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VOL. 52 NO. 11
ISSUE 841
MARCH 1977

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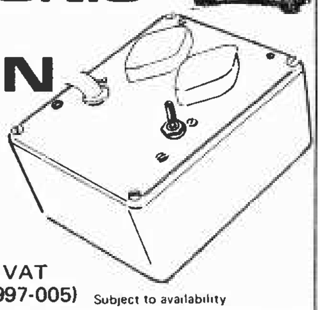

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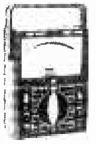

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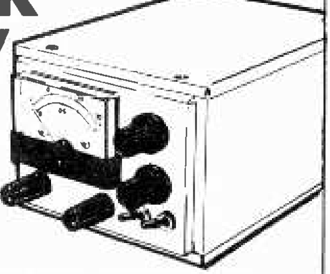

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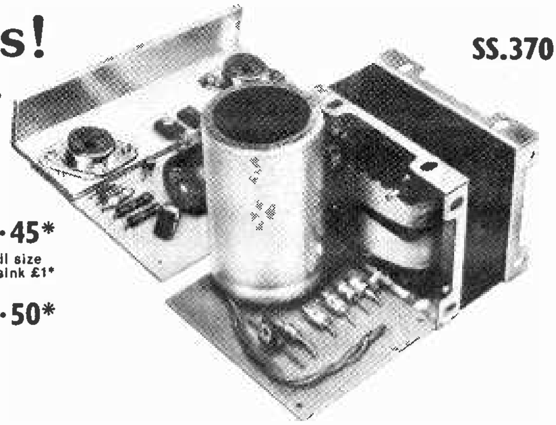

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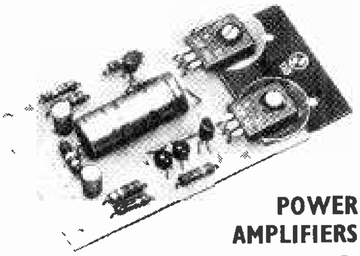

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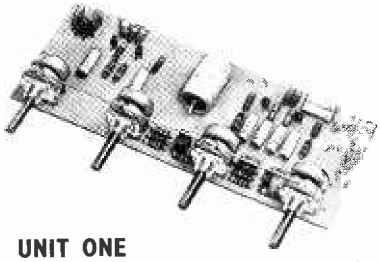

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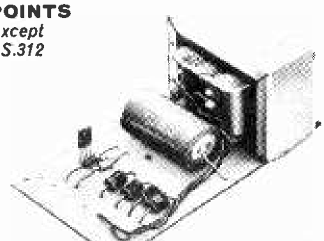

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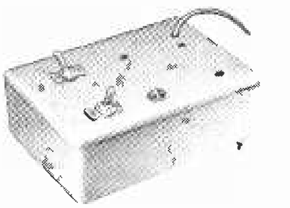

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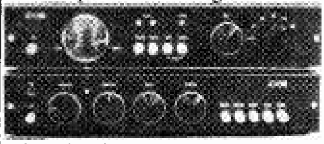

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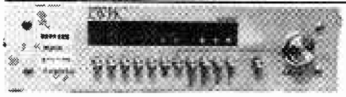

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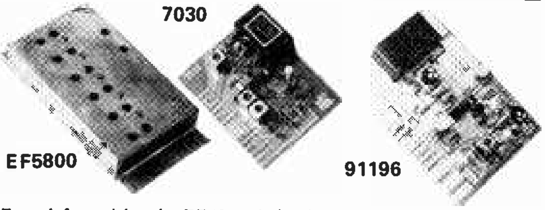

From left to right, the EF5800 6 circuit varicap FM tunerhead. Two MOS RF stages, both with AGC control, and an ultra stable oscillator. Next the 7030 Linear Phase 10.7MHz IF. Distortion 0.08%, muting, AGC, meter, auto stereo switch outputs. Finally the new 91196 mpx decoder and combined birdy filter. Mono THD 0.05%, stereo sep. 55dB at 1kHz, 42dB at 10kHz - the best decoder module yet.
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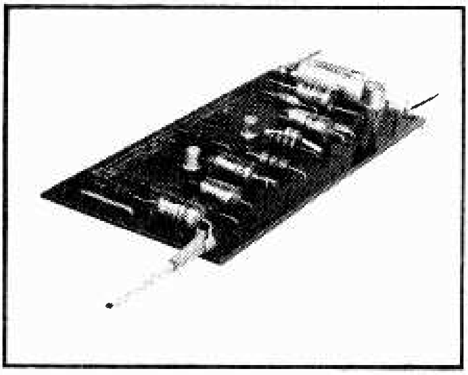

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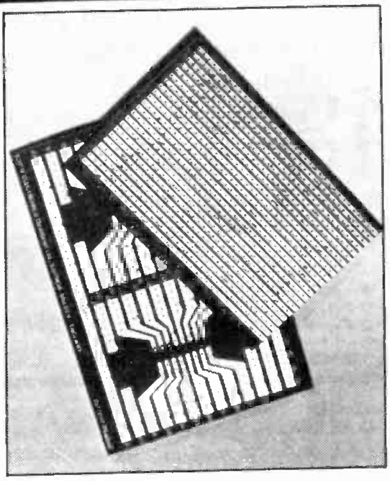

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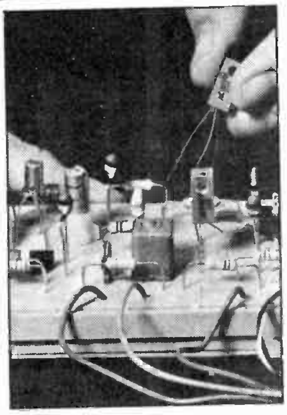

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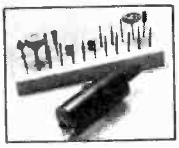

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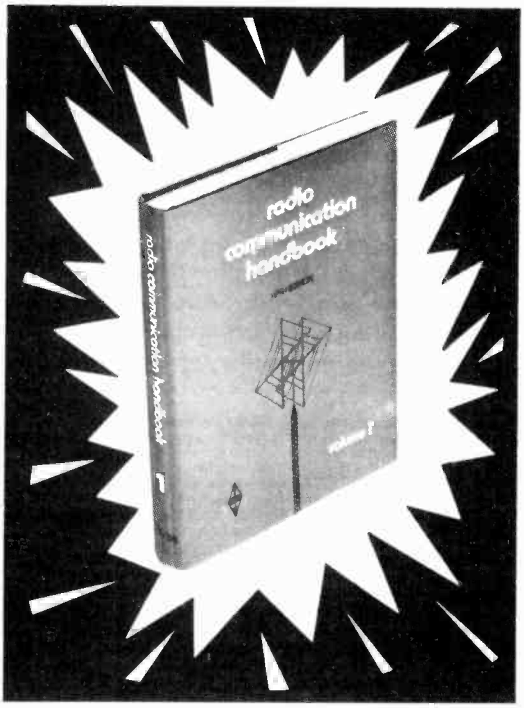

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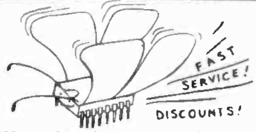

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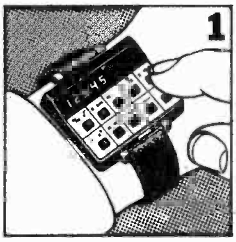

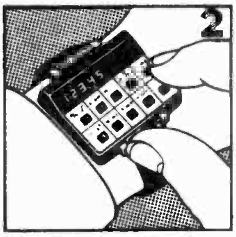

1. The switch in its normal, central position. With the switch centred, numbers – which make up the vast majority of key-strokes – are tapped in the normal way
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The display uses 8 full-size red LED digits, and the calculator runs on readily-available hearing-aid batteries to give weeks of normal use.

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The wrist calculator kit comes to you complete and ready for assembly. All you need is a reasonable degree of skill with a fine-point soldering iron. It takes about three hours to assemble. If anything goes wrong, Sinclair Instrument will replace any damaged components *free:* we want you to enjoy assembling the kit, and to end up with a valuable and useful calculator.

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Display.
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The wrist-calculator kit is available only direct from Sinclair Instrument. Take advantage of this 10-day money-back undertaking.

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7403	0·11	0·10	7453	0·12	0·10	74145	0·75	0·72
7404	0·11	0·10	7454	0·12	0·10	74150	1·10	1·05
7405	0·11	0·10	7460	0·12	0·10	74151	0·65	0·60
7406	0·28	0·25	7470	0·24	0·23	74153	0·70	0·68
7407	0·28	0·25	7472	0·20	0·19	74154	1·20	1·10
7408	0·12	0·11	7473	0·26	0·22	74155	0·70	0·68
7409	0·12	0·11	7474	0·24	0·23	74156	0·70	0·68
7410	0·09	0·08	7475	0·44	0·40	74157	0·70	0·68
7411	0·22	0·20	7476	0·26	0·25	74160	0·95	0·85
7412	0·22	0·20	7480	0·45	0·42	74161	0·95	0·85
7413	0·26	0·25	7481	0·90	0·88	74162	0·95	0·85
7416	0·28	0·25	7482	0·75	0·73	74163	0·95	0·85
7417	0·26	0·25	7483	0·88	0·82	74164	1·20	1·10
7420	0·11	0·10	7484	0·85	0·80	74165	1·20	1·10
7422	0·19	0·18	7485	1·10	1·00	74166	1·20	1·10
7423	0·21	0·20	7486	0·28	0·26	74174	1·10	1·00
7425	0·25	0·23	7489	2·70	2·50	74175	0·85	0·82
7426	0·25	0·23	7490	0·38	0·32	74176	1·10	1·00
7427	0·25	0·23	7491	0·65	0·62	74177	1·10	1·00
7428	0·36	0·34	7492	0·43	0·35	74180	1·10	1·00
7430	0·12	0·10	7493	0·38	0·35	74181	1·90	1·80
7432	0·20	0·19	7494	0·70	0·68	74182	0·80	0·78
7433	0·38	0·36	7495	0·60	0·58	74184	1·50	1·40
7437	0·26	0·25	7496	0·70	0·68	74190	1·40	1·30
7438	0·26	0·25	74100	0·95	0·90	74191	1·40	1·30
7440	0·12	0·10	74104	0·40	0·35	74192	1·10	1·00
7441	0·60	0·57	74105	0·30	0·25	74193	1·05	1·00
7442	0·60	0·52	74107	0·30	0·25	74194	1·05	1·00
7443	0·95	0·90	74110	0·48	0·45	74195	0·80	0·75
7444	0·95	0·90	74111	0·75	0·72	74196	0·90	0·85
7445	0·80	0·75	74118	0·85	0·82	74197	0·90	0·85
7446	0·80	0·75	74119	1·30	1·20	74198	1·90	1·80
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LEND A HAND

It may be supposed that the great majority of our readers are reasonably sound in wind and limb and able to move around, more or less freely, under their own steam. They can look at a project in the magazine, decide to make it and then jump into their car, or take a bus, and go and get the parts that they need. If they are very lucky and don't live in London or one of the other big cities then they can pop down to the local postbox and send off their order to one of our advertisers.

Having just received the latest copy of *Radial*, the magazine of the Radio Amateur Invalid and Bedfast Club, I am reminded that there are those among us who are not quite so fortunate. Some who are very enthusiastic licensed radio amateurs or listeners but who are handicapped in one way or another and must rely upon others to set up and maintain their gear and aerials. But can you imagine the joy that these people derive from being able to communicate with or listen to other amateurs from all over the world?

The Club is very active and prospering under the Presidency of Bill Browning G2AOX and his committee but it must be remembered that it is the ordinary healthy member who is so important and on whom so much depends. One such recent recruit was Ken Alford G2DX (what a fabulous call!) who at 83 feels he ought to be helping the youngsters, no doubt!

How many of our readers have bits of equipment or, in particular, short wave receivers, knocking about in the attic or garden shed that could be put into good working order and handed over to the RAIBC without a great deal of trouble? Many, for sure. So even if you don't want to join the Club you can still help in a very practical way those who are generally unable to help themselves.

If you do help you will certainly feel a little glow of satisfaction after having done your bit and may even be tempted to carry on the good work. It might even mean a couple of hours less spent working the DX from your own rig but it will be worth while. After all, conditions aren't so good all the time! If you feel that you want to become involved write in the first instance to RAIBC Secretary Harry Boutle G2CLP of 14 Queen's Drive, Bedford and he'll put you on to the right track. Now, where's that loft ladder?

If you'd like to hear the RAIBC boys on the air try 3750kHz SSB at 1000 on Tuesdays or 1400 on Wednesdays when the Net controller is G3WJT or perhaps the Cheshire Homes Net around 3650 to 3700kHz SSB at 1330 on Thursdays when the MC is G3OPY.

Member Tony G4BPX summed it up very well, in an article in *Radial*, when he said 'In thinking with and for less able friends for over twenty years I have become less handicapped myself' Think about it!

Eric Dowdeswell—*Assistant Editor*

This issue contains the first of the free PW Info-Cards, on Resistors and Capacitors, see page 938. The second Info-Card will be given away with the May issue of PW and will deal with Semiconductors.

DON'T MISS IT!

NEWS...

Polling time

THE International Short-Wave Club is now holding the tenth in its series of official polls which have been held every three years since 1950 to determine, in the listeners opinion the most popular short-wave Broadcasting stations. The poll began on November 1st, 1976 and will continue until February 28th, 1977. In order to enter, write on a postcard your five favourite Short-Wave stations, in order of preference, and add in not more than 30 words, the reasons for your first choice.

Results will be published in the April issue of the ISWC and announced by many stations. Further information from *Mr G. C. Gibbs, 118 Bournemouth Park Road, Southend-on-Sea, Essex, SS2 5LS. Please enclose an SAE with all correspondence.*

New licence explained

FROM January 1, 1977, the Home Office has been issuing four new types of radio amateur licence which have replaced all existing amateur licences when they become due for renewal.

The new Amateur Licence A (full facilities) and B (having certain limitations) will include all those facilities available to holders of the existing Amateur (Sound) Licences A or B, and will also include operation from a vehicle, or vessel other than at sea, or as a pedestrian. Fascimile, amateur television, slow scan television, data on amateur bands 144-146 MHz and above, as well as double sideband suppressed carrier operation will also be included. Emergency County Planning Officers will also be added to the categories able to call upon Raynet (emergency communications).

The purposes of the new-style licences are:

(1) to give more flexibility to

NEWS... NEWS... NEWS...

British radio amateurs, so that they may pursue their hobby without having to make special application for several of the above facilities at present needing separate licences or authorities.

(2) to enable the Home Office to deal with the increase in applications for amateur licences and regulatory work over the next few years with the minimum delay.

Existing facilities authorised by a total of 20 licences and special authorities will thus be contained (with a few exceptions) in the new Amateur Licence A or B; and for Aliens combined fixed and mobile facilities in the Amateur Licence C or D. The new fee for all UK amateur licences will be £5·50.

Catkin, Red E, Trigatrons . . . !

AT a recent meeting of the University College of North Wales ARS John Lawrence, GW3JGA, gave a talk on the "Development of the Radio Valve" and showed part of his collection of historic radio valves. On display were over 200 valves covering the 60 year period from 1915 to 1975.

The pre-war range included an "R" triode, AOR triodes, early indirectly-heated valves, screen grid types, "Catkin", Mullard "Red E" and Mazda octal versions. The wartime range included klystrons, trigatrons, magnetrons (including a MAG1) and a range of unusual disc-seal triodes which were used in early radio-location equipment. The wartime and post-war types included many transmitting valves, one of the latest vapour cooled triodes on show being rated at 60kW CW output.

Smaller types such as acorns, deaf-aid valves and Nuvistors were also included. In addition to valves a number of opto-electrical devices, photo-cells, camera and convertor tubes were on display. To give a cheery atmosphere to the meeting, two large VT31 tetrodes were set up with their directly-heated filaments glowing brightly (filament rating 10V 10A).

Navy days

ACTIVITY period from HMS *Belfast*, in the Pool of London, 8th to 17th April. Call sign will be GB3RN.

