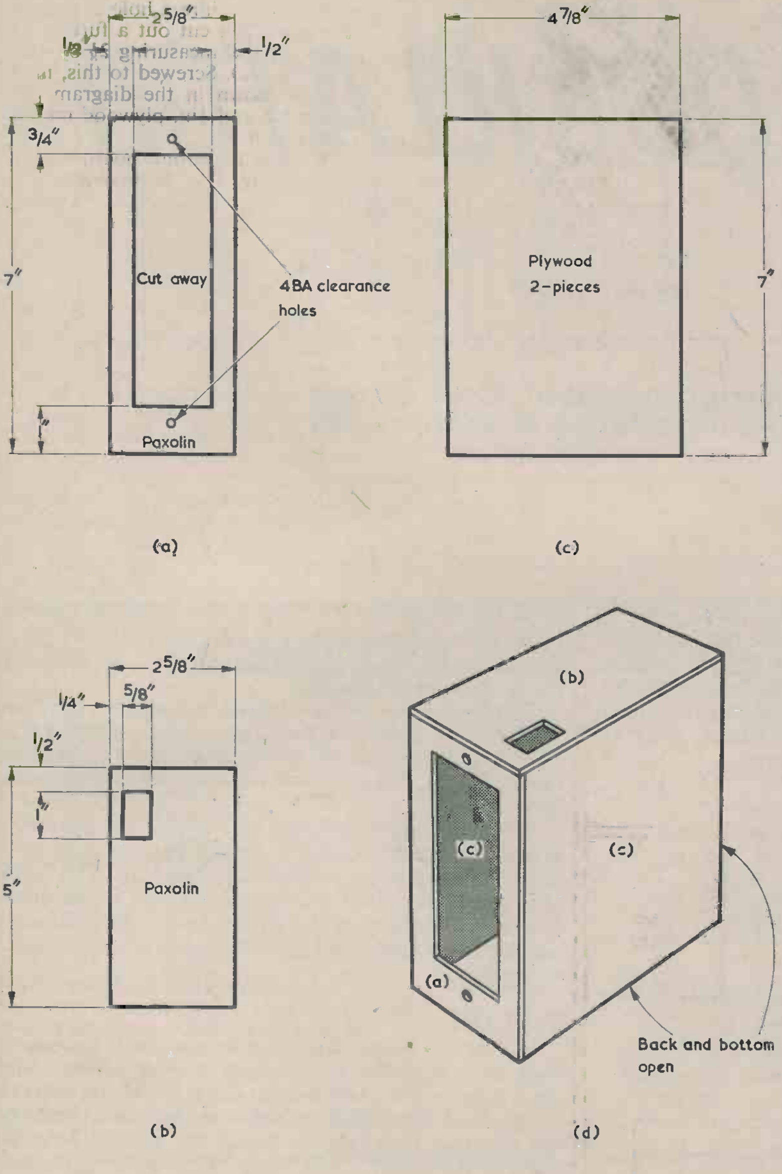


Fig. 6. Details of a simple case for the receiver

meshed. Tuning must be accurate for good quality, and VR1 should not be advanced further than is necessary or distortion will set in. Adjust the direction and length of the aerial for best results. Any possible difficulties with hand capacitance can normally be overcome by careful adjustment of aerial length. VR3 may finally be adjusted, in the manner already described, for best balance from the speakers.

CABINET

A simple case can be made up as in Fig. 6, which is virtually self explanatory. The two $\frac{1}{4}$in. plywood side pieces are glued to the Paxolin front panel so that their outer surfaces are flush with the panel edges. The top panel is then glued to the tops of these three pieces. The 5in. dimension of the top panel assumes that the Paxolin front panel has a thickness of $\frac{1}{8}$in. In practice the dimensions in Fig. 6 should only be taken as a guide, in any case, and the actual dimensions which are employed should be those which conform with the completed receiver. This method of working takes up small errors in construction and such points as the possibility of the plywood employed not being exactly $\frac{1}{4}$in. thick. The two 4BA clear holes in the Paxolin front panel can be marked off from the two 4BA bolts protruding from the front of the receiver. The case is secured by positioning it so that the 4BA bolts pass through the holes in the case front panel. Two dome nuts passed over the outside of the bolts then hold the case securely, and present an attractive appearance. The aperture for the aerial in the top of the case is slotted, to provide sufficient freedom of movement for the case to be fitted in place. The case may be covered with Fablon or Contact, as may also the Paxolin panel at the rear of the receiver assembly.

The battery current drawn by the tuner is about 2mA only, and so the battery will last well. It should be replaced when frequency drift or a fall in sensitivity occurs soon after switching on, as these indicate that its voltage is dropping.

There should be little difficulty in making this very effective tuner, but the reader is once again advised of the necessity to use the specified components, particularly so far as transistors and diodes are concerned.

Finally, some notes on the use of the tuner with the amplifier section of the earlier 'Stereosim' design. The switch references which follow apply to the 'Stereosim'. It will be found helpful to remove the existing lead from S1(a)2 to S1(c)2, and from S1(c)2 to chassis, and to take the two non-earthy output leads from the 'Quasister' to S1(a)2 and S1(c)2. The centre position of the gram-radio switch, previously providing an earth connection to prevent break-through of strong radio signals on gram, now becomes the position for v.h.f., leaving the other two positions with their original functions. A further refinement is to join S1(b)3 to S1(b)2, so that the negative feedback tone control is effective on both channels, with v.h.f., as it is at present with gram. However, with this tuner external tone controls should be adjusted with discretion, and with the 'Stereosim' amplifier best results are given with VR3 of the 'Stereosim' fully anticlockwise, unless hiss is troublesome whereupon it may be set accordingly. With other amplifiers tone controls should be set for best results, which will usually be given with the controls in the 'flat' position. ■

SINGLE FREQUENCY TEST OSCILLATOR

by A. Foord

A thermistor-stabilized Wien Bridge a.f. oscillator offering an output with very low distortion

In audio design work a wide range oscillator is often used with an oscilloscope to plot the frequency response of an amplifier. However for straightforward signal injection purposes a simple single frequency test oscillator may prove adequate. The oscillator described in this article was built for such applications, and has also been used in distortion measurements.