Mobile Rally at HMS *Mercury*, nr. Petersfield, Hants. Sunday, 19th June.

Navy Days at Portsmouth and Plymouth dockyards, 27th, 28th and 29th August. GB3RN and GB3GUZ.

Jamboree-on-the-Air Camp and Radio Teach-In at HMS *Mercury*, 15th and 16th October.

Annual General Meeting at HMS *Mercury*, nr. Petersfield, Hants, 22nd October.

For further details or membership details of the RNARS write to M. J. Matthews, G3JFF, Hon. Secretary, HMS *Mercury*, East Meon, Petersfield, Hants.

Spring show

A SHORT note here for those readers who attend, or would like to attend the All-Electronics Show which is held annually. This year's show promises to be as successful as those in the past, and will be held at Grosvenor House, Park Lane, London W1 on the 19th-21st April. Watch this page in the coming months for more news on this exhibition.

Teach-in

THE Department of Electrical Engineering Science at Essex University will be holding its annual Electronics Summer School for teachers during the week July 11-15, 1977. Two courses will be run simultaneously. The Linear Circuit Design course is concerned with the use of transistors and operational amplifiers in analogue applications and the basic circuits of a HiFi amplifier will be investigated in detail. The Digital Circuit Design course concentrates on the use of the transistor as a switch and develops design using integrated logic circuits.

Further information from: *R J. Mack, Department of Electrical Engineering Science, University of Essex, Wivenhoe Park, Colchester CO4 3SQ, telephone Colchester (0206) 44144, extension 2408 or 2299.*

Circuits for AUDIO AMPLIFIERS

PART 1

F. G. RAYER G3OGR

THE circuits in this series are intended to give practical essential information for the construction of pre-amplifiers, mixers, tone-controls, low-level and Class A output stages as well as various types of push-pull output stages and IC audio amplifiers. Some circuits can be added to existing equipment, or require few components and can be constructed as separate units. Others are more ambitious.

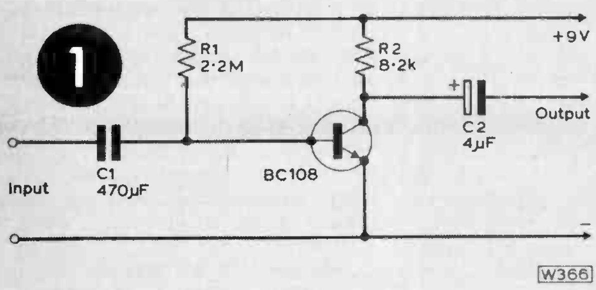
The simpler circuits can be assembled on tag-board but for the larger circuits Veroboard can be used, or printed circuit boards can be prepared. Copper-clad board and the other necessary materials for this purpose are readily obtainable. Numerous cases and cabinets suitable for housing the finished equipment are available and they can include space to accommodate the battery or AC power pack, as appropriate. Input and output sockets and controls can be mounted on the case panel, as well as brackets to carry the circuit board.

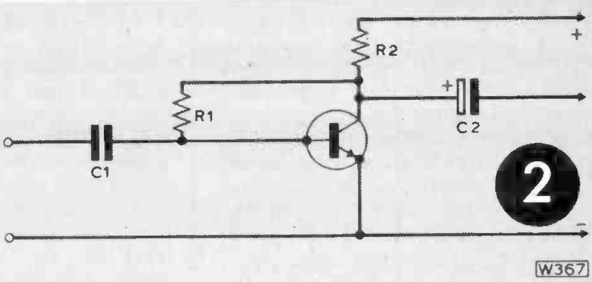
The circuits here employ both negative and positive "earth" or chassis line. This will prove to be convenient when new equipment has to suit existing units. Some circuits are readily adapted for either negative or positive earth though, in general, the positive earth is more likely to be found with older amplifiers employing PNP transistors.

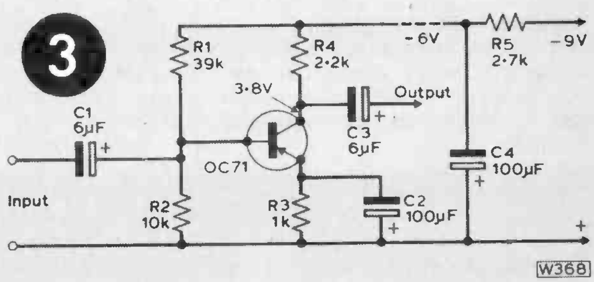
LOW-LEVEL "CLASS A" STAGE

A Class A stage is one which is required to amplify the whole audio cycle. The output from the stage should be as faithful a copy of the input as possible, unless some deliberate frequency correction has been made. A pre-amplifier or early audio stage should introduce as little noise as possible, as this would be amplified by later stages. Typical Class A low-level stages include pre-amplifiers and the early stages of an amplifier.

Fig. 1 is a simple low-level Class A stage. Resistor R1 furnishes base bias and the NPN transistor is used as a grounded emitter amplifier. This particular circuit can be used by itself or in simple equipment, but lacks any form of stabilisation. As a result, collector current and operating conditions could vary considerably due to spreads in transistor characteristics, changes in temperature or variations in voltages. It is thus necessary with this circuit to limit base and collector currents to low levels. This circuit can be modified by taking R1 to the collector, Fig. 2. This provides a useful degree of stabilisation since base current through R1 depends on collector voltage, as well as on the value of R1. Component values may be as in Fig. 1.







The circuit of Fig. 3, which has a positive earth line, is stabilised. Resistors R1 and R2 form a potential divider setting the base operating point. R3 is the emitter bias resistor and R4 the collector load. With the PNP transistor, the base will be slightly negative, relative to the emitter. Should transistor spread, supply voltage or a rise in temperature cause collector current to be unusually high, the voltage drop across R3 rises due to the increased emitter current. The emitter moves negative, so that the base is relatively less negative with respect to the emitter than before, thus reducing collector current.

Should conditions result in an unusually low collector current, the reverse happens. The voltage drop across R3 is reduced. The emitter thus moves positive, so that the base is relatively more positive and this tends to maintain collector current. In this way stable, satisfactory working conditions are maintained.

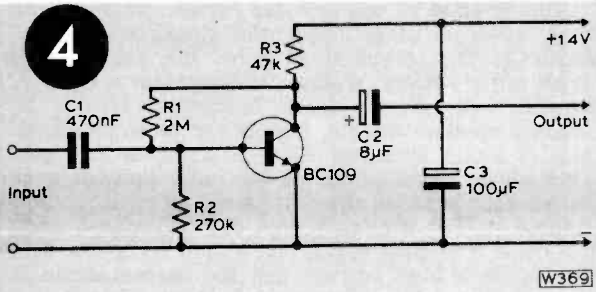


Fig. 4 is another low-level amplifier, using a low-noise NPN transistor and it may be used to boost low-level inputs. The 14V supply line is not essential and R3 may be reduced in value with lower voltages, good results being obtained with 6V or less if necessary.

TONE CONTROLS

Tone controls may curtail or emphasise treble or bass, according to the circuits used, and are employed to obtain more satisfactory tonal balance or to compensate for recording characteristics, speaker deficiencies or other factors.

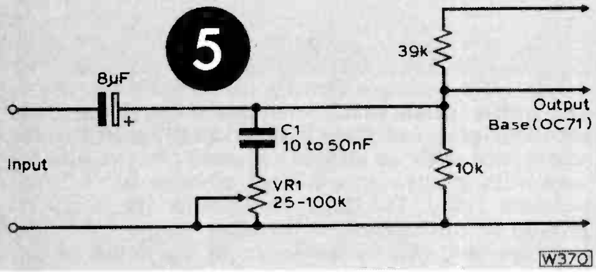
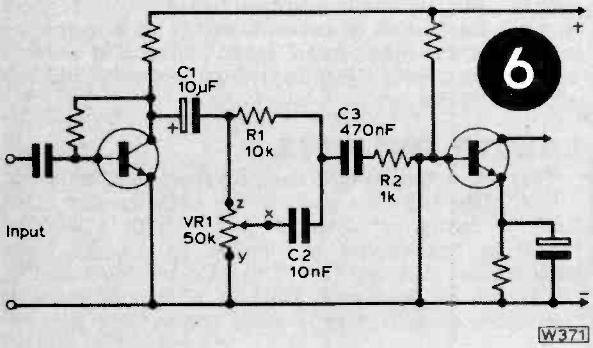
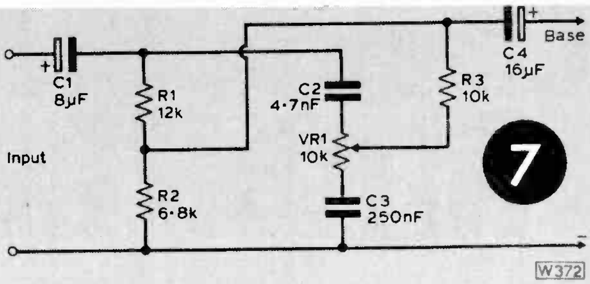


Fig. 5 is a simple top-cut control, treble response being curtailed as the value of VR1 is reduced. The values shown are not critical. Such tone controls should not be added to a stage over which negative feedback takes place but to an early stage outside the feedback loop.

The reactance of a capacitor falls as frequency rises. In Fig. 5 C1 has a lower reactance to high frequencies, so that their amplitude is reduced at the transistor base. This change of capacitor reactance

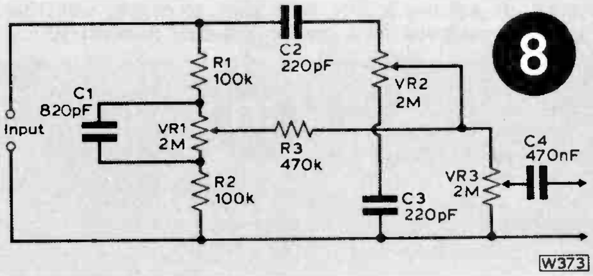




with frequency is generally used in tone control circuits. Cutting treble and turning up the amplifier gain effectively increases the bass frequencies.

Fig. 6 is a circuit in which the potentiometer VR1 allows top frequencies to be cut when slider X is moved towards Y (similar to Fig. 5). However, when X is moved towards Z, C2 is increasingly effective across R1, to lift treble response. These and similar circuits can often be placed in existing equipment. Base, emitter and collector resistors are as for the stage without tone control.

Fig. 7 is another tone control for an early stage. R1 and R2 form an audio potential divider for C4 and the base of the following stage. VR1 provides best bass reproduction when adjusted towards C3 and best treble response when towards C2. Fig. 8 also controls bass and treble but has individual potentiometers. It can be fitted before the first stage if required. VR1 is the bass control and VR2 is for treble. VR3 is the volume control. This is a purely



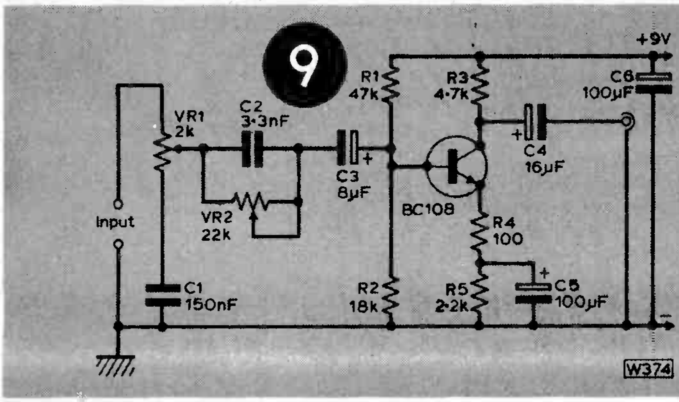
passive circuit which may be assembled in a metal screening box and requires no battery.

Circuits such as these can often be added to existing amplifiers without difficulty as they do not upset the DC working conditions. Some extra gain may be needed to compensate for losses in the tone control circuit when this does not incorporate a transistor. All values can be considerably modified, though there is no point in providing extremes of bass or treble which will never be wanted.

PRE-AMP WITH TONE CONTROL

Fig. 9 is a circuit of a pre-amplifier which incorporates two variable tone controls, VR1 is for treble cut and VR2 for bass cut. A volume control may be incorporated between VR1 and the input circuit, if required. Such a stage is useful when the main amplifier lacks sufficient gain for some particular purpose. This circuit also allows tone controls to be provided as well, with no changes to the main amplifier. If a pre-amplifier is operated from its own battery, no difficulties of hum or coupling through the power supply can arise.

When operation is required from the same supply as the main amplifier, a decoupling resistor is added



in the positive supply line, between C6 and the supply circuit. As most amplifiers will be operated from the mains these components (resistor and C6) also help to assure a smooth, hum-free supply for this stage.

A pre-amplifier can have circuits designed for various inputs such as for radio, or for moving-coil or crystal microphones. These may be selected by switching.

INPUT IMPEDANCE

Tuners, crystal pick-ups and other inputs are best operated into loads of a particular impedance. This is not too critical for general purposes but becomes important for improved fidelity. A suitable impedance is frequently obtained with a resistor network. It causes a loss in signal strength, but this is easily restored by a pre-amplifier, if necessary.

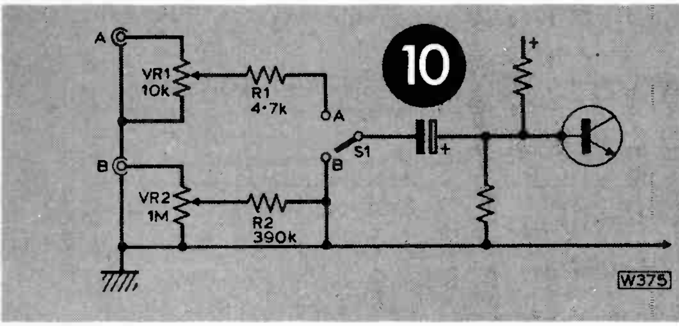


Fig. 10 is a circuit having two inputs, "A" is of relatively low impedance for a radio tuner, pre-amplifier and other inputs of around 10kΩ impedance. Input "B" is more suitable for a crystal pick-up and other high impedance inputs, where a low impedance would reduce frequency response. Individual volume controls VR1 and VR2 can be set to suit the signal levels provided.

INPUT LEADS

The microphone, pick-up or other input leads to the pre-amplifier and amplifier must be screened. So must the inter-connecting audio circuit leads from pre-amplifier, tuner or other units to the main amplifier. The purpose of such screening is to avoid pick-up of hum or other currents induced from adjacent circuits, which, if introduced into the input circuit would be amplified and accompany the signal or cause instability.

The screened leads are fitted with jack plugs or other audio-type connectors to match the equipment. The outer conductors of the leads form the earthed or chassis return, but should not be used to carry power between units.

"CLASS A" OUTPUT

The addition of one or more further stages to the first, low-level stage raises the signal level, eventually to that required to drive the loudspeaker. With a dry battery, a single transistor as a Class A amplifier can provide ample headphone volume, or modest speaker volume, mainly for personal listening. A single transistor Class A amplifier can give very much higher power in car radio equipment or in mains-operated circuits where current is not limited to that available from dry batteries. Powerful Class A circuits require an output transistor able to handle a high current and the current drain is greater than with an equivalent power Class B output stage (described later). For this reason large Class A stages are not used in battery operated receivers or amplifiers.

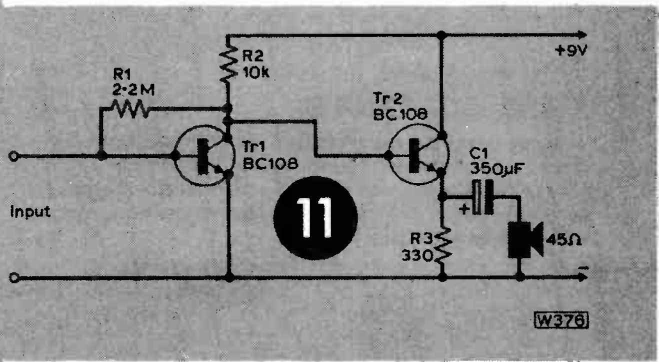


Fig. 11 is a simple directly coupled 2-stage amplifier with a small Class A output stage. It provides excellent gain and gives a surprisingly good volume when used with an efficient speaker. It can also be used with phones or a midget speaker for a small personal radio. The input is suitable for a crystal pick-up or microphone. With other inputs, an isolating capacitor will be necessary in the input circuit so that bias conditions (via R1) for Tr1 are not upset.

Tr2 is an emitter follower, with grounded collector. The collector is earthed as far as audio signals are concerned, as the battery supply is considered to have zero impedance. DC operating conditions for Tr2 are not upset by the speaker resistance as C1 isolates the speaker, but results are best if the speaker is of moderately high impedance.

When a Class A stage is operating properly, a milliampmeter placed in the supply circuit should show no significant change of current with varying signals. But in small amplifiers like Fig. 11 there is some fluctuation of current, except at low volume levels. On the other hand, large changes in current are expected with Class B push-pull circuits and are quite in order.

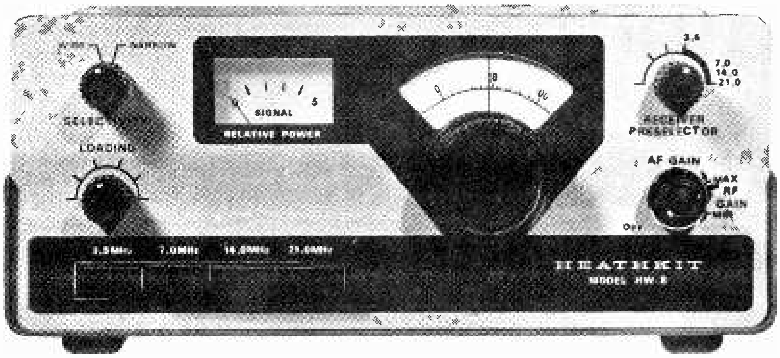
LARGER OUTPUTS

Class A output stages running from accumulators, about 12 to 14V, are popular for vehicles and often have a rating of about 2 to 5W with a current drain in the region of 400mA to 1A. A large power Class A stage for 12 to 14V is shown in Fig. 12. It can be used with PNP or NPN transistors of the OC26 or BD121 type with appropriate polarity

continued on page 927

SPECIAL PRODUCT REPORT

HEATHKIT



HW8 QRP TRANSCEIVER

Many thousands of radio amateurs were introduced to the thrills of operating with low power CW when Heathkit thought up the earlier HW7 transceiver. However that did not have the 80 metre band available, a sad omission in these days of low sunspot activity. There was no gain control on the RF side and there was separate dial calibration for each of the three bands. On the credit side, it was possible to plug in a crystal for fixed frequency operation, a facility lacking on the HW8.

But what is 'low power'? In the USA, 100W or so is spoken of as low power, which it probably is when one considers their maximum licensed power. I prefer to go along with our ideas over here, which is something below 10W input, although there are many enthusiasts who use, and get good results from, a few hundred milliwatts.

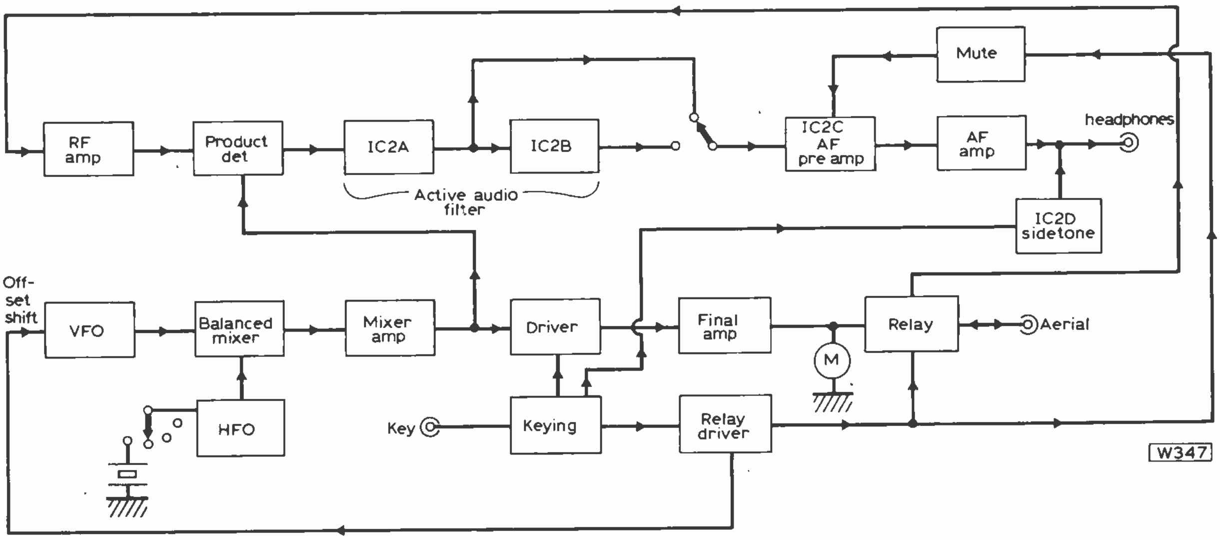
DESCRIPTION

The HW8 transceiver is designed to work from a nominal 12VDC supply, in practice from a car battery if in the field or from a mains unit if at home or in a hotel on vacation. In either case the actual input voltage will be nearer to 13·4V. On transmit the HW8 provides an input of around 3W on CW on the bottom 250kHz portion of the 3·5, 7, 14 and 21MHz bands. The output impedance is fixed at 50Ω with an output loading control on the front panel, coupled with a relative output meter. The receiver uses the direct conversion technique, as did the HW7, and as well as having an RF stage it has a switchable two-stage active filter giving audio bandwidths of 375 and 750Hz (6dB) at 750Hz. In use this means that SSB is just about uncopyable which is rather a pity, although only CW can be transmitted. The two modes are far from incompatible.

THE CIRCUIT

On both receive and transmit the VFO output (8·645 to 8·895MHz) is mixed with the output of an RF oscillator which provides four crystal controlled frequencies, 12·395, 15·895,

This block diagram shows how several of the stages of the HW8 are used on both transmit and receive.



abridged specification

TRANSMITTER		RECEIVER
DC Input	80m 3·5W	Direct conversion, CW only
	40m 3·0W	**Sensitivity** 1μV with 0·2μV
	20m 3·0W	providing readable signal
	15m 2·5W	**Selectivity** Wide:—750Hz @
Output		6dB down. Narrow:—375Hz @
Impedance		6dB down. Passband Freq.
50Ω unbalanced		750Hz
		Output Imp. 1kΩ

Transmit Offset 750Hz lower

GENERAL

Frequency Range MHz	3·5 to 3·750, 7·0 to 7·250 14·0 to 14·250, 21·0 to 21·250
Frequency Stability	Less than 150Hz/hour after 1 hour
Power Required	13·4VDC nominal 90mA/receive 430mA/transmit
Dimensions	9¼ x 4¼ x 8½in. deep overall. (235 x 108 x 216mm)
Weight	4lbs. (1·8kg)

22·895 and 29·895MHz. The difference frequency is selected for each band by tuned circuits, thus giving 3·5 to 3·750, 7·0 to 7·250, 14·0 to 14·250 and 21·0 to 21·250MHz. The dial calibration of 0 to 250 is thus constant for each band. These frequencies are also used as the heterodyne frequencies for the direct conversion receiver.

This is a good point at which to say that there are 20 tuned circuits plus the four crystals all of which are diode switched! The band switch thus operates at DC rather than at RF, except for the PA tuned circuits. It is not surprising then that the main PCB carries some 300 or so components! There are 32 coils, 37 diodes, 92 resistors, 120 capacitors and 16 transistors/IC's. Whether all this sophistication is justified to provide a couple of watts of CW on four bands is a matter of opinion!

On transmit the output of the mixer is amplified and fed to a tuned driver stage into the 2N4427 power amplifier. This stage is protected against excessive SWR conditions or accidental no-load dangers. Keying takes place in the driver stage, also activating the transmit/receive relay, the keying sidetone and the receiver muting circuits. There is an adjustable drop-out time control on the T/R relay.

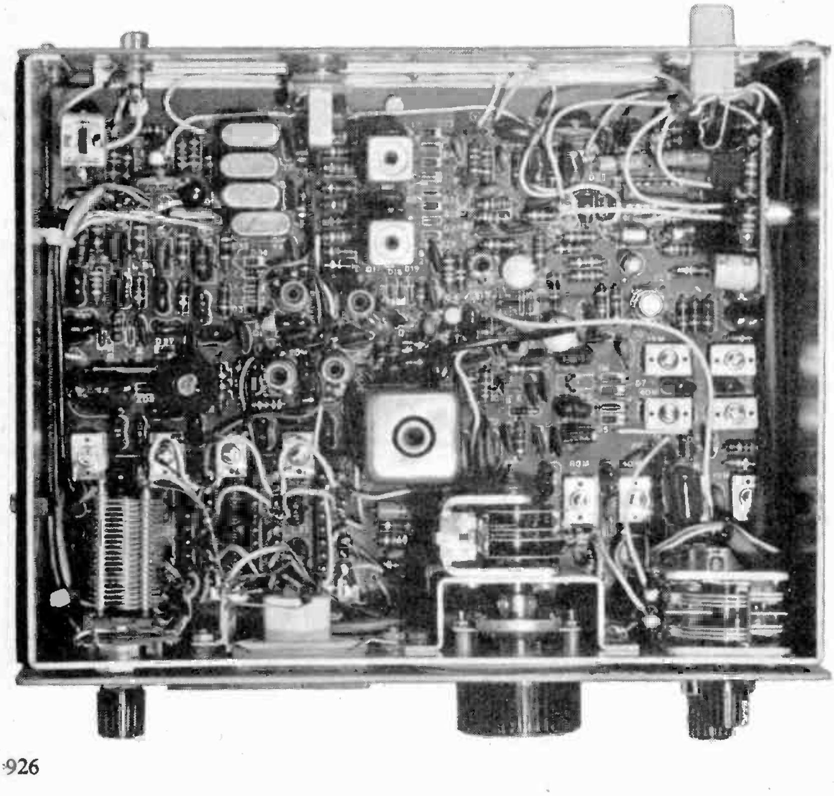
The receiver has an RF stage with the simplest of gain controls, which many amateurs, who complain of cross-modulation on their sets, would do well to copy. Namely, a potentiometer across the input terminals! An MC1496G IC forms the balanced product detector, also fed with a signal from the mixer stage, as previously mentioned. The active audio filter stages have also been covered earlier. Because of the 750Hz peaking effect of the audio filters the carrier has to be offset 750Hz on transmit. This is done automatically when the key is down. In practice this means tuning down from the HF end of a band and tuning a signal right 'on the nose' of the filter giving a 750Hz beat note. The transmitted signal will then be spot on the frequency of the incoming signal.

Two further stages of audio amplification feed a headphone socket at high impedance, nominally 1kΩ, but in practice a stereo low impedance headset performed quite well! But an old pair of Browns diaphragm type of 4kΩ really got the signals pumping out when peaked on the filter frequency!

CONSTRUCTION

As with any kit the components supplied must be checked against the parts list. Every part, down to the nuts and bolts, is illustrated in the Heathkit manual which is an education in itself and even before construction begins a good knowledge of the HW8 is obtained. Personally, I always read the manual right through anyway, before ever lifting the soldering iron! It is time well spent, often explaining points that might otherwise prove mystifying during construction.

The bulk of the work is on the main PCB which carries no



Top view of the finished transceiver. All the cabling round the inside of the cabinet is fitted to the PCB before the cabinet is assembled round the board. The T/R relay is in the top left hand corner close to the aerial socket, with the four HF crystals further to the right. The large screened can in the centre is the VFO unit with the VFO tuning immediately in front on the panel. While the PCB may appear rather cluttered up, the wiring in of the components presented no difficulty at all. There are no components under the PCB which is in the bottom of the cabinet.

less than 308 components! Actually the job of wiring so many resistors and diodes etc. gets boring so give it a break now and again to avoid making errors. The PCB and the associated cabling took nine hours to complete. It is an excellent board on which to work and need not be any cause for apprehension for potential constructors. The PCB was carefully checked for solder 'bridges' with the aid of a watchmaker's eyeglass and all was well.

The simple cabinet, front and rear panels are fitted round the PCB and the wiring completed to the various controls on the front and sockets on the rear panel. The aerial socket is a 'phono' type easily changed to Belling-Lee type or to suit the rest of the station's RF cabling. After completing the PCB a further 5½ hours work saw the transceiver completed. A further check on the PCB underneath and the general wiring was made before tests began.

TESTING

Although the manual did not mention it, it was thought advisable to check the resistance across the 12V input terminals just in case there was a short there! The multimeter red prod (neg polarity) was connected to negative input, giving a reading of 550Ω with the transceiver switched on and on receive. The power unit used for testing was the Heathkit HWA-7-1 giving approx. 13·2V. The initial tests laid down in the manual all proved satisfactory. The relay worked on keying, the sidetone was present and the receiver controls worked but little RF output was present at this stage.

The test equipment required is a receiver, preferably of the communication type, capable of providing accurate checks at 7 and 7·250kHz for checking the VFO, and a high input impedance voltmeter preferably with an RF probe. The alignment is quite clearly described and it is a matter of logical progression which can be completed easily in half an hour.

If one runs into trouble there is plenty of advice in the manual including PCB layout drawings with the voltages to be expected at various points. With a stabilised input voltage of 13VDC the current on receive was 93mA and on transmit 450mA, remaining fairly constant over the four bands. The RF output was measured at the dummy aerial load with the dial set at mid position and the loading control peaked and was found to be 2W on 80m and 40m, 1·8W on 20m and 1·6W on 15m.

Since the accepted segments of the bands on CW are a lot less than the 250kHz coverage available on the HW8 it would seem feasible to align the circuits at, say, 50kHz from the band edge and improve the general performance on both transmit and receive. In practice with the recommended alignment the RF output is remarkably constant over the whole 250kHz.

GENERAL COMMENTS

The transmitted signal was monitored externally on all four bands and found to be clean with excellent keying characteristics. In fact it was possible to get the relay to follow keying up to about 25wpm although some may prefer to increase the relay drop-out time to a second or so. Plenty of DX has been heard on all four bands and the two position audio filter can really sort out the weak ones among the QRM. The RF gain control was most effective especially with some of the powerful signals on 80m.

AERIALS

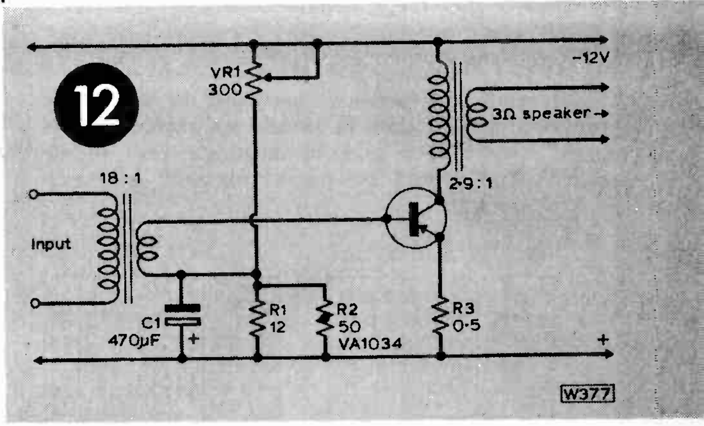
Nothing spectacular has been worked on any band yet due to lack of suitable aerials. It is a problem to get a four band aerial which provides a low impedance feed on all bands, without using a tuning unit. Anything introduced between the aerial and the set is going to absorb some of the precious power. A trapped dipole is the quick answer but it is a compromise and rather 'lossy'. It is hoped to erect a four band ground plane with a coax feeder when a further report on results obtained will be published. *AED*

Heathkit k/HW8 Price £108·19 inc. VAT and post and packing from Heath (Gloucester) Ltd., Gloucester GL2 6EE.

CIRCUITS FOR AUDIO AMPS.—*contd. from page 924*

of supply, that is positive earth for PNP and negative earth for NPN devices. It can be driven by an AC128 (PNP), BC108 (NPN) or similar stage. The transformer ratios are typical and need not be exactly as shown.