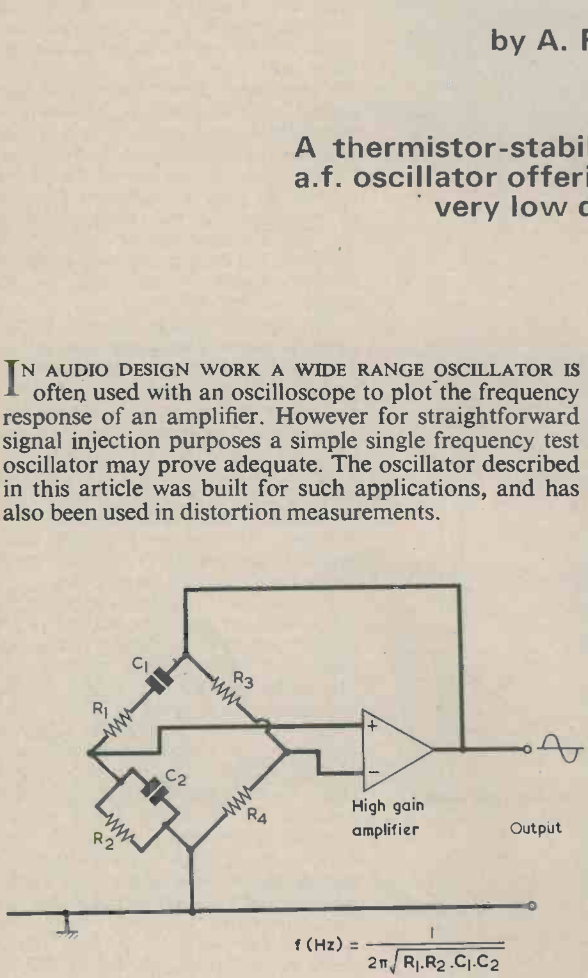


Fig. 1. The basic Wien Bridge oscillator

THEORY

The basic Wien Bridge oscillator arrangement of Fig. 1 is used. Like all resistance – capacitance tuned oscillators it is essentially a positive feedback amplifier in which the positive feedback is applied through a frequency selective network. Here R1, R2, C1 and C2 form the frequency selective network, which has zero phase shift and a signal loss of three times at a frequency dependent on the values in the network, as shown by the formula in the diagram.

This frequency is the oscillation frequency. R3 and R4 form a negative feedback loop which maintains the overall gain at exactly three times. In the practical circuit of Fig. 2 the resistor R3 becomes the thermistor TH1.

When the unit is switched on the cold thermistor has a high resistance, giving a circuit gain of over three times which allows oscillations to build up. The thermistor warms up as it passes current and its resistance decreases, whereupon the circuit gain is maintained at exactly three times and the amplitude of oscillation is controlled.

CIRCUIT

In Fig. 2 a three-stage amplifier is used. Transistors TR1 and TR2 are in common emitter stages, while TR3 is an emitter follower to drive the thermistor, the output and the frequency selective network. Although the nominal frequency is 1kHz, the ganged potentiometer, VR1(a) (b), allows a two-to-one variation around this value.

Capacitors C3 and C4 should have a tolerance on value of 2½% or less. Close tolerance capacitors are available in polystyrene or silvered mica. If necessary, C3 and C4 could each consist of two close tolerance 5,000pF silvered mica capacitors in parallel. An equivalent for the R53 thermistor is the R.S. Components thermistor type TH-B18.

The oscillator gives a maximum output of 1.3 volts r.m.s. with an open-circuit load. Total harmonic distortion is 0.016%, and nominal supply voltage is 18 with a maximum of 24 volts. Current consumption at 18 volts is approximately 13mA. The frequency range is 800Hz to 1.6kHz.

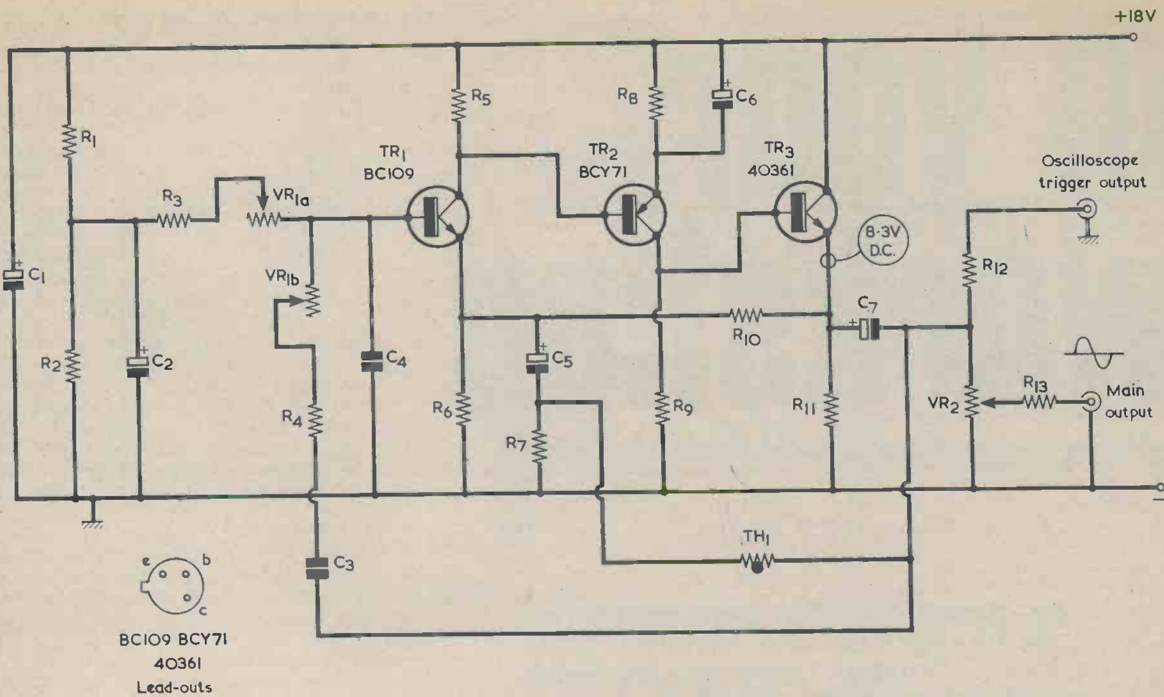


Fig. 2. The complete working oscillator circuit

COMPONENTS

Resistors
(All fixed values ¼ watt 5%)

R1	22kΩ
R2	10kΩ
R3	10kΩ
R4	10kΩ
R5	22kΩ
R6	10kΩ
R7	820Ω
R8	1.5kΩ
R9	3.9kΩ
R10	10kΩ
R11	820Ω
R12	10kΩ
R13	560Ω
VR1(a) (b)	10kΩ + 10kΩ dual gang potentiometer linear
VR2	5kΩ potentiometer, linear

Capacitors

C1	20μF electrolytic, 25 V.Wkg.
C2	10μF electrolytic, 16 V.Wkg.
C3	0.01μF, 2½%
C4	0.01μF, 2½%
C5	20μF electrolytic, 16 V.Wkg.
C6	20μF electrolytic, 16 V.Wkg.
C7	10μF electrolytic, 16 V.Wkg.