Collector current is set by VR1 and this can be the lowest which gives satisfactory performance. Begin with VR1 at maximum value, corresponding to a low collector current. Actual collector current depends on the transistor and performance and should be around 350mA to 900mA. As the DC operating conditions of this stage are isolated from other stages it is useful for experimental circuits and can actually be employed with about 9V to 24V. With the higher voltages, check carefully that the transistor is not over-run.



The load impedance can be around 25Ω but it is not too critical, depending somewhat on the supply voltage. Note that with a Class A stage a loudspeaker can only be connected directly to the collector circuit when it is able to carry the required collector current. This is why a transformer is necessary in Fig. 12.

Thermistor R2 is for stabilisation, as described later, whilst R3 also assists in this direction and can be about 1Ω if the volume is sufficient. Resistor R2 may be omitted for low voltages, or providing a check is kept that the current is not too high.

TO BE CONTINUED

PW 'Easybuild' VIDEO-WRITER

PART 8

M. J. HUGHES M.A., C.Eng. MIERE

NON-KEYBOARD KEYING

Early on in the series we promised an alternative means of entering data to obviate an expensive keyboard. This is done with seven single pole toggle switches and a push-to-make button with an "anti-bounce" circuit.

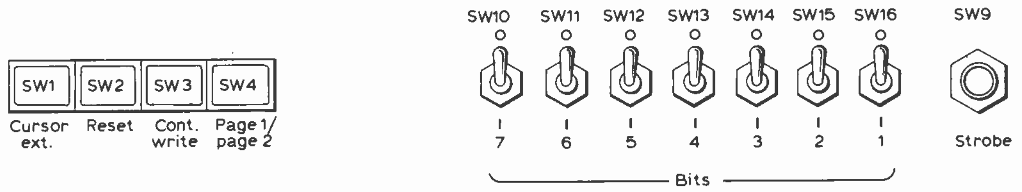
The code for the character or control function is set up on the switches in binary form and the button depressed to produce a strobe. If this method is used it is suggested that a table of the codes be prepared to tally with the switch positions. The suggested front panel layout and circuit are shown in Figs. 38 and 39. These codes might come in use-

Bits →	7	6	5	4	3	2	1
A	1	0	0	0	0	0	1
B	1	0	0	0	0	1	0
C	1	0	0	0	0	1	1
D	1	0	0	0	1	0	0
E	1	0	0	0	1	0	1
F	1	0	0	0	1	1	0
G	1	0	0	0	1	1	1
H	1	0	0	1	0	0	0
I	1	0	0	1	0	0	1
J	1	0	0	1	0	1	0
K	1	0	0	1	0	1	1
L	1	0	0	1	1	0	0
M	1	0	0	1	1	0	1
N	1	0	0	1	1	1	0
O	1	0	0	1	1	1	1
P	1	0	1	0	0	0	0
Q	1	0	1	0	0	0	1
R	1	0	1	0	0	1	0
S	1	0	1	0	0	1	1
T	1	0	1	0	1	0	0
U	1	0	1	0	1	0	1
V	1	0	1	0	1	1	0
W	1	0	1	0	1	1	1
X	1	0	1	1	0	0	0
Y	1	0	1	1	0	0	1
Z	1	0	1	1	0	1	0

Bits →	7	6	5	4	3	2	1
Ø	0	1	1	0	0	0	0
1	0	1	1	0	0	0	1
2	0	1	1	0	0	1	0
3	0	1	1	0	0	1	1
4	0	1	1	0	1	0	0
5	0	1	1	0	1	0	1
6	0	1	1	0	1	1	0
7	0	1	1	0	1	1	1
8	0	1	1	1	0	0	0
9	0	1	1	1	0	0	1
+	0	1	0	1	0	1	1
–	0	1	0	1	1	0	1
—	1	0	1	1	1	1	1
#	0	1	0	0	0	1	1
$	0	1	0	0	1	0	0
%	0	1	0	0	1	0	1
&	0	1	0	0	1	1	0
=	0	1	1	1	1	0	1
@	1	0	0	0	0	0	0
*	0	1	0	1	0	1	0
?	1	1	1	1	1	1	1

Bits →	7	6	5	4	3	2	1
^	1	0	1	1	1	1	0
!	0	1	0	0	0	0	1
"	0	1	0	0	0	1	0
'	0	1	0	0	1	1	1
(	0	1	0	1	0	0	0
)	0	1	0	1	0	0	1
[	1	0	1	1	0	1	1
]	1	0	1	1	1	0	1
\	1	0	1	1	1	0	0
;	0	1	1	1	0	1	1
:	0	1	1	1	0	1	0
,	0	1	0	1	1	0	0
.	0	1	0	1	1	1	0
/	0	1	0	1	1	1	1
<	0	1	1	1	1	0	0
>	0	1	1	1	1	1	0

Bits →	7	6	5	4	3	2	1
Space	0	1	0	0	0	0	0
CA. rtn.	0	0	0	1	1	0	1
LN feed	0	0	0	1	0	1	0
FW/rev	0	0	0	1	0	0	1
Cursor step	0	0	0	1	0	0	0



W400

Fig. 38. A suggested layout of the front panel when toggle switches are used for data entry.

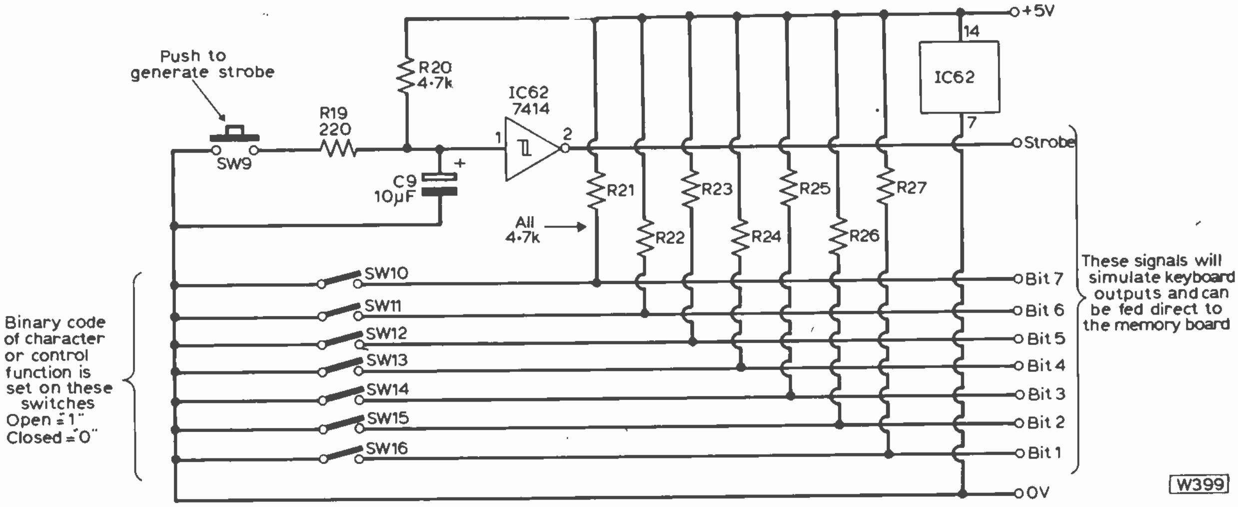


Fig. 39. The circuit diagram of the switching required to set data manually. A closed switch gives a logic "0", an open switch a logic "1".

ful for anyone carrying out the trouble shooting procedure mentioned earlier.

Although this method of entering data will be very tedious for normal use it is ideal for setting up permanent or semi-permanent displays.

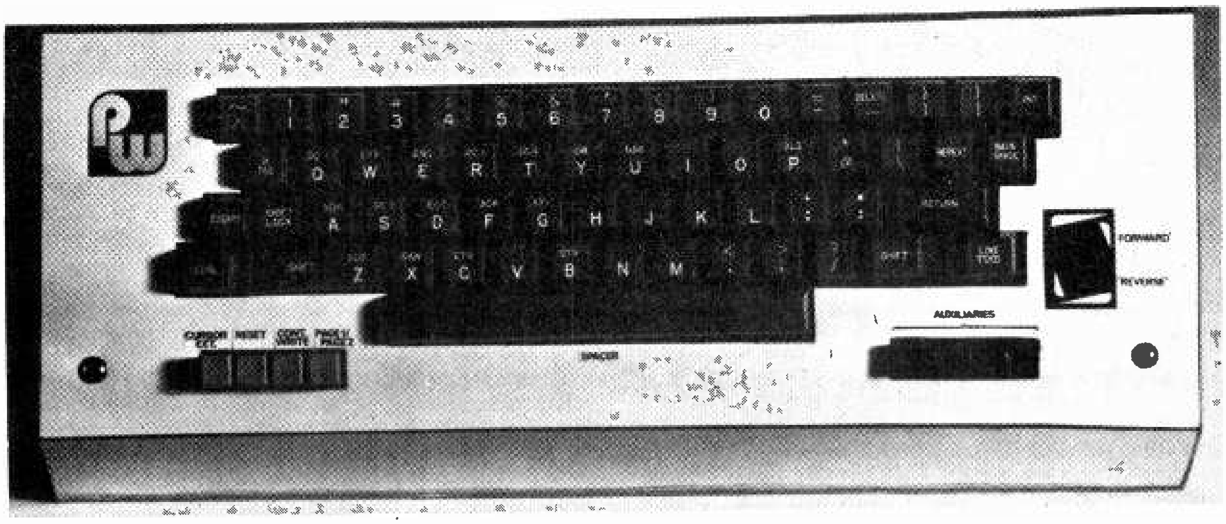
PAGE SEQUENCER

A page is selected by applying a logic level "1" or "0" to the most significant address bit of the random access memory. For page 1 this bit is held at logic "1" by R9 on the memory board. To change to page 2 the junction of R9 and the address input is shorted to ground (thus applying a logic level "0"). This is carried out by closing switch SW4 (page 1/2 select). This function could be carried out electronically by an oscillator and would give automatic page sequencing.

A variable-speed page-sequencing circuit can be added to the basic video-writer without any modifications to the original layout. The requirements are a small extra circuit board and a number of flying leads connecting it to the existing pinned "leadouts" on the main boards.

The circuit for such a sequencer is shown in Fig. 40 where IC62, a 555 operating in astable mode, is the oscillator and the frequency is set by VR1 and one of the three capacitors C9-C11. The range is set by selecting one of these capacitors via the auxiliary bank of switches (already embodied in the prototype).

VR1 gives fine control within the range selected and, in the prototype, is a preset but could be front panel mounted if desired. IC62 produces negative going pulses at the page sequencing rate and these are fed to the first part of IC63 which is a D-type



A photograph of the original keyboard. Note that the auxiliary switches are retained on the proposed layout for Non-Keyboard Keying.

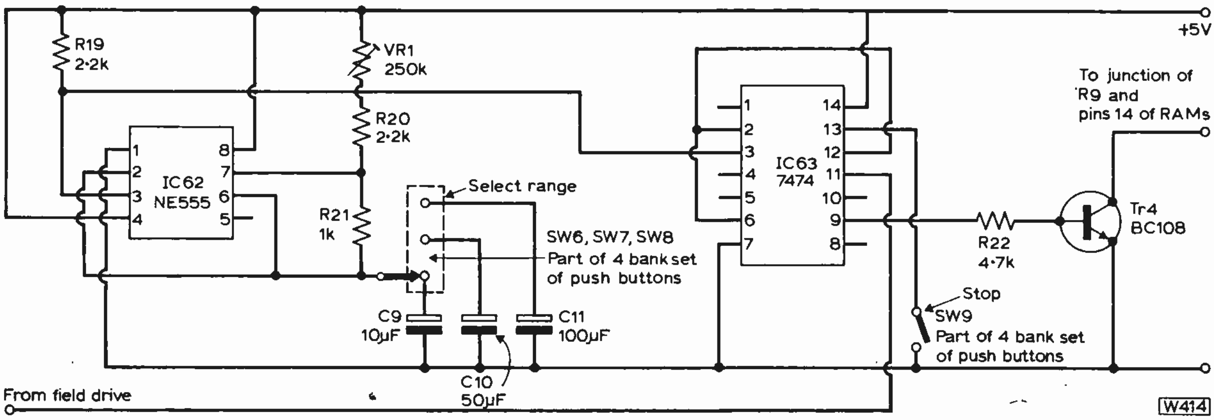
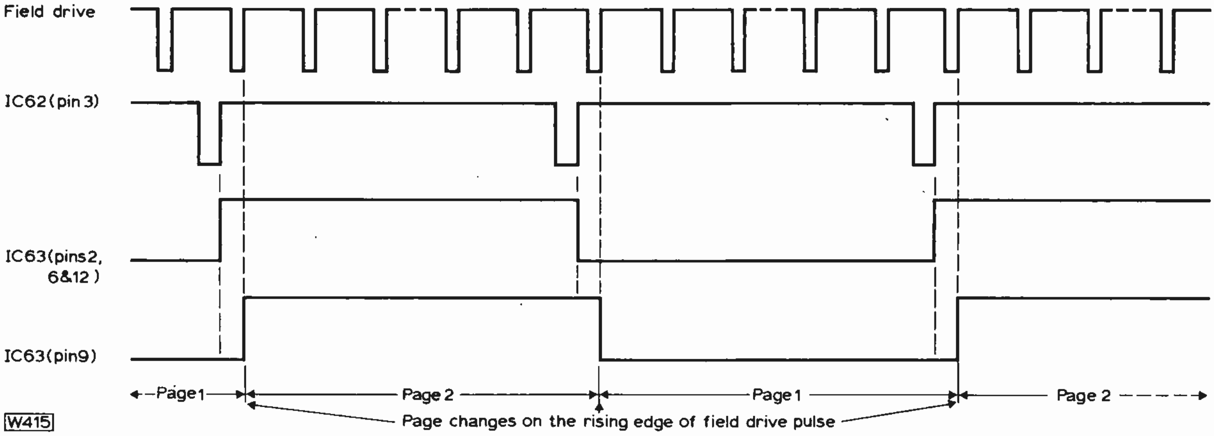


Fig. 40. The circuit diagram for the automatic page sequencer. SW4 must be open (i.e. switched to page 1) for this circuit to operate. C9, 10 and 11 can be selected for any range of speed required.

Fig. 41. The waveform appearing in the Page Sequencer.



flip-flop giving unity mark space output waveform.

It is desirable for the page to change during the field sync period. This prevents the displayed information changing while the scan is in the middle of a raster.

To do this it is necessary to synchronise the output at pins 2 and 6 of IC63 with the field drive pulse (obtained from the Sync Generator Board). This is done by aplying the output of the first D type flip-flop in IC63 to the "D" input of its twin and using the Field Drive Pulse as a clock signal. The Clear input of this second half is connected to the fourth push-button of the auxiliary bank which serves as a "disable" to the page sequencer, (i.e. switches it off), and holds the output on pin 9 at logic level "0". The associated waveforms are shown in Fig. 41.

This signal has to be applied to the junction of R9 and the paralleled connections to pins 14 of the random access memories. This is most easily accomplished by the open collector transistor (TR4) which will pull the junction to ground when the output from the page sequencer is at logic level "1". Provided the manual page select switch SW4 is in an open circuit condition, TR4, in conjunction with R9, will allow the address to alternate from "1" to "0", according to the instruction from the sequencer unit.

If the disable button SW5 is pressed there is no base drive into TR4 and SW4 is free to give manual control of page selection. Note that for automatic page sequencing to occur, SW4 must be in an open circuit state otherwise the address will be permanently grounded (displaying "Page 2").

Using the values of capacitors and variable resistor in the parts list the duration of the page display can be varied from approximately 20 seconds a page to a fraction of a second a page.

High speed page strobing can produce interesting effects for advertising but should be used with discretion due to the hypnotic effects that can be induced. It is possible to strobe at the "Bio" Beta Frequency and under certain circumstances this can produce unpleasant side effects in a viewer.

The wiring pattern of the printed circuit board is shown as Fig. 42 and the component layout as Fig.

VAT INCLUSIVE PRICES

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Add 20p P & P—No other extras

TTLs by TEXAS

7400	16p	7492	55p
74H00	30p	7493	43p
7401	18p	7494	90p
7402	18p	7495	70p
7403	18p	7496	90p
7404	24p	7497	340p
74H04	30p	74100	116p
7405	25p	74104	60p
7406	43p	74105	60p
7407	43p	74107	36p
7408	22p	71409	70p
7409	22p	74110	55p
7410	18p	74111	80p
74H10	22p	74118	90p
7411	26p	74121	32p
7412	27p	74122	52p
7413	40p	74123	73p
7414	85p	74125	70p
7416	40p	74126	65p
7417	40p	74132	75p
7420	18p	74136	81p
7421	43p	74141	85p
7422	28p	74142	300p
7423	38p	74145	95p
7425	33p	74148	173p
7427	40p	74150	120p
7428	39p	74151	77p
7430	18p	74153	92p
7432	37p	74154	164p
7437	37p	74155	97p
7438	37p	74156	97p
7440	18p	74157	96p
7441	85p	74159	220p
7442	75p	74160	107p
7443	116p	74161	107p
7444	116p	74162	107p
7445	120p	74163	107p
7446	95p	74164	130p
7447	90p	74165	159p
7448	80p	74166	140p
7450	18p	74167	340p
7451	18p	74170	300p
7453	18p	74173	160p
7454	18p	74174	120p
7460	18p	74175	107p
7470	36p	74176	131p
7472	32p	74177	100p
7473	36p	74180	108p
7474	37p	74181	322p
7475	45p	74182	89p
7476	37p	74185	146p
7480	54p	74190	155p
7481	103p	74191	155p
7482	85p	74192	130p
7483	99p	74193	130p
7484	103p	74194	76p
7485	120p	74195	102p
7486	36p	74196	108p
7489	340p	74197	108p
7490	43p	74198	270p
7491	90p	74199	270p

C-MOS ICs

4000	21p	4029	120p
4001	21p	4030	59p
4002	21p	4042	90p
4006	104p	4043	100p
4007	21p	4046	150p
4009	67p	4047	110p
4011	21p	4049	68p
4012	22p	4050	50p
4013	55p	4054	120p
4015	90p	4055	120p
4016	54p	4056	145p
4017	100p	4060	120p
4018	120p	4069	40p
4019	50p	4071	29p
4020	120p	4072	29p
4022	180p	4081	19p
4023	21p	4082	29p
4024	75p	4510	142p
4025	21p	4511	160p
4026	200p	4516	140p
4027	81p	4518	140p
4028	152p	4528	130p

LOW PROFILE DIL SOCKETS BY TEXAS

8 pin 12p, 14 pin 13p, 16 pin 14p, 24 pin 40p

VOL. REGS.

FIXED—Plastic 3 Terminals

1 Amp	Positive	
5V	7805	130p
12V	7812	130p
15V	7815	130p
18V	7818	150p
24V	7824	150p
1 Amp	Negative	
5V	7905	215p
12V	7912	215p
15V	7915	215p
18V	7918	215p
24V	7924	215p

LM309K (TO3) 5V 1 Amp 150p
LM323K (TO3) 5V 3 Amp 750p
TBA625B (TO5) 12V 0·5A 99p
7805 (TO3) 5V 1Amp 150p

VARIABLE VOL. REG.

723 14 Pin DIL 45p

TRANSISTORS

AC125	20p	BC184	14p	BF258	39p	TIP30A	60p
AC126	20p	BC187	32p	BFR39	34p	TIP30C	72p
AC127	20p	BC212	14p	BFR40	34p	TIP31A	56p
AC128	20p	BC213	12p	BFR79	34p	TIP31C	68p
AC176	20p	BC214	17p	BFR80	34p	TIP32A	63p
AC187	20p	BC337	24p	BFR88	37p	TIP32C	85p
AC188	20p	BC478	32p	BFX30	32p	TIP33A	97p
AD149	54p	BCY70	20p	BFX84	30p	TIP33C	120p
AD161	39p	BCY71	24p	BFX85	30p	TIP34A	124p
AD162	39p	BD124	140p	BFX86	30p	TIP34C	160p
AF114	22p	BD131	39p	BFX87	30p	TIP35A	243p
AF115	22p	BD132	43p	BFX88	30p	TIP35C	290p
AF116	22p	BD135	54p	BFY50	17p	TIP36A	297p
AF117	22p	BD136	55p	BFY51	16p	TIP36C	360p
AF139	40p	BD139	56p	BFY52	17p	TIP41A	70p
AF239	48p	BD140	60p	BRY39	48p	TIP41C	84p
BC107/B	10p	BDY56	225p	BSX19	20p	TIP42A	76p
BC108/B	10p	BF115	24p	BSX20	20p	TIP42C	96p
BC109	10p	BF167	25p	BU105	175p	TIP2955	76p
BC109C	11p	BF170	25p	BU108	312p	TIP3055	60p
BC147	9p	BF173	27p	MJE340	49p	TIS93	28p
BC148	8p	BF177	28p	MJ2955	130p	ZTX108	11p
BC149	10p	BF178	30p	MJE2955	130p	ZTX300	16p
BC157	11p	BF179	35p	MJE3055	70p	ZTX500	19p
BC158	13p	BF180	35p	MPSA06	37p	ZTX504	60p
BC159	13p	BF181	35p	MPSA12	62p	2N697	25p
BC169C	15p	BF182	35p	MPSU06	78p	2N698	43p
BC171	12p	BF184	24p	MPSU56	98p	2N706	22p
BC172	11p	BF185	24p	OC28	90p	2N708	22p
BC177	20p	BF194	13p	OC35	90p	2N918	43p
BC178	17p	BF195	11p	OC41	19p	2N930	19p
BC179	20p	BF196	17p	OC42	19p	2N1131	25p
BC182	12p	BF197	19p	OC45	19p	2N1132	25p
BC183	12p	BF200	40p	OC71	25p	2N1304	45p
		BF257	34p	TIP29A	50p	2N1305	45p
				TIP29C	62p	2N1306	48p

2N1307	48p	2N3708	11p
2N1613	22p	2N3709	11p
2N1711	22p	2N3707	14p
2N1893	32p	2N3773	320p
2N2219	22p	2N3866	90p
2N2222	22p	2N3904	22p
2N2369	15p	2N3905	22p
2N2484	32p	2N3906	22p
2N2904/A	22p	2N4058	19p
2N2905/A	22p	2N4060	19p
2N2906/A	22p	2N4123	22p
2N2926RB	9p	2N4124	22p
2N2926OG	11p	2N4125	22p
2N3053	19p	2N4126	22p
2N3054	43p	2N4289	24p
2N3055	54p	2N4401	34p
2N3439	72p	2N4403	34p
2N3442	151p	2N4427	97p
2N3702	12p	2N5089	34p
2N3703	14p	2N5296	58p
2N3704	12p	2N5401	62p
2N3705	14p	2N6107	70p
2N3706	12p	2N6247	200p
		2N6254	140p
		2N6292	70p
		40360	43p
		40361	43p
		40362	45p

40410	75p
40409	75p
40411	325p
40594	90p
40595	97p

FETs

BF244	45p
MPF102	40p
MPF103	40p
MPF104	40p
MPF105	40p
2N3819	27p
2N3820	50p
2N3823	54p
2N5457	40p
2N5458	40p
2N5459	40p
3N128	81p
3N140	92p
3N141	81p
40603	63p
40673	58p

UJTs

TIS43	40p
2N2160	95p
2N2646	45p
2N4871	40p

PUJT

2N6027 60p

DIODES SIGNAL

OA47	9p
OA81	10p
OA85	11p
OA90	7p
OA91	9p
OA95	9p
OA200	8p
OA202	10p
1N914	4p
1N916	11p
1N4148	4p

RECTIFIER

BY100	31p
BY126	15p
BY127	12p
1N4001	6p
1N4002	6p
1N4004	7p
1N4005	7p
1N4007	8p

ZENER

2·7 to 33V
400mW 11p
1W 22p

NOISE

Z5J 140p

BRIDGE RECTIFIERS

1A 50V	25p
1A 100V	27p
1A 400V	28p
1A 600V	32p
2A 50V	40p
2A 100V	48p
2A 400V	56p
3A 200V	63p
3A 600V	72p
4A 100V	84p
6A 50V	90p
6A 100V	104p
6A 400V	120p

TRIACS

Amp	Volts	
3	400	130p
6	400	162p
6	500	194p
10	400	200p
10	500	270p
40430		108p
40669		97p

DIAC

BR100 32p

OP. AMPS

301A	Ext. Comp. 8 pin DIL	40p
536T	FET Op. Amp TO 99	300p
709	Ext. Comp. 8/14 pin DIL	30p
710	Diff. Comp. 14 pin DIL	45p
741	Int. Comp. 8/14 pin DIL	25p
747	Dual 741 14 pin DIL	76p
748	Ext. Comp. 8 pin DIL	40p
776	Prog. Op. Amp TO 99	153p
1458	Dual Op. Amp. 8 pin DIL	75p
3130	CMOS/Bipolar Mosfet	108p
3140	BIMOS/FET Input 8 pin DIL	108p
3900	Quad. Op. Amp. 14 pin DIL	70p

LINEAR I.Cs.

AY-1-0212	Tone Gen. 16pin DIL	650p
CA 3028A	Diff. Cascade Amp. To 99	112p
CA 3046	5 Transistor Array 14 pin DIL	85p
CA 3048	Quad. Low Noise Amp.	250p
CA 3053	Diff. Cascade Amp. TO5/DIL	75p
CA 3080	Op Transconduct. Amp 8 DIL	97p
CA 3089E	FM IF System 16 pin DIL	250p
CA 3090AQ	FM Stereo Decoder QIL	500p
ICL8038CC	VCO Fun.ken 14 pin DIL	370p
LM380N	2W Audio Amp 14 pin DIL	112p
LM381N	Stereo Pre Amp 14 pin DIL	190p
LM389N	Aud Amp +3 Trs. Arr. 18 DIL	175p
M252	Rhythm Ken 16 pin DIL	850p
MC1310	FM Stereo Decoder 14 pin DIL	180p
MC1351P	Lim/Det. Audio Preamp	104p
MC1495	Multipher 14 pin DIL	370p
MC1496	Bal. Mod/Demod 14 DIL	115p
MC3340P	Elec. Attenuator 8pin DIL	180p
MFC4000B	¼W Audio Amplifier PCB	90p
NE540L	Audio Pwr. Driver TO99	140p
NE555V	Timer 8 pin DIL	40p
NE556	Dual 555 14 pin DIL	76p
NE561B	PLL with AM Demod	425p
NE562B	PLL with VCO 16 pin DIL	425p
NE565	PLL 14 pin DIL	200p
NE566V	PLL Function Gen 8 pin DIL	200p
NE567V	PLL Tone Decoder 8 pin DIL	200p
2567	Dual 567 16 pin DIL	400p
SN72733	Video Amplifier 14 pin DIL	150p
SN76003N	Audio Pwr. Amp with HS	275p
SN76008	10W in 4 ohms 5pin Plas.	280p
SN76013N	Audio Pwr Amp with HS	175p
SN76023N	Audio Pwr Amp with HS	175p
SN76033N	Audio Pwr. Amp with HS	275p
TAA621A	Aud. Amp. for TV QIL	310p
TAA661B	FM IF Amp Lim/Detector QIL	150p
TBA641B	Audio Amp QIL	300p
TBA800	5W Audio Amp QIL	100p
TBA810	7W Audio Amp QIL	125p
TBA820	2W Audio Amp QIL	100p
TDA2020	20W Audio Amp QIL	405p
XR2240	Prog Timer/Counter 16 pin DIL	400p
ZN414	TRF Radio Receiver TO18	140p

SCR THYRISTORS

1A 100V TO5			45p
1A 400V TD5			50p
3A 400V STUD			81p
7A 400V TO5 + HS			97p
16A 400V Plastic			195p
16A 600V Plastic			238p
BT106	150p	2N3525	120p
C106D	70p	2N4444	200p
MCR101	27p	2N5064	43p
LP1186 Mullard FM Tunerhead			850p

OPTO-ELECTRONICS

PHOTO-TRANSISTORS

OCP70	50p
OCP71	140p
2N5777	58p

LDRs

ORP12	70p
ORP60	75p
ORP61	75p

LEDs

TIL209 Red	15p
TIL211 Green	36p
TIL32 Infrared	81p
MV5025	27p
0·2″	
Red + clip	18p
Green	36p
Yellow	32p

SEVEN SEGMENT DISPLAYS

3015F	Minitron 0·3″	200p
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22 Ranges plus AF/IF Oscillator 20,000Ω/Volt.
Vdc—0·5—1000V in 7 ranges
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Idc—0·05—500mA in 5 ranges
Resistance—5Ω—1MΩ in 4 ranges.
Accuracy—5% of F.S.D.
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34 Ranges. High sensitivity. 20,000Ω/Volt.
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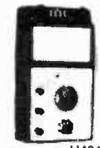
Idc—0·06—3A in 6 ranges.
Iac—0·3—3A in 5 ranges.
Resistance—25Ω—5MΩ in 5 ranges.
Accuracy—dc and R—2½% of F.S.D. ac and db—4% of F.S.D.
Size—167 x 98 x 63mm.
Supplied complete with storage case, test leads, spare diode and battery.
PRICE £16·66 net U4324

MULTIMETER U4341

27 Ranges plus Transistor Tester. 16,700Ω/Volt.
Vdc—0·3—900V in 8 ranges.
Vac—1·5—750V in 6 ranges.
Idc—0·06—600mA in 5 ranges.
Iac—0·3—300mA in 4 ranges.
Resistance—2KΩ—2MΩ in 4 ranges. Accuracy—dc—2½% ac—4% of F.S.D.
Ife—10—350 in 2 ranges.
Size—115 x 215 x 90mm.
Complete with carrying case, test leads and battery.
PRICE £16·66 net U4341



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Vdc—1·5—600V in 9 ranges.
Vac—1·5—600V in 9 ranges.
Idc—60—120 microamps in 2.
Idc—0·6—1500mA in 6 ranges.
Iac—0·6—1500mA in 6 ranges.
Resistance—1KΩ—1MΩ in 4 ranges.
db scale—10 to + 12db.
Accuracy—dc—1½%, ac—2½%.
Size—115 x 215 x 90mm.
Complete with carrying case. test leads and battery.
PRICE £19·90 net U4313

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Fig. 42. The etched wiring pattern of the Page Sequencer board drawn full size.

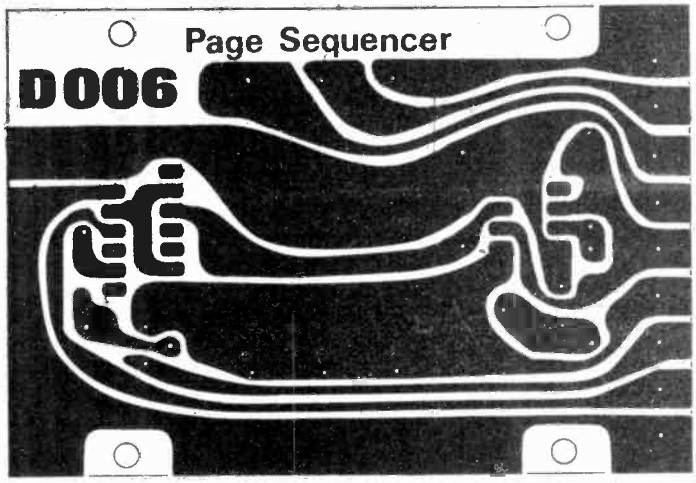
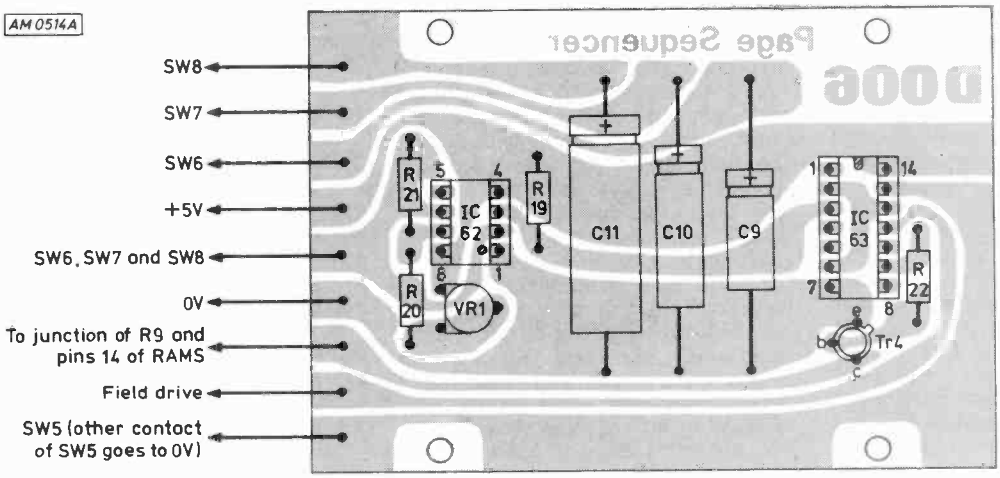


Fig. 43. The component overlay information. Observe the +ve marking when using polarised capacitors. VR1 is shown as a miniature preset but could be externally mounted.