Transistors

TR1	BC109
TR2	BCY71
TR3	40361

Thermistor

TH1	R53

Miscellaneous
2 coaxial sockets
2 knobs
18 volt supply

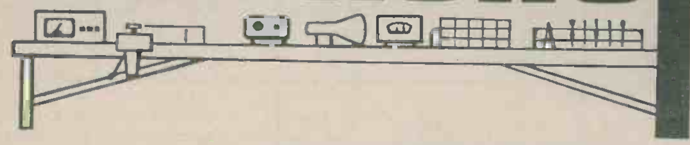
POSSIBLE MODIFICATIONS

Although originally designed as a single frequency test oscillator with a total harmonic distortion of less than 0.1%, the circuit can be used over a wider range if required. If all the capacitors other than C3 and C4 are increased in value by a factor of five times and suitable timing components are used in the VR1(a) (b), R3, R4, C3 and C4 positions, then a frequency range of 10Hz to 100kHz in decades is possible. The values for VR1(a) and R3, and for VR1(b) and R4, should be chosen so that the maximum does not exceed 110kΩ and the minimum is not less than 1kΩ. Suitable values, for example, would be 10kΩ in the potentiometer and 1kΩ in the series fixed resistor, 50kΩ in the potentiometer and 4.7kΩ in the series fixed resistor, or 100kΩ in the potentiometer and 10kΩ in the series fixed resistor. Naturally, in each case the values of VR1(a) and (b) would be equal, as would the values of R3 and R4. The capacitances required in C3 and C4 for a given frequency range may be calculated from the formula.

The total harmonic distortion will rise at frequencies below 1kHz due to the characteristics of the thermistor.

In conclusion, it may be stated that the circuit of Fig. 2 has proved useful for simple testing purposes where the cost of more elaborate equipment cannot be justified. ■

In your workshop



This month Smithy the Serviceman, together with his able assistant, Dick, takes a further look at transistor television circuits. They examine in particular the advantages of video a.c. couplings and beam limiting diodes in 625 line monochrome receivers

"I'VE BEEN THINKING."

Carefully, Smithy peeled the wrapping paper from a pork pie. He placed the paper in the waste bin at his side and then took a gargantuan bite from the pie. Masticating steadily he turned a solemn gaze on his assistant.

"Yes," repeated that worthy. "I've been thinking."

Smithy swallowed, then took a further enormous bite from the pie.

"Well, there we are then," continued Dick. "What I'm trying to say is that I've been thinking."

The Serviceman's jaw moved rythmically and, after a due period, he once more swallowed. Again, he bit into the pie.

A.C. COUPLING

"Ye gods," snorted Dick irately, as he watched the busy movement of Smithy's mouth. "I can't get any sensible conversation in this darned place at all. It's like talking to an old cow who's chewing the cud all the time."

The comment galvanised Smithy into speech.

"Hey," he spluttered, "don't be so disrespectful. I'm still the guv'nor round here, you know."

"And a darned messy guv'nor you are, too," retorted Dick critically. "Blimey, you've just shot about a pound of half-chewed pie over your trousers."

Smithy looked down, saw a large piece of the pork pie lodged near his knee, picked it up and popped it back nto his mouth.

"Honestly, Smithy, you're just revolting. How much longer are you going to be eating that repulsive pie of yours?"

"Last few bites coming up now," said Smithy indistinctly.

Dick waited impatiently whilst Smithy finished the pie. With an air of intense satisfaction, the Serviceman picked up his battered tin mug and drank deeply of its contents.

"Ah, that's better," he remarked, smacking his lips. "Now what's all this about you thinking?"

"Stap me, you can remember back as far as that?"

"Of course I can. I was just concentrating for the moment on my lunch."

"I'll say you were. Anyway, what I was thinking about was something that cropped up during the last gen session we had together. We were talking then about single standard 625 line monochrome TV receivers and you said that it was very common practice for these to have a.c. couplings between the video output transistor and the picture tube. That is to say, couplings by way of a capacitor instead of a direct d.c. connection. We never used to have so many a.c. couplings in the old 405 line sets and I've been wondering whether there's a particular aspect of 625 line reception that makes them more desirable in 625 line sets."

Smithy considered his assistant's remarks.

"Well," he said after a moment's thought, "there is one obvious difference between 405 line operation and 625 line operation which would quite definitely make a.c. video coupling on 625 lines a good thing. This has to do with the basic fact that the 625 line system uses negative vision modulation, whilst the 405 line system has positive vision modulation."

"Hang on a jiffy," said Dick. "Let's get these modulation schemes sorted out first. On 405 lines the transmitted signal increases in amplitude as the picture brightness increases. But on 625 lines the signal amplitude decreases as picture brightness increases." (Fig. 1.)

"That's right," confirmed Smithy. "With 405 lines, peak white corresponds to maximum signal strength. But on 625 lines peak white corresponds to minimum signal strength which, with the British system, is 20 per cent of maximum amplitude."

"Fair enough," commented Dick. "Let's go on from there."

"Okey-doke," said Smithy obligingly. "We can start off by considering a video output stage whose input is directly coupled to the vision detector and whose output is directly coupled to the cathode of the picture tube. Let's say, first of all, that it's handling a 405 line signal. You can think of the direct coupling to the tube as a simple