★ components list

NON-KEYBOARD KEYING

R19	220Ω 10% ¼W
R20	4·7kΩ 10% ¼W
R21	4·7kΩ 10% ¼W
R22	4·7kΩ 10% ¼W
R23	4·7kΩ 10% ¼W
R24	4·7kΩ 10% ¼W
R25	4·7kΩ 10% ¼W
R26	4·7kΩ 10% ¼W
R27	4·7kΩ 10% ¼W
C9	10μF 12V 10% ¼W
SW9	Push-to-make button switch
SW10–SW16	Single pole toggle switches
IC62	7414

Small piece of Veroboard.

43. The +5V and 0V supply lines are taken off the respective pins of the memory board; the output from the page sequencer goes to the Page 1/Page 2 input of the memory board; the Field Drive is taken from its associated pin on the Sync Generator Board and the page sequencer disable and range select inputs are taken to the respective contacts on SW5, 6, 7 and 8.

★ components list

PAGE SEQUENCER

R19	2·2kΩ, 10%, ¼W
R20	2·2kΩ, 10%, ¼W
R21	1kΩ, 10%, ¼W
R22	4·7kΩ, 10%, ¼W
VR1	250kΩ (sub-min horizontal pre-set)
C9	10μF (10V)
C10	50μF (10V)
C11	100μF (10V)
TR4	BC 108
IC6	NE 555
IC6	7474

One off 8 pin DIL socket
One off 14 pin DIL socket
SW5–SW8 Interlocking bank of 4 push switches
Printed Circuit Board
Printed Circuit Board Pins

This extra board can be mounted inside the Videowriter in any convenient position.

These two modifications complete the original article. Other add-on and interface units are under consideration and, subject to there being sufficient demand, will be published at a later date.

Dear Sir, letters

Thermionic passion

Being a long-standing reader, and not too old to remember valves, I really must protest about the dismissal of the Good Old Valve. December issue letters raised my passion. I rarely write protest letters but Mr. Harcourt must surely remember the Coherer, this being one of the earliest forms of detector and non-semiconductor.

Mr. Hill should live surrounded by transmitters as I am. Radio 4 appears as 150mV of RF at the aerial and can be measured using a 20,000Ω voltmeter in a tuned circuit. The poor transistor, be it unipolar or bipolar, just cannot stand the strain unlike the good old valve, which can be abused to a great degree before it gives up the ghost. Transistors and I.C.s die at the first spike or serious overload, but they still have their uses.

My final comments are that the valve will not be replaced for many years, and to this day there are jobs where the valve remains supreme master. Two examples are front-end stages of communications receivers and high power transmitters. Ask the Radio Amateurs! **G. Sims** (Derbyshire).

Powerful argument

With reference to Mr. Nuttall's comments in the November issue on your August Editorial, he complains of ignorance on your part, but what hypocrisy!

I refer Mr. Nuttall in the following to "Hi-Fi in the Home", by John Crabbe. (Never heard of it, Mr. Nuttall?)

The amount of power required by an amplifier in excess of 30W RMS has got very little to do with headroom. It is a question of relating power to loudspeaker efficiency, equated to the volume of the listening environment. Up to 30W power should give plenty of headroom. If it doesn't, then turning down the volume on any amp will assist, and if the result is then lack of loudness and realism in the music, this is a sign that the amp—to speaker—to room conversion efficiency, is unbalanced. High power amps have uses, such as filling halls and auditoriums, but the myth that they are necessary to smooth reproduction all the time is a half-baked truth. Certainly they can help, but only when considering numerous other factors, such as the power supply, pre-amp overload, and speakers.

For the sound powers needed in all but the most exceptional domestic surroundings, the electrical power required from the amp depends mainly on speaker efficiency:- "The quantities of acoustic energy transmitted into the air in a normal sized room when reproducing orchestral music at a realistic loudness, are absolutely minute; a power level of about half of one acoustic watt representing the very maximum needed during peaks of the most enormous climaxes. But most loudspeakers are so inefficient that production of this $\frac{1}{2}$W of sound output requires about 10W of electrical input. An electro-acoustic efficiency of 5 per cent".

I can assure Mr. Nuttall that low power amps are quite capable of Hi-Fi. If they are not, then it is not the power output availability which is failing, but rather pre-amp overload, transistor junction storage capability, rise-time and slow rate related to negative feed-back. A 20W RMS amp with the correct degree of engineering will probably knock up 80W music power, which covers transient peaks quite effectively, other factors allowing. How the loudspeaker interprets this is another story again, depending on the thermal energy and general elasticity of the system amongst other factors.

The newer loudspeaker enclosures on the market are rarely above 2-3 per cent efficient throughout the whole audio bandwidth, so higher power amps are required. But not because they give more headroom, but because the speakers need on average a slightly higher drive level on music content, all the time. Check the difference between old and new speakers.

So, Mr. Nuttall, although at certain peaks, muddiness does set in on Hi-Fi systems (in this you are right). You are not strictly correct in interpreting its cause. Lets face it Mr. Nuttall, any amp (even your Naim 160) of any power description, will cause its output transistor to bang its head against the power rail and say, "that's enough, no more" if driven hard enough. It's only good pre-amp engineering, transistor stage design and your hand on the volume pot which prevents this—and here we reach the crux, which was partly the point made in the August Editorial. Power transistors cost many pence, signal transistors (even low-noise ones) are comparatively cheap. This is why it is possible for a well designed amp of £30 to be well up in Hi-Fi quality.

My point is made Mr. Nuttall. Your view on power reminds me of the gentleman in the sports car who once said to me, he believed he went a lot, lot faster with the hood down!

Wake-up Mr. Nuttall, and when you do, try appraising what you read or hear a little, before criticising.—**E. Hoskins,** (Technical Director, CEH Audio-Visual Enterprises, Tonbridge).

Any ideas?

Being an "old timer" I have been a reader of Practical Wireless for many years and am particularly interested in the "Going Back" series. A hobby (or rather a hobby within a hobby) of mine is the rebuilding of pre-war and pre-1930 radio designs and I have accumulated a large amount of gear of this date. One snag is that loudspeaker and headphone magnets have nearly always seriously deteriorated in strength and despite the most thorough reading of technical books available, no worth while information is available on the remagnetisation of these components (I think mostly of balanced armature speakers). Do any PW readers know of literature that deals with this, or can supply any info. on this subject.—**T. Howells,** (Radio Officer, m/v Geestcrest, c/o Geest Industries , Barry Dock, Glamorgan.

T.T.L. 74 I.C's By TEXAS, NATIONAL, I.T.T., FAIRCHILD Etc

7400 17p
7401 17p
7402 18p
7403 18p
7404 25p
7405 25p
7406 45p
7407 45p
7408 25p
7409 25p
7410 18p
7411 28p
7412 27p

7413 40p
7414 80p
7416 35p
7417 40p
7420 18p
7422 25p
7423 40p
7425 35p
7426 38p
7427 40p
7428 45p
7430 18p

7432 30p
7437 33p
7438 33p
7440 18p
7441 76p
7442 76p
7445 95p
7446 110p
7447 85p
7448 85p
7450 18p
7451 20p
7453 20p

7454 20p
7460 20p
7470 33p
7472 30p
7473 35p
7474 37p
7475 45p
7476 36p
7483 100p
7485 130p
7486 37p
7489 295p

7490 45p
7491 82p
7492 55p
7493 45p
7495 75p
7496 85p
74100 135p
74104 60p
74105 60p
74107 35p
74109 66p
74118 115p

74120 115p
74121 35p
74122 55p
74123 75p
74125 70p
74126 75p
74130 150p
74131 130p
74132 77p
74135 100p
74136 85p
74137 125p

74138 135p
74139 135p
74141 80p
74142 320p
74143 320p
74144 320p
74145 90p
74147 245p
74148 180p
74150 155p
74151 80p
74153 90p

74154 170p
74155 90p
74156 100p
74157 100p
74160 120p
74161 120p
74162 120p
74163 120p
74164 130p
74165 170p
74166 150p
74167 370p

74170 280p
74173 180p
74174 180p
74175 100p
74176 130p
74177 130p
74178 160p
74179 160p
74180 120p
74181 330p
74182 90p
74184 185p
74185 150p

74188 370p
74189 350p
74190 200p
74191 160p
74192 130p
74193 130p
74194 130p
74195 100p
74196 125p
74197 125p
74198 250p
74199 250p

SEMICONDUCTORS
by MULLARD, TEXAS, MOTOROLA, SIEMENS, I.T.T., R.C.A.

AA113 10p
AA144 10p
AAZ17 30p
AC121 30p
AC126 19p
AC127 19p
AC127/01 25p
AC128 18p
AC151 25p
AC176 20p
ACY17 35p
ACY21 30p
AD149 60p
AD161 40p
AD162 40p
AD161/2MP 90p
AF114 22p
AF115 22p
AF116 22p
AF117 22p
AF118 50p
AF125 25p
AF139 35p
AF239 45p
ASY26 40p
BA114 9p

BA121 9p
BA138 16p
BA148 16p
BA154 12p
BA157 15p
BA173 15p
BA216 16p
BA318 16p
BAX13 5p
BAX16 5p
BB105A 35p
BB110 45p
BC107 10p
BC108 10p
BC108C 15p
BC109 10p
BC109C 14p
BC113 12p
BC117 19p
BC125 20p
BC126 15p
BC146 12p
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BC158 10p

BC159 10p
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BC168B 14p
BC168C 15p
BC169C 15p
BC171 12p
BC172C 12p
BC178A 16p
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BC182L 12p
BC183 10p
BC183L 12p
BC184 10p
BC184L 12p
BC186 24p
BC205 14p
BC212 11p
BC212L 12p
BC213L 12p
BC214 13p
BC214L 14p
BC258 13p
BC294 35p
BC303 55p
BC317 15p
BC323 60p
BC328 13p

BC338 12p
BC547 12p
BC548 12p
BC549B 13p
BC549C 14p
BC557 13p
BCY34 80p
BCY70 15p
BCY71 20p
BCY72 15p
BD123 100p
BD131 36p
BD132 39p
BD133 45p
BD135 40p
BD137 40p
BD139 38p
BD140 40p
BD181 80p
BD182 80p
BD207 70p
BD263 65p
BDY10 100p
BDY62/01 90p
BF120 50p
BF166 30p

BF167 25p
BF173 25p
BF179 35p
BF179C 40p
BF180 30p
BF181 35p
BF182 30p
BF183 30p
BF186 25p
BF194 10p
BF195 10p
BF196 10p
BF197 10p
BF199 25p
BF200 30p
BF224 20p
BF225 20p
BF241 16p
BF244B 35p
BF257 26p
BF258 26p
BF259 30p
BF274 15p
BF336 35p
BF337 35p
BF363 60p
BFS94 30p

BFW58 20p
BFX29 30p
BFX81 130p
BFX84 25p
BFX85 30p
BFX87 25p
BFX88 25p
BFY50 20p
BFY51 20p
BFY52 20p
BR101 35p
BRY39 35p
BRY56 35p
BSX20 20p
BSY40 25p
BSY95 20p
BT100A 80p
BU105 150p
BU133 75p
BU208 220p
BY100 20p
BY126 15p
BY127 15p
BY133 22p
BY164 50p
BYX94 8p
C1120 30p

C1164 20p
MJE340 45p
MPSA06 25p
OA10 40p
OA90 6p
OA91 6p
OA202 8p
OC23 200p
OC25 100p
OC28 75p
OC35 75p
OC42 35p
OC43 35p
OC45 35p
OC71 25p
OC72 30p
OC75 30p
OC81 30p
OC81D 25p
OC83 50p
OC84 50p
OC140 150p
OC171 40p
OC200 80p
ORP12 70p
R1039 150p

TIP29 45p
TIP29A 47p
TIP29C 75p
TIP30 55p
TIP30A 58p
TIP30B 65p
TIP30C 80p
TIP31 55p
TIP31A 58p
TIP31B 65p
TIP31C 70p
TIP32 60p
TIP32A 65p
TIP32B 85p
TIP32C 90p
TIP33 100p
TIP33A 105p
TIP33B 115p
TIP33C 130p
TIP34 115p
TIP34A 118p
TIP34B 145p
TIP35 225p
TIP35A 230p
TIP35C 280p
TIP36A 350p
TIP41A 70p

TIP41B 75p
TIP41C 80p
TIP42A 80p
TIP42B 85p
TIP2955 70p
TIP3055 55p
TIS90 25p
TIS91 25p
IN914 5p
IN3754 10p
IN4001 5p
1N4002 5p
IN4003 5p
IN4004 5p
IN4005 5p
IN4006 6p
IN4007 7p
IN4148 4p
IS44 4p
2N456A 90p
2N697 15p
2N929 20p
2N930 20p
2N1302 25p
2N1305 30p
2N1306 38p

2N1308 50p
2N1711 22p
2N2219A 25p
2N2483 30p
2N2906 18p
2N2907 20p
2N3053 20p
2N3054 50p
2N3055 60p
2N3439 50p
2N3702 11p
2N3703 12p
2N3704 11p
2N3705 12p
2N3706 11p
2N3711 12p
2N3715 300p
2N3772 175p
2N3819 25p
2N3866 95p
2N3904 15p
2N4062 14p
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68V 15p
72V 15p
160V 15p

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2V4 10p
2V7 10p
3V0 10p
3V3 10p
3V6 10p
3V9 10p
4V7 10p
5V1 10p
5V6 10p
6V2 10p
6V8 10p
7V5 10p
8V2 10p
9V1 10p
10V 10p
11V 10p

BZY88
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LM748 8P DIL 45p
NE555 8P DIL 45p
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TAA300 150p
TAA350 190p
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TAD110 200p
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3·3/25 5p
4·7/10 5p
4·7/16 5p
4·7/25 5p
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10/35 5p
10/50 5p
22/6V3 5p
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33/6V3 5p
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100/10 6p
100/16 6p
100/25 6p
100/50 8p
100/63 10p
125/15 6p
220/16 10p
220/25 12p
220/50 20p
330/25 15p
330/35 16p
330/50 18p
470/10 12p
470/25 16p
470/35 18p
470/50 22p
680/25 25p
1000/16 25p
1000/35 30p
2200/10 28p
2200/16 35p
2200/63 60p
2200/100 120p
3300/16 40p
3300/25 42p
3300/63 80p
4700/25 45p
4700/40 50p
4700/63 120p

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Mullard or Erie
μ/F
·001 5p
·0022 5p
·0033 5p
·0047 5p
·0068 5p
·01 5p
·022 5p
·033 5p
·047 5p
·1 6p
·22 7p
·33 9p
·47 12p
1·00 20p
2·2 25p
4·7 35p
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5K Lin 30p
10K Lin 30p
25K Lin 30p
50K Lin 30p
100K Lin 30p
250K Lin 30p
500K Lin 30p
1 Meg Lin 30p
2 Meg Lin 30p
5K Log 30p
10K Log 30p
25K Log 30p
50K Log 30p
100K Log 30p
250K Log 30p
500K Log 30p
1 Meg Log 30p
2 Meg Log 30p