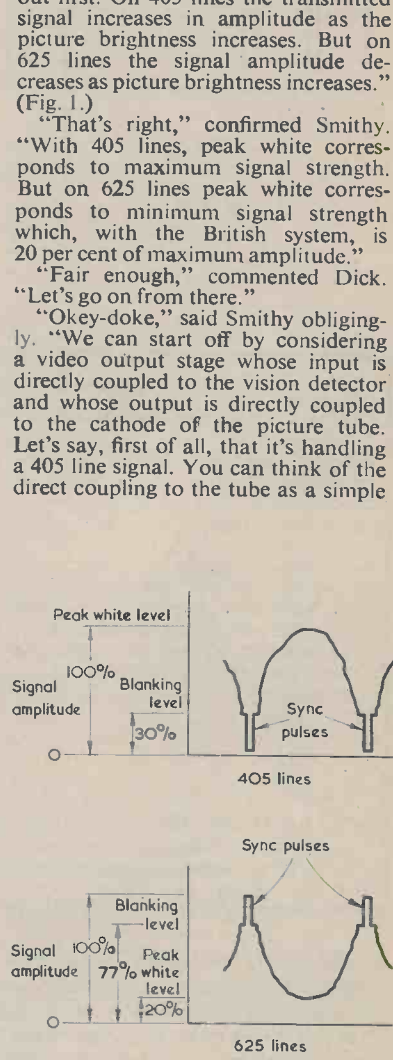


Fig. 1. The waveforms of the 405 and 625 line signals. Essentially, maximum signal amplitude corresponds to peak white on 405 lines and to sync pulse tips on 625 lines

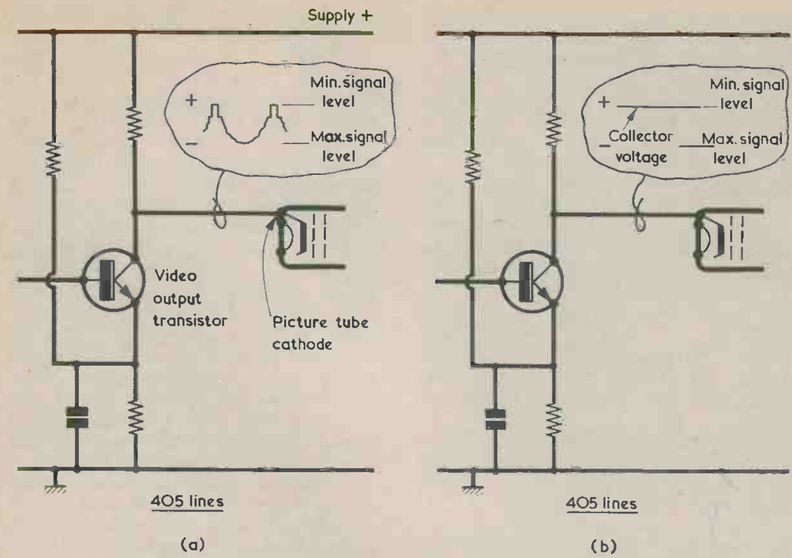


Fig. 2 (a). Circuit conditions at a video output stage handling the 405 line signal and having a direct coupling to the picture tube cathode
(b). In the absence of signal the collector voltage takes up a potential corresponding to minimum signal level

direct wire connection. Now, picture tube brightness goes up as the picture tube cathode goes negative. All right?" (Fig. 2(a).)

"Yes, I'm with you up to now."

"Right," said Smithy briskly. "Well, with 405 lines an increase in signal amplitude means that the picture tube cathode goes more negative. The sync pulses will take the tube cathode positive and, ideally, into cut-off, so that there is no cathode ray beam at all during the retrace period between lines. Now, what happens if, for some reason, the video signal disappears?"

"You mean if, say, the transmitter goes off the air?"

"Yes," confirmed Smithy, "or as occurs if the set happens to be switched to a dead channel, or if the aerial plug gets pulled out, or anything like that."

WHITER THAN WHITE

Dick pondered for a moment.

"Why," he remarked, "the output from the video output stage will take up a voltage equivalent to zero signal. It will go slightly positive of the voltage it took up in the presence of sync pulse tips." (Fig. 2(b).)

"And the picture tube?" Smithy prompted him gently.

"Well," said Dick, frowning, "since the sync pulse tips took the tube cathode past the cut-off point, the video output voltage corresponding to zero signal will take it just a little further beyond cut-off."

"Exactly," commented Smithy. "In other words the picture tube screen will simply go black in the absence of signal. In practice we know that this doesn't always happen on 405 lines, partly because viewers don't set up their contrast and brightness controls correctly and partly because many of the old single standard 405 line sets had partial d.c. rather than full d.c. couplings to the tube. But, even when these things are taken into consideration, the tube screen would at least show a low grey level in the absence of signal. Let's next take a look at the same set of circumstances with a 625 line signal. Assume once again that we have a video output stage which is directly coupled to the cathode of the picture tube. What happens this time when the video output stage is handling a 625 line signal?" (Fig. 3(a).)

"It'll be the same as with 405 lines," said Dick. "Increasing picture brightness in the video signal will take the picture tube cathode negative and the sync pulses will take the cathode positive, beyond cut-off. Just the same as on 405 lines."

"Right," confirmed Smithy. "In this case, however, quite a different effect will be given if the video signal ceases. Since peak white on 625 lines corresponds to minimum video signal amplitude, absence of video signal will cause the video stage output to go even more negative than peak white. The result will be that we'll get a blank raster on the tube that is white overall, and which is actually brighter than the brightest part of any scene which was reproduced when the signal was present. We'll get a voltage at the tube cathode which can be described as being 'whiter than white'." (Fig. 3(b).)

"Blimey," commented Dick. "I'd never looked at it like that."

"Well, that's what happens," said the Serviceman. "This means that, in the absence of signal, the tube screen in the directly coupled 625 line receiver is going to go brightly white all over, with the result that the tube will draw

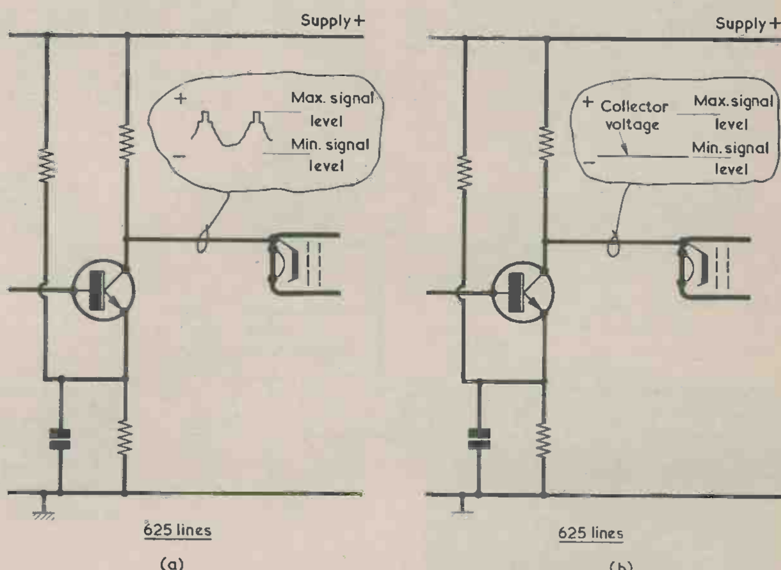


Fig. 3 (a). The same waveform is produced when the video output stage handles a 625 line signal, but the positions of maximum and minimum signal level are reversed
(b). When the input signal is removed, the video output collector assumes a potential equal to minimum signal level

a correspondingly high current from the e.h.t. supply. This current is bound to be quite a bit greater than that which flows at any time when the 625 line signal is present."

"This business of the video output going 'whiter than white' in the absence of a signal is still a little bit difficult to take in," commented Dick.

"Visualise the set-up between the vision detector and the video output point," suggested Smithy. "Now, as I told you in our last session, in transistor TV's there's usually an emitter follower between the vision detector and the video output transistor. The video output transistor is connected as a common emitter amplifier, which means that the signal at its collector has opposite phase to that at its base. At the same time the emitter follower output has the same phase as its input. Next, let's say that there are direct d.c. couplings all the way between the vision detector and the video output point, and imagine the set-up which is required if we were to handle a 405 line signal. The vision detector would be connected so that the rectified signal was taken from its cathode. The rectified signal would then go more positive as signal amplitude increased, which is what we want here, since the phase inversion in the video output stage would cause the tube cathode to go negative as picture brightness went up. For 625 line reception the vision detector would have to be turned round, and the rectified signal would be taken from its anode. This time the rectified signal would go more positive as signal amplitude *decreased.*" (Figs. 4(a) and (b).)

"The emitter follower doesn't reverse the phase of the signal from the vision detector," said Dick musingly. "But the video output stage does. Whereupon we once again have the video output collector going negative for increasing picture brightness. And to an even greater negative voltage if the picture signal ceases. Yes, I think I've got the idea now, Smithy."

"Good," said the Serviceman. "The video output stage bias conditions would have to be different for the two cases. With the 405 line set-up the video output transistor would need to be biased so that it was nearly fully off under no-signal conditions, whilst with the 625 line set-up the video output transistor would have to be biased so that it was approaching being fully hard on in the absence of signal."

"Ah," remarked Dick, his expression suddenly brightening, "that bias business is the clincher! Now I fully understand what happens."

"Good show," said Smithy. "You can now see that if, on 625 lines, the video output stage is directly coupled to the picture tube cathode, the screen will be bright white all over in the absence of signal. This won't damage the tube but it will mean that a heavy current demand is placed on the e.h.t. circuit which supplies its final anode. The e.h.t. circuit should be able to stand up to this extra current for a reasonable length of time, but it might well be asking a lot of it if the period were extended. Say, for instance, you went to bed and forgot to switch the TV off at night-time. It would then be running with an exceptionally bright screen all the time that the transmitter it was tuned to was off the air."

"I can visualise," put in Dick, "all other sorts of situation where a TV could run for long periods without an input signal."

"Exactly," agreed Smithy. "Anyway, the problem of a very bright screen in the absence of signal doesn't arise if there is an a.c. coupling to the picture tube cathode. This cathode would normally be biased so that in the absence of signal the tube gave a raster at about half peak white value. When a signal was present, the a.c. coupling capacitor would then charge up such that the average voltage level of the signal was equal to the biasing level, and the picture would be reproduced in the usual manner." (Fig. 5).

"And," added Dick, "all that would happen when the input signal ceased was that the whole raster would stay at around half peak whiteness. Which the e.h.t. supply could cope with quite happily for very long periods of time."

"That's it," confirmed Smithy. "Not all sets have this a.c. coupling. Some sets, for instance, have what is effectively d.c. coupling by way of a beam limiting diode which prevents the tube cathode from going too far into the 'whiter than white' state."

With these words, Smithy reached towards the back of his bench and produced a paper bag. From this he extracted a Swiss roll, the cellophane wrapping of which he pulled back. He took a large bite into the roll.

"What's this business with beam limiting diodes?" queried Dick. "And for goodness sake what are you eating now?"

Smithy attacked the Swiss roll with gusto.

"This is my afters," he said, in a muffled tone. "I like to have a sweet following the main course."

"I'll bring the cheese board round

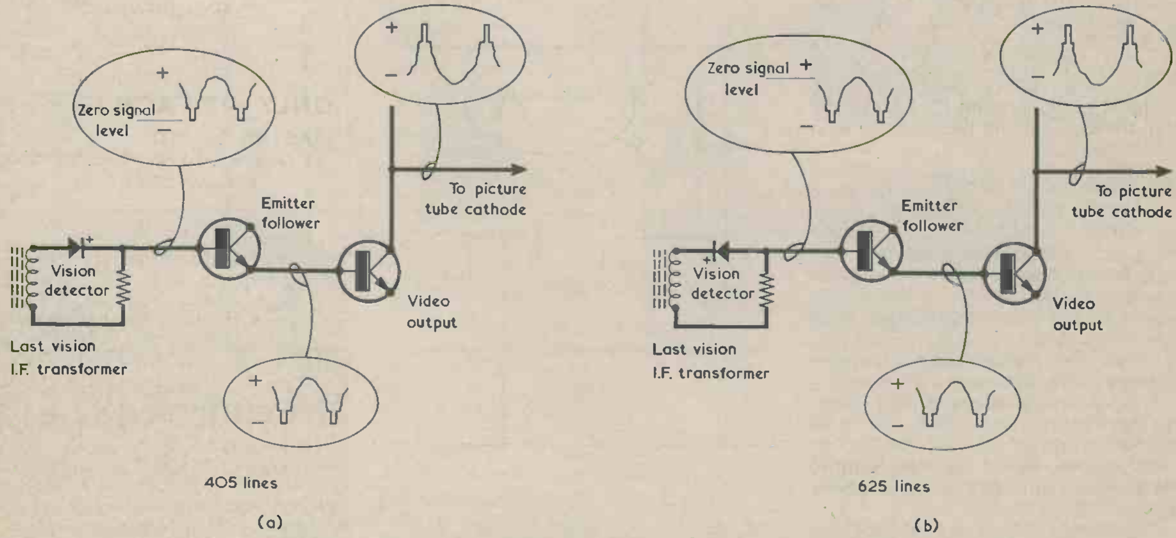


Fig. 4 (a). Waveform polarities relative to zero signal level in a directly coupled 405 line video amplifier
(b). With 625 lines the waveforms have the same polarities but the zero signal level point differs

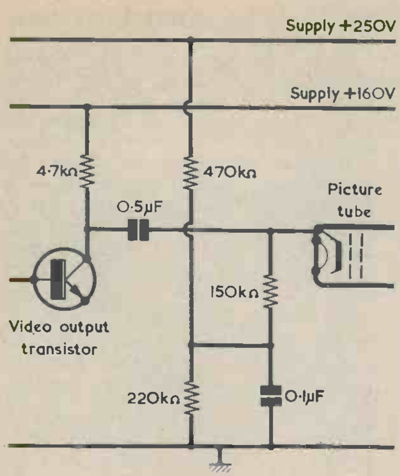


Fig. 5. A typical basic circuit incorporating an a.c. coupling between the video output transistor collector and the picture tube cathode. Component values are representative of commercial practice

in a minute," commented Dick sarcastically. "Or, perhaps, Sir would like me to hover around playing Hungarian music on my violin?"