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3P 4W 40p
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LA5 30–100KHz 100p
LA7 < 10KHz 100p
LA13 FOR W.W. OSCILLOSCOPE 200p

FX1014, FX1023, FX1036, FX1060, FX1067, FX1085, FX1089, FX1095, FX1106, FX1112, FX1155, FX1158, FX1191, FX1193, FX1229, FX1231, FX1240, FX1248, FX1265, FX1277, FX1306, FX1322, FX1336, FX1356, FX1358, FX1378, FX1445, FX1467, FX1476, FX1489, FX1490, FX1505, FX1525, FX1558, FX1584, FX1585, FX1593, FX1605, FX1606, FX1634, FX1636, FX1681, FX1764, FX1795, FX1801, FX1888, FX1889, FX2027, FX2142, FX2144, FX2211, FX2256, FX2270, FX2277, FX2318, FX2323

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LA1162, LA1183, LA1167, LA1168, LA1169, LA1173, LA1174, LA1198, LA1200, LA1201, LA1208, LA1221, LA1255, LA1258, LA1262, LA1263, LA1277, LA1278, LA1279, LA1281, LA1288, LA1289, LA1292, LA1344, LA1350, LA1360, LA1370, LA1372, LA1377, LA1382, LA1386, LA1396, LA1424, LA1427, LA1435, LA1440, LA1441, LA1448, LA1450, LA1451, LA1454, LA1455, LA1462, LA1463, LA1465, LA1466, LA1467, LA1468, LA1471, LA1479, LA1494, LA1497, LA1521, LA2100, LA2106, LA2107

LA2108, LA2134, LA2206, LA2207, LA2208, LA2234, LA2236, LA2300, LA2302, LA2307, LA2312, LA2321, LA2330, LA2336, LA2400, LA2401, LA2402, LA2406, LA2436, LA2501, LA2502, LA2506, LA2512, LA2517, LA2519, LA2532, LA2550, LA2554, LA2560, LA2700, LA2701, LA2704, LA2705, LA2750, LA2754, LA2760, LA2761, LA2802, LA2852, LA2906, LA2954, LA3105, LA3127, LA3128, LA3145, LA3244, LA3305, LA3306, LA3329, LA3343, LA3348, LA3355, LA3356, LA3404, LA3405

LA3406, LA3441, LA3445, LA3504, LA3517, LA3529, LA3545, LA3547, LA3554, LA3558

No Technical Details on Above

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E299D/P118
E299DD/P224
E299DD/P226
E299DD/P236
E299DD/A238
E299DD/P342
E299DD/P350
E299DD/P354
VA1008
VA1011
VA1063
VA1067
VA1072
VA1077
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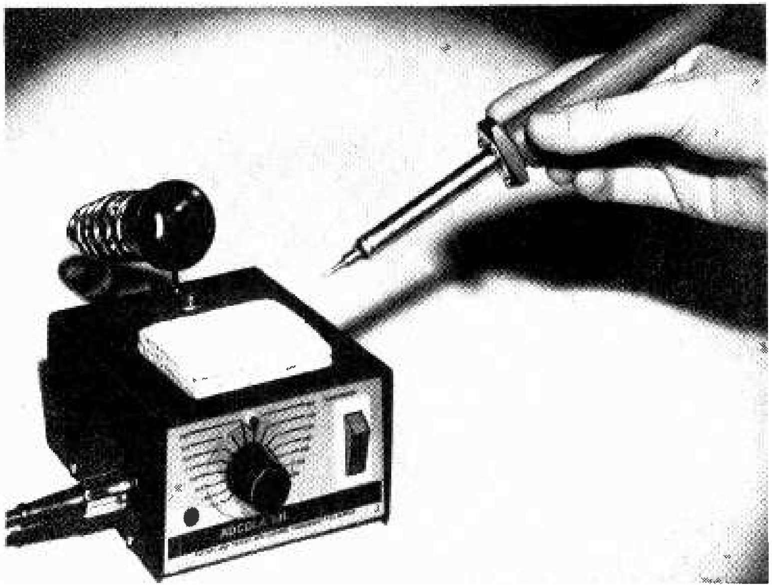


Spot-on iron

I suppose there must be literally hundreds of soldering irons of one kind or another available in the UK at this very moment. Of course the cheap iron that is thrust upon an unsuspecting constructor, accompanied with the words 'psst—wanna buy a cheap iron guv' is little better than useless. A good maxim when looking for an iron is the one that says 'you pays yer money and takes yer choice', and although the latest iron from Adcola is a little on the expensive side, it could be argued that is is simply one of the best irons available to the general public.

Incorporating a thermocouple at the rear of the soldering bit, which then feeds an Op. amp and other circuitry, the temperature can be kept within $\pm 2\%$ of the indicated dial temperature which is 120°C to 420°C. Heating time from a cool 24°C up to a blistering 420°C is claimed to be less than 2 minutes, while at any temperature the handle stays cool and comfortable for the user.

Operating from a 24V torodial transformer, this 50W, Unit 101 soldering station carries a price tag of £36·75.

Further information from *Adcola Products Ltd., Adcola House, Gauden Road, London, SW4.*

Space age tape

'Enough to go to the Moon and back 24 times' is the claim put forward by AMSA Magnetics, who further claim to be the largest manufacturer of cassette tape in the world. Realising the enormous potential of the UK market, they have launched a new range of cassettes which are said to be of a very high quality and feature a specially developed jamproof mechanism—Paraflo guides.

The range of cassettes available are Standard—a quality low noise tape with a permanent head cleaner leader. Extra—available in C66 or C99 lengths and featuring the new Paraflo guides and head cleaner Leader. Super—Ferric Oxide tape, and XHE—the top of the range tape containing Magnalinc™ Ferric Oxide which is claimed to give a superior S/N ratio and good frequency response. The XHE cassette also features instant-start recording and a jamfree mechanism. Prices range from 89p for a standard C-60 to £2·65 for a C-120 XHE.

AMSA Magnetics, 121 Loverock Road, Reading, Berks.

Keep-it-kleen

Record cleaners tend to follow much the same lines these days, with the designs based loosely on the pick-up arm. In an endeavour to get away from this standard design, Bib have introduced a new parallel tracking record cleaner, called the Groov-Kleen 101.

As the name of this new cleaner implies, a lightweight carrier fitted with a velvet pad and cleaning brush, automatically tracks parallel across the record, silently, at the same speed as the pick-up arm.

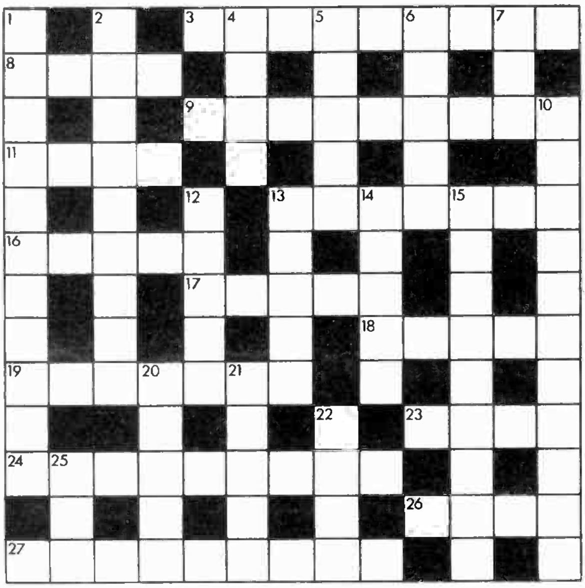
The Groov-Kleen is supplied with

cleaning brush, a spare tracking brush plus velvet pad, together with spare self-adhesive base pads.

Price of this new Bib accessory is £3·97 and can be obtained from all good audio shops.

Bib HiFi Accessories, PO Box 78, Hemel Hempstead, Herts. Tel: 0442 61291.

PW TECHNICROSS PUZZLE No. 18



ACROSS

3 Only one part of the set (9)
8 A circuit-breaker misses a turn on it? (4)
9 Type of receiver for dance or brass enthusiasts? (9)
11 Answer distortion pique out east? (4)
13 Repro blemish that needs solving inside? (7)
16 Choose to add Ron to the energetic unit? (5)
17 Turn in on cell starter for lightweight set? (5)
18 Does without a diode use to say goodbye? (5)
19 Lacking outside interference in pastoral areas (7)
23 Neat oscillator with a heat generator? (4)
24 Microphone with an illegal bar? (9)
26 Only a saint understands this circuit! (4)
27 It gives you a measure of power (9)

DOWN

1 How often are they very high? (11)
2 Harshness in the reception area? (9)
4 The load we are carrying? (4)
5 Oriental in part assembly for Dad? (5)
6 Not a shilling Scottish audio for an Indian? (5)
7 Two-way system for a dedicated lady? (3)
10 Equipment said to make you oldfashioned anon? (11)
12 Tax for a broken coral circuit? (5)
13 Fear copper casing of Ian's rectifier? (5)
14 A lot of water from one A.C. vibrator? (5)
15 Live modulator at hand endlessly in a big vessel (9)
20 Swapped tales of miniaturization? (5)
21 Mrs Forsyte in the wire network? (5)
22 Coast-to-coast hook-up excludes it? (4)
25 He's no ham! (3)

FOR AMUSEMENT ONLY
ANSWERS NEXT MONTH

HERE IT IS!

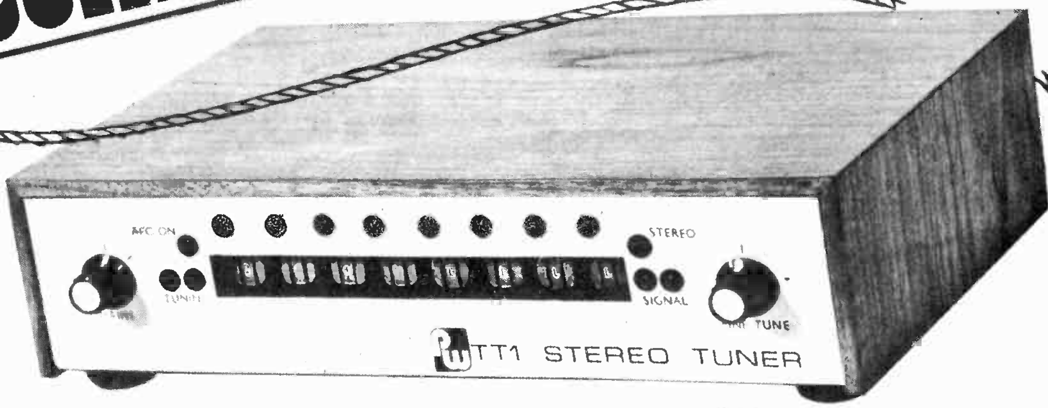
- Your first Info-Card, presented free this month, is designed to be used flat, or folded as shown here.

- When folded it fits into almost any pocket thus providing a readily accessible source of information when buying resistors and capacitors. Check the wattage rating of resistors by comparing them with the full size drawings.

- Do you wonder what nanofarad or nF means? It's all explained on the PW Info-Card for Capacitors and Resistors.

Our PW 'SPRING COLLECTION'

IN NEXT MONTH'S PRACTICAL WIRELESS



FM STEREO TOUCH TUNER (PART 2)

If Part 1 of this project on page 940 has excited your interest then make sure that you order the April issue which will contain details of the remaining PCB's plus assembly and alignment information.

TUG-O-WAR

It's usually a game reserved solely for those muscular, hairy he-men, but now you ordinary mortals have a chance to take part in PW's latest electronic game—Tug 'O' War.

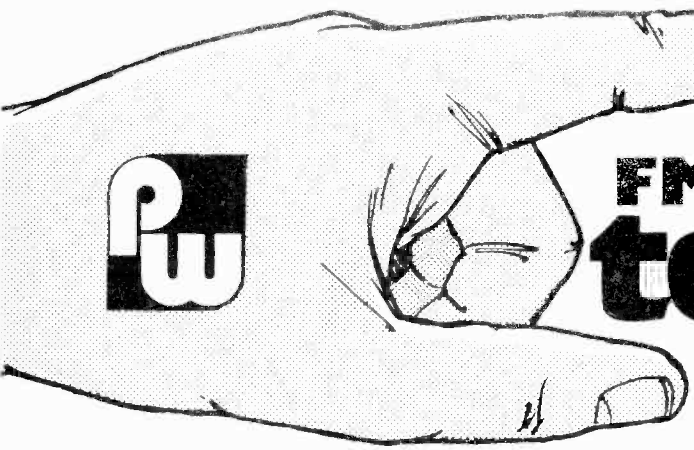
SMOKE SENSOR ALARM

This project incorporates a sensor unit sensitive to many different gases and to smoke. A sensitivity control sets the level at which the audio alarm is triggered. Can be run from a 12 volt battery or the mains.

PLUS ALL THE REGULAR FEATURES

ON SALE IN MARCH

WHILST touch selection of preset stations is not uncommon on modern TV sets, such a method of tuning has yet to make an impact in the FM tuner market. The tuner to be described is therefore unusual in that it possesses just this feature. Any one of eight pre-tuned stations may be selected simply by touching the appropriate "button" on the front panel. The tuner also has stereo defeat, mute and automatic frequency control functions and the required combination of these is set up for each station by a pre-arrangement of diodes inserted in two dual-in-line sockets. Thus when a station is



FM STEREO touch tun

selected, the desired associated set of functions is also switched in.

The tuner itself makes use of fairly orthodox circuitry, using for the most part readily available integrated circuits and a Mullard tunerhead. Light emitting diodes are used to give indications of the station selected, tuning accuracy and signal strength, the presence of a stereo transmission and whether the AFC circuitry is operative or not.

Fig. 1 shows the power supply, which uses two 723 IC regulators. The main power supply rail should be set to about 12V. The tuner will work with anything between about 9 and 14V, but for a variety of reasons, the figure quoted is the most suitable. When a strong signal is being received, and consequently several LEDs are on, current consumption rises to about 200mA; under no-signal conditions it is only 70mA. The tuning voltage is obtained from a separate regulator, IC2. The touch selection ICs require a tuning supply at least 2V higher than the main voltage, and a value of about 17·5V is chosen. Both supplies include current limiting protection and the main power supply uses a power transistor, Tr1,

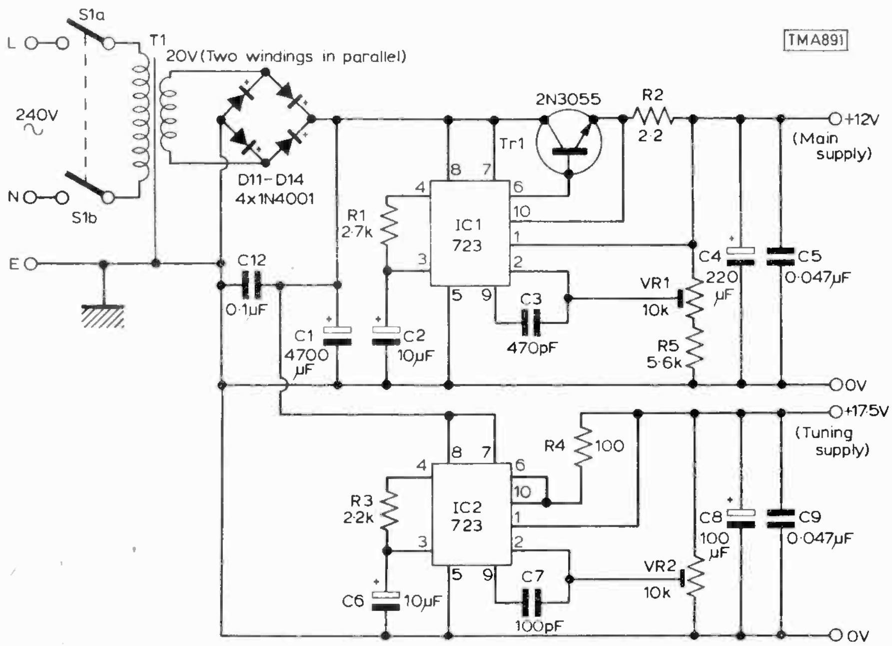
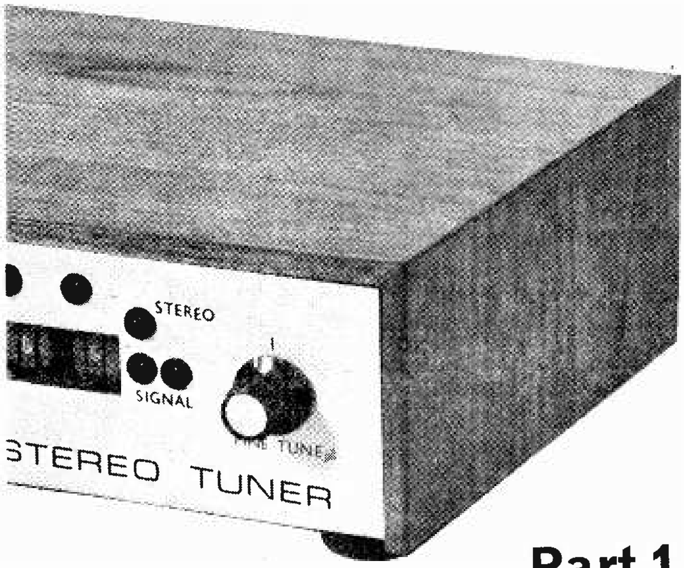


Fig. 1: The power supply section of the tuner provides two regulated voltages, one for the tuning circuitry only and the other for the remainder of the tuner requirements.