Smithy made no answer and proceeded to make huge inroads into the roll.

"You're supposed to cut slices off a Swiss roll and eat them from a plate," commented Dick disdainfully. "Anyway, what's this business about beam limiting diodes?"

"Hang on a bit," replied Smithy.

He squashed the roll flat, took a bite across its entire width, then held the remainder out to examine it. About half the roll had disappeared. Satisfied, he folded the cellophane wrapping back over its edge and opened a drawer in his bench. From this, he took out a rubber band which he snapped neatly around the end of the roll, thereby holding the cellophane in position.

Carefully, the Serviceman placed the remainder of the roll on the shelf above his bench, beside his signal generator.

"That," he remarked contentedly, "will do to finish off my lunch tomorrow."

"At least," commented Dick, "you might have put that Swiss roll on the shelf so that its flat end pointed out into the room. The end that's pointing out now is all concave and semicircular with teeth-marks on it. It looks disgusting."

"Nonsense, boy," retorted Smithy. "What was it you were raving on about just now?"

"I wanted to know what these beam limiting diodes are all about."

"Did you now?" replied Smithy. "Well, I'll have to see if I can help you a bit there."

The Serviceman took another enormous draught of tea from his mug, and then walked over to the filing cabinet which held the service manuals. He selected one and then checked its circuit.

"Ah yes," he said. "This represents a good example. Come over to my bench and I'll show you a typical beam limiting diode circuit."

As Smithy returned to his bench, Dick picked up his stool and walked across the Workshop with it. He settled himself comfortably whilst Smithy placed the manual on the bench. The Serviceman indicated a section of the circuit in the manual. (Fig. 6).

"Now, here we are," he commented. "This is a typical example of a beam limiting diode circuit in a 625 line monochrome receiver. The diode is a silicon type and it's connected between the video output collector and the cathode of the picture tube. As you can see, it has a 0.2μF capacitor across it. There is also a cathode bias resistor of 330kΩ between chassis and the cathode. If there were no external connections here, the normal cathode current of the tube would cause a voltage to be dropped across the 330kΩ resistor. Its actual value would depend upon the other tube supply potentials and the setting of the brightness control, but for the purpose of explanation, let's say that the voltage is 80 volts."

"In other words," said Dick, "if no external connections were made to that tube cathode, it would settle down to a potential which is 80 volts positive of chassis."

"That's right," said Smithy. "The actual voltage figure will also vary for different makes of set, but 80 volts should be a reasonably representative figure. Let's next look at the circuit

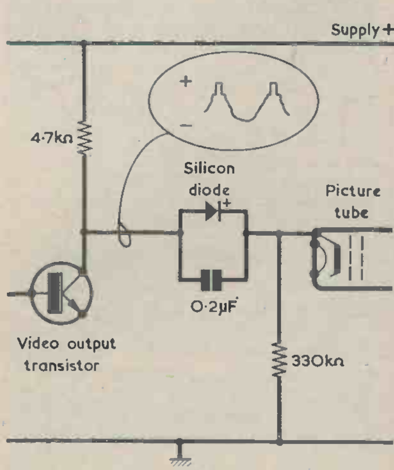


Fig. 6. A coupling circuit incorporating a beam limiting diode between the video output collector and the cathode of the picture tube

whilst the video output stage is handling a 625 line signal. With a standard mains-driven set, the video waveform at the video output collector could well be of the order of 60 volts peak-to-peak. We arrange things such that, with contrast and brightness controls properly set up, the collector of the video output transistor is always positive of the 80 volt potential which the tube cathode could otherwise take up, and with peak white taking the cathode very close to but not beyond that 80 volt potential. Since the video output collector is always more positive than the 80 volt figure we can make the assumption that the diode between the collector and the tube cathode is always conducting, thereby giving us an effective d.c. coupling between the collector and the tube cathode. Ideally, the sync pulses would take the tube into cut-off and, as I said just now, the peak white signal amplitude would take the tube cathode close to, but not beyond, its natural 80 volt figure."

"That seems fair enough," remarked Dick. "If we say that the series diode is conducting all the time we then have a true d.c. coupling to the tube cathode."

"Correct," said Smithy. "Let's next see what happens when the video signal is cut off. The video output collector will take up the 'whiter than white' potential and this will be lower than 80 volts above chassis. If the diode were not in circuit the collector would then pull the tube cathode negative by this amount, giving the very bright blank raster we referred to earlier. But, with the diode in circuit, all that happens is that it becomes reverse biased and the cathode potential cannot fall below the 80 volt natural figure. Thus, the tube screen goes up to full brightness but not to an excessive brightness. The diode will also, incidentally, prevent the flow of excess e.h.t. current if the brightness control happens to be set too high. Another mode of operation can be given in which the whiter parts of a video signal take the diode into non-conduction, with the result that these sections of the signal are a.c. coupled to the tube cathode by the 0.2μF capacitor. The blank raster given in the absence of signal will then be less bright than the peak white level."

A.C. COUPLING CAPACITOR

"Is that," asked Dick, "the main purpose of the 0.2μf capacitor?"

"It has another more important function," replied Smithy, "and that is to provide a low impedance coupling during periods in the signal when the diode is reverse biased. I assumed just now that the diode is always conducting when the video output collector is positive of the 80 volts level. However, this is not the case when the picture information causes the video output collector to go very rapidly from a positive to a negative level. Sudden swings in this direction are carried to the tube cathode by the 0.2μF capacitor and not by the diode. Don't forget that the cathode of a picture tube can have a capacitance of around 3pF or so to its heater, which is at chassis potential so far as video frequencies are concerned." (Fig. 7.)

"Well?"

"In consequence," said Smithy, "if you just had the series diode on its own that self-capacitance would prevent the cathode from going rapidly negative in step with the video output collector. All that would happen would be that the diode would become reverse biased and the cathode potential would fall at a rate given by the 3pF cathode to heater capacitance discharging into the 330kΩ cathode resistor."

"Here, come off it, Smithy. Don't tell me that a capacitance of 3pF is going to slow things up all that much!"

"Won't it?" retorted Smithy, stung by his assistant's disbelief. "All right then, what's the discharge time constant of 3pF and 330kΩ?"

"It's the time," replied Dick promptly, "taken up by the 3pF capacitor in discharging to 37 per cent of its initial value."

"Yes, I know that," said Smithy impatiently, "but what is it in actual microseconds?"

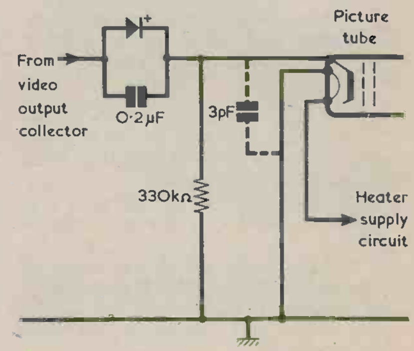


Fig. 7. The operation of the beam limiting diode circuit takes into account the stray capacitance (typically 3pF) which exists between the picture tube cathode and the heater

"Blimey Smithy, have a heart," protested Dick. "When I work out time constants I never go beyond ohms, farads and seconds!"

Smithy sighed.

"Fair enough," he replied resignedly. "Using the units you're familiar with, the time constant of 1 ohm and 1 farad is 1 second. But it's usually easier to work in megohms and microfarads and so we can also say that the time constant of 1 megohm and 1 microfarad is 1 second. This must be true because we're multiplying the ohm by a million and dividing the farad by a million. A picofarad is the same as a micromicrofarad, and in fact that's another word for the unit, and so the time constant given by 1 megohm and 1 picofarad is 1 microsecond. Okay?"

"Yes, I think so," said Dick doubtfully.

"I've divided the microfarads by a million and the seconds by a million."

"Ah yes," said Dick, his brow clearing. "I see it now."

"Good," remarked Smithy. "We've got 3pF here together with 330kΩ, which is a third of a megohm, rough check, and so the time constant works out at about 1 microsecond."

"Is that so very slow?"

"Of course it is," snorted Smithy. "Dash it all, Dick, the *lowest* frequency gratings in the 625 line colour test card are at 1.5MHz, which means that a whole cycle at this frequency, along each horizontal line on the tube screen, takes up less than 1 microsecond. If you had a time constant of more than 1 microsecond at the tube cathode, you wouldn't get even these gratings resolved."

"Blimey," said Dick, impressed. "I hadn't realised that a capacitance of only 3pF could cause so much trouble."

"Fortunately," said Smithy, "it doesn't when the 0.2μF capacitor is connected across the beam limiting diode. What happens then is that when the video output collector goes quickly positive, it is the diode which offers a low impedance path to the picture tube cathode, and when the video output collector goes quickly negative it is the 0.2μF capacitor which provides the low impedance path to the tube cathode. And that is pretty well all there is to tell you about the beam limiting diode circuit."

"Well," said Dick, "you've certainly cleared it up very nicely."

"No more questions?"

"None at all," replied Dick. "In fact you seem to have covered everything I can possibly think of."

"Good," commented Smithy, pleased. "It's pleasant to think that, for once, you've run out of technical questions!"

EXPIRED DATES

Dick got ready to leave Smithy's bench, then glanced up at the half-consumed Swiss roll on the shelf laongside the signal generator. It presented a lacerated end depicting a jam spiral of markedly elliptical form.

"That Swiss roll looks horrible," commented Dick, reaching up. "I'm going to turn it round."

He picked up the roll, idly glancing at its cellophane wrapping as he did so.

"Hallo," he remarked, "what's this?"

"What's what?"

"The printing on this cellophane. It says 'Sell by 4th February'."

"Well?"

Smithy's voice betrayed a worried undertone.

"Blimey, we're well into April now, Smithy. That roll should have been eaten a couple of months ago."

Dick spied the wrapping from Smithy's pork pie in the waste bin and quickly fished it out.

"Gosh, this is worse. The wrapping paper here says 'Sell by 11th January'."

Smithy grabbed the paper feverishly and examined it closely.

"Ye gods, so it does. That pork pie was getting on for three months old, and I've just gone and eaten it!"

A colour television engineer, looking at Smithy's face at the moment, would have diagnosed almost complete failure of the red and blue drive circuits.

"Where did you get that pie and Swiss roll, Smithy?"

"At Joe's Caff," groaned Smithy hopelessly. "I bought them on the way to work."

"Then you *were* asking for trouble," commented Dick briefly. "*Nobody* buys things like that at Joe's Caff. They say he incubates penicillin cultures in his meat pies for the local hospital."

"Food manufacturers shouldn't darned well date-stamp their products like this," complained Smithy wretchedly. "In the old days you just scoffed their stuff without any worries and that was all there was to it. Putting date-stamps on food is interfering with Nature."

Dick turned a clinical glance on the stricken Smithy.

"Is there anything I can get you?"

There was no reply.

"Sodium bicarb?"

"No thanks."

"Some grass?"

"Grass?"

"Dogs eat grass when they feel sick."

"I don't feel sick. I just feel poisoned."

"Ah, a stomach pump, then."

The Serviceman's eye fell on his tin mug.

"*That*," he exclaimed desperately, "is what I need. Make up some more tea, Dick, pints of it!"

And thus it was that Smithy was able to neutralise whatever substances he had unwittingly ingested, having been warned, albeit almost too late, of their possible noxious content. For Smithy had utter faith in tea as the sovereign remedy for all ills.

And we all know what faith can do. ■

Radio Topics

By Recorder

I always look upon the 240 volt a.c. mains which wanders around our houses as being a source of quite definite danger. What is more, it imposes on those of us who are technically minded a moral responsibility to ensure that all mains-driven equipment is reliably maintained and, where applicable, properly earthed.

To give an example of what can occur, an aunt of mine complained to me recently that her electric smoothing iron gave her a 'tingling sensation' whenever she touched its metalwork whilst it was switched on.