Fig. 2: Circuit of the tuner proper comprising the tunerhead, IF amplifier IC3, demodulator IC4, stereo decoder IC5 and the audio output filter.



er

Part 1

FRANCIS HOW (B.A. Cantab)

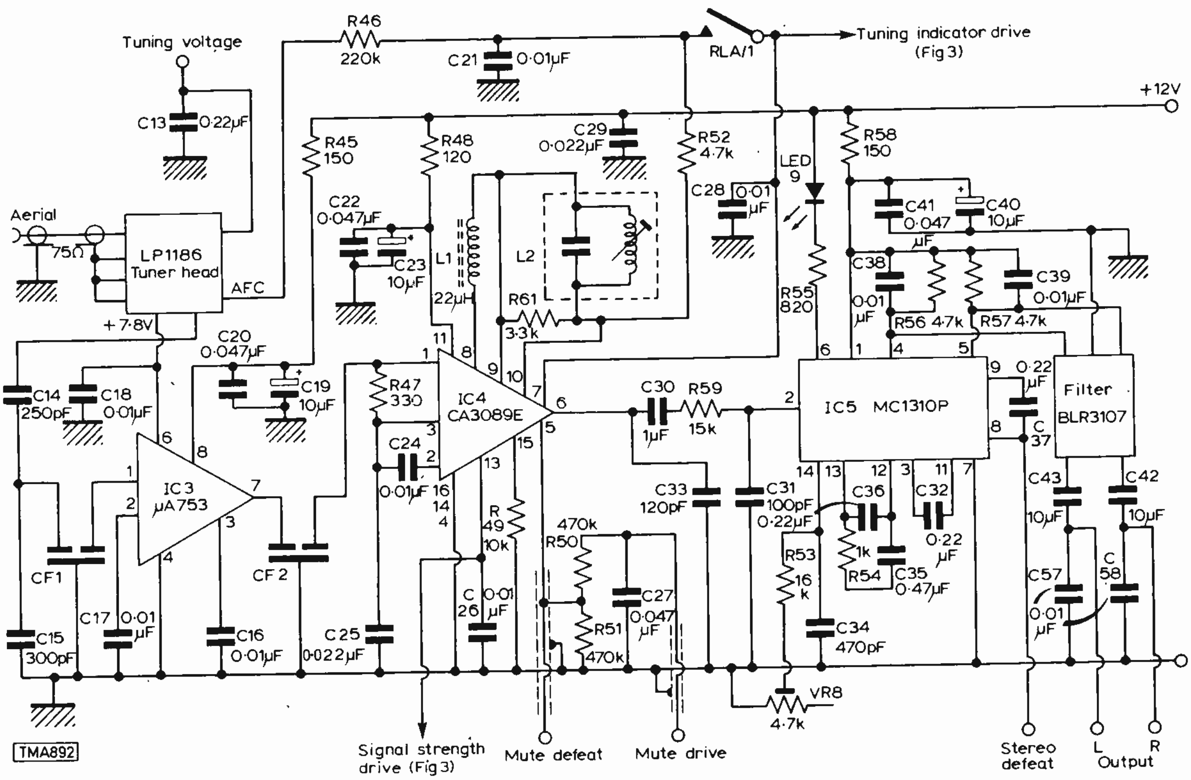
to dissipate the heat generated in dropping the voltage.

TUNER-IF-AFC

The circuitry for the radio part of the tuner is shown in Fig. 2. The tunerhead is a Mullard LP1186 module which is prealigned and provides a partially filtered IF output of 10·7MHz. This avoids one of the most difficult problems of FM tuner construction, namely that of designing a good, trouble-free RF amplifier and frequency changer. IC3 is an IF amplifier designed particularly for use with ceramic filters (CF1 and CF2) in the configuration shown, having suitable matching impedances of 330Ω. It has two outputs of differing levels, and here it is quite sufficient to use the lower one (pin 7). The device has a useful additional feature in that pin 6 provides a stabilised DC voltage of 7·8V suitable for driving the tunerhead.

In the prototype CFSA10·7 ceramic filters were used; if however it is intended to use the tuner for long range reception where it may be rather trying to separate stations less than about 300kHz apart it may be worthwhile paying a little more for Vernitron FM4 filters. These have a better out-of-band performance and will make the receiver less susceptible to heterodyning of adjacent station signals (which have leaked through the system) with any stereo pilot tones present, producing annoying chirping in the output.

The well-known CA3089E (IC4) is employed to demodulate the filtered IF signal and a single-tuned detector coil (L2) simplifies alignment of this stage. The IC provides an AFC voltage on pin 7. When the AFC is switched on this voltage is fed via reed relay contact RLA1 to the local oscillator in the tunerhead. When off, the oscillator is left tied only to the reference voltage on pin 10 via R52. The tuning indication voltage is also obtained from pin 7, and a signal strength indication from pin 13. The IC also includes a muting circuit which cuts off the audio output in the absence of a signal of sufficient strength. In this instance it is not possible to drive the mute logic (input on pin 5) from the internal



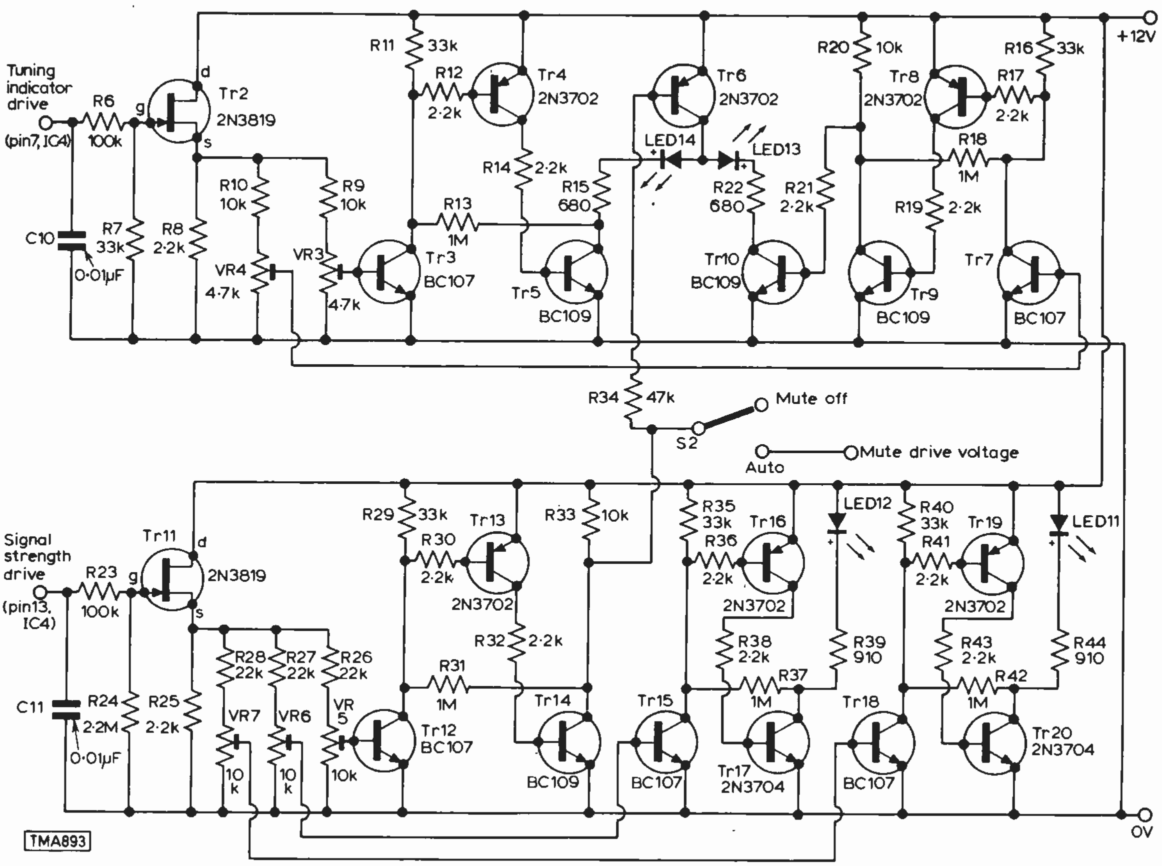


Fig. 3: Tuning indicator circuit including the LED tuning indicators is at the top with the signal strength and associated LEDs at the bottom.

mute drive voltage (pin 12) because the stability of this voltage is upset by the use of a high gain IF stage preceding IC4. Pin 5 is therefore driven by an externally derived voltage.

STEREO DECODER

The stereo output from IC4 (in its multiplexed form) is fed to the stereo decoder MC1310P (IC5) via C33, C30, R59 and C31 which produce a high frequency roll-off to help prevent leakage of adjacent station signals to the decoder (as mentioned before). This filter is not chosen for a −3dB point at 55kHz (the ideal situation) as this tends to diminish the stereo separation. More complicated circuitry would be needed to prevent the leakage and still maintain the full 53kHz bandwidth occupied by the two channels.

The decoder is a phase-locked loop system and the only adjustment required is alteration of the internal oscillator by VR8 until the device captures and de-multiplexes the incoming signal. The decoding action can be defeated by earthing pin 8, and the means of doing this will be shown later. The output is fed to a DIN socket via the filter module BLR3107. This unit severely attenuates the 19kHz and 38kHz pilot and multiplex frequencies in the output. If this were not done the frequencies might cause disastrous whistling and howling when recording from the tuner by mixing with the tape head bias frequency. The presence of a stereo signal is indicated by the illumination of the beacon, LED9. Capacitors C57 and C58 are inserted to balance to audio output. The filter should be terminated with 4·7kΩ resistors but a better tonal quality was obtained with the arrangement shown. The reader may wish to alter this to suit himself or his amplifier!

TUNING INDICATORS

A pair of LEDs is used to indicate the tuning accuracy. When properly adjusted both lights will come on, and as the receiver is de-tuned one way or the other, will be extinguished depending upon the direction of de-tuning. Similarly the signal strength is indicated by a pair of LEDs. Under good signal conditions both will be on, but only one or neither for weaker signals. With zero or extremely weak signal reception the tuning LEDs will also be extinguished. Most LED tuning indicators of the type described use a long-tailed pair, but the switching of the lamps by this circuitry is not particularly sharp.

The author preferred indicators with a sharp on/off action, and to this end a voltage level detector circuit was designed with low hysteresis but a sharp transition. The basic unit is used five times in the indicator circuitry, Fig. 3. Each is fed by one of two FET buffers via a preset potentiometer (VR3-VR7) which determines the switching level of the circuit. Circuit action is fairly straightforward, the 1MΩ resistors introducing a small amount of positive feedback to sharpen the switching action.

The top half of the circuit shows the tuning indicator drive. It will be seen that the second level detector contains an extra transistor, Tr10. This

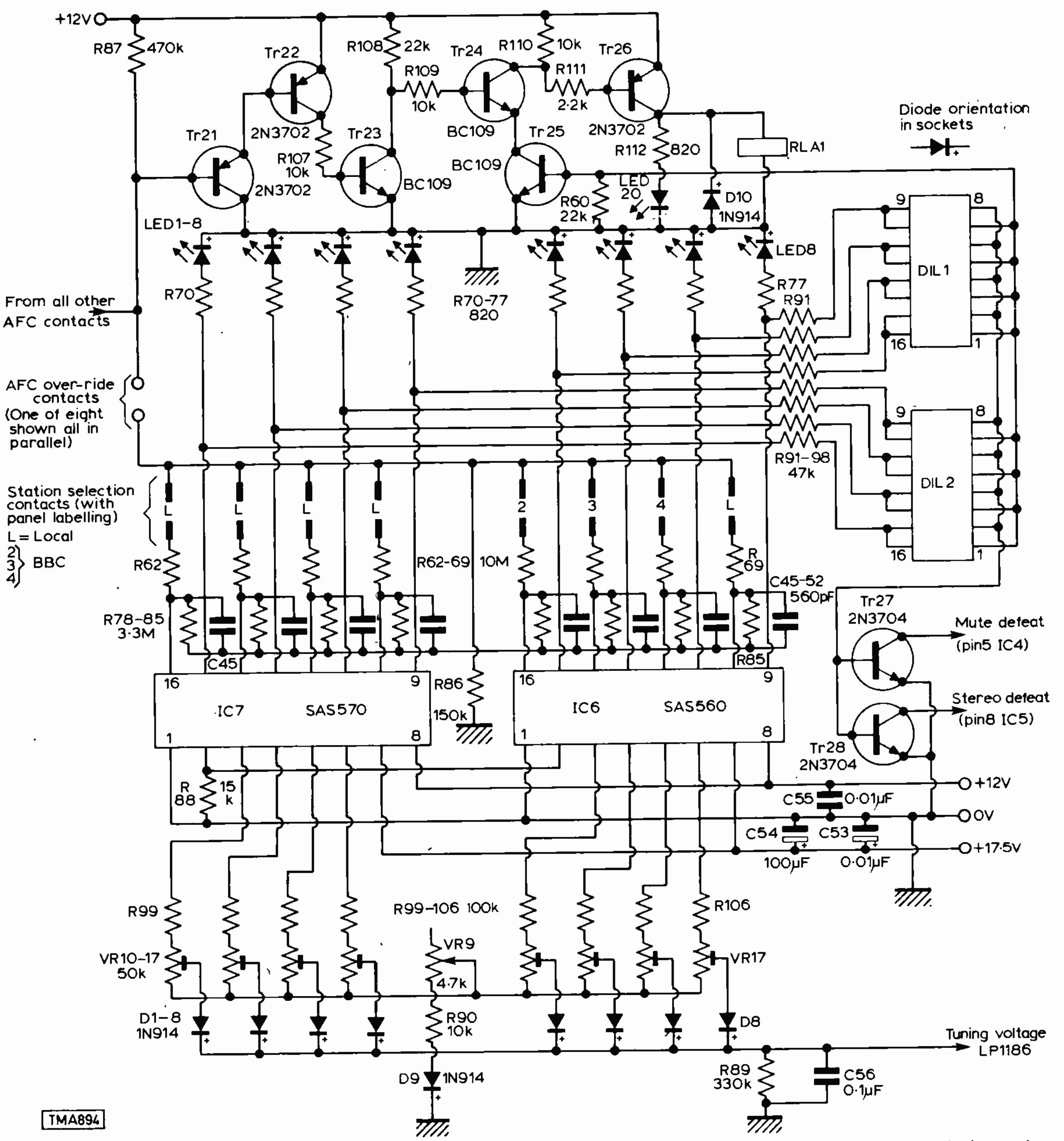