NO EARTH

Rather to my horror, she said that she had been experiencing this tingling effect for quite a few months. Since she uses the iron in a kitchen which is fitted with a large gas oven and a sink with cold and hot water taps, all offering low resistance earth points so far as shock is concerned, there was a good chance that the iron metalwork had become live and that, up to the time she was telling me about the trouble, she had had the good fortune not to touch the metalwork of the iron with one hand and any of the many earthed objects in the kitchen with the other. I told her not to use the iron any more until I'd seen it and I popped over to have a look at it that very evening.

I felt a certain easing of mind when I saw that the flex of the iron was terminated in a standard 13 amp B.S.1363 3-way plug. It was, at least, 'officially' earthed. There are still far too many smoothing irons knocking around which are simply plugged into a 2-way bulb holder and have no earth connection at all.

I had my meter with me and I soon found that there was no continuity at all between the earth pin of the plug and the metalwork of the iron. As it happened, the live and neutral wires were fully isolated from the metalwork and so the tingling must have been just the result of capacitive leakage, mainly between the element and the sole of the iron. Further checking revealed the cause of the fault: the earth terminal screw and nut on the iron itself were simply not in electrical contact with the metalwork at all.

The reason for this state of affairs soon became apparent as I dismantled the iron. The earth terminal screw passed through a steel plate at the rear of the iron, and both of these had rusted so badly that the screw and its nut had become completely insulated from the steel plate.

Now, here was a problem. If all the rust were cleaned away from the steel plate and a new bolt of suitable size fitted, then there would be an earth connection once more. But for how long? Once it had commenced rusting that steel plate was bound to continue rusting and, no matter how tightly the new earth terminal was fitted, the rust would inevitably creep over the steel plate surface under the bolt head and nut and break the earth connection once more. I could, perhaps, fit spring washers with points which would dig into the bolt head, the nut and the steel plate, but even this idea didn't appear to me to be particularly attractive as a long term solution.

DILEMMA

This is one of those dilemmas which raises the moral responsibility I mentioned at the beginning. I could fix the iron for the time being but would then have the nagging feeling that, after a year or two, the earth connection could once more become open-circuit. An internal short-circuit to the metalwork would not then blow the fuse in the plug and could cause the iron to become quite literally a death-trap.

Fortunately my aunt, whilst not understanding the technicalities of the situation, was quite prepared to accept the fact that the iron was potentially dangerous. Much to my relief she went out next day, bought a brand new iron and consigned the old one, which had admittedly given many years of good service, to the dust-bin. My reputation as a repairer may not have been enhanced by this incident but the outcome certainly saved me quite a little worry!

Some people may think I am a bit too fussy about electrical safety, but I have had one or two very nasty shocks myself from the ordinary mains supply and I didn't like them one little bit. I have also encountered an incident where a man was electrocuted whilst using an unearthed electric drill on a corrugated iron roof. Perhaps the most hair-raising story I've heard occured some years ago. A young man took an a.c./d.c. mains radio with a live chassis and with the wave-change knob missing into the bathroom. Whilst he was actually in the bath he attempted to turn the metal wave-change switch spindle with a pair of uninsulated pliers and was, of course, killed instantly.

The 240 volt mains supply is deadly dangerous and it is foolhardy to pretend that it is not. Remember that there must always be two points or areas of contact to produce a shock, one being at a mains live potential and the other being earth or the mains neutral. A concrete floor, incidentally, offers a connection to earth that is, so far as shock is concerned, nearly as low in resistance as an earthed metal surface. When working on a concrete floor, or out in the open, never rely on the fact that you are wearing rubber or plastic soled shoes. These can easily become sufficiently damp to allow the passage of a shock current.

There is only one answer to the shock hazard and that is to maintain a continual guard against it all the time.

TERMINOLOGY

Turning to lighter matters, a hoary old gag in the R.A.F. was concerned with the odd aircraft fitter who was somewhat dimmer and slower than his mates. Such a type would be universally referred to as 'Rigger Mortis'.

But we must move with the times. A similarly sluggish character is employed on a local work-site near to me. His co-workers have re-christened him 'Action Replay'. ■

"Bit unusual, but I think the trouble is rising damp!"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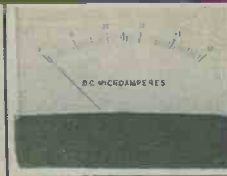

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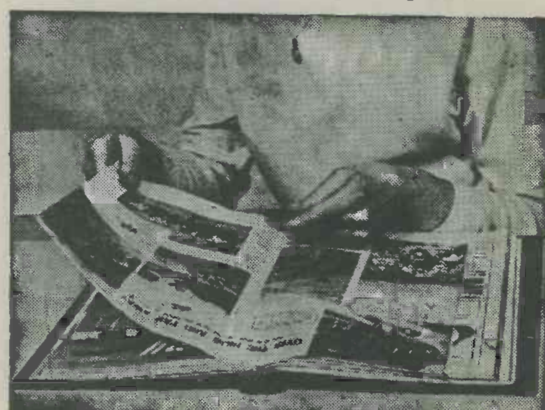

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Resistance of Metals

The Table lists resistivity (i.e. resistance of a standard cube) relative to that of copper at unity of metals encountered in electronics, together with their temperature coefficients per degree C. The temperature coefficients are positive except where zero is shown, whereupon the coefficient is plus or minus a small number. Constantan, Electrum (German silver), Eureka, Manganin and Nichrome are resistance wire alloys. All figures are approximate, particularly with brass and phospher-bronze where alloy constituent proportions are not precisely defined. With elemental metals approximations are necessary due to small variations resulting from different levels of purity and methods of metal production. Also, resistance wire alloys may be manufactured in different grades.

Metal	Relative Resistivity	Temperature Coefficient	Metal	Relative Resistivity	Temperature Coefficient
Copper	1.0	0.0039	Manganin	26.0	0
Aluminium	1.6	0.0045	Mercury	57.0	0.00089
Brass	4.1	0.003	Molybdenum	3.4	0.004
Cadmium	4.5	0.004	Nichrome	64.0	0.0001
Cobalt	5.5	0.003	Nickel	5.7	0.005
Constantan	29.0	0	Phosphor-bronze	6.0	0.004
Electrum	18.0	0.0003	Platinum	6.2	0.004
Eureka	28.0	0	Silver	0.96	0.004
Gold	1.4	0.0034	Tantalum	9.1	0.003
Iron	5.9	0.006	Tin	6.8	0.004
Lead	12.0	0.004	Tungsten	3.3	0.004
Magnesium	2.7	0.004	Zinc	3.5	0.0035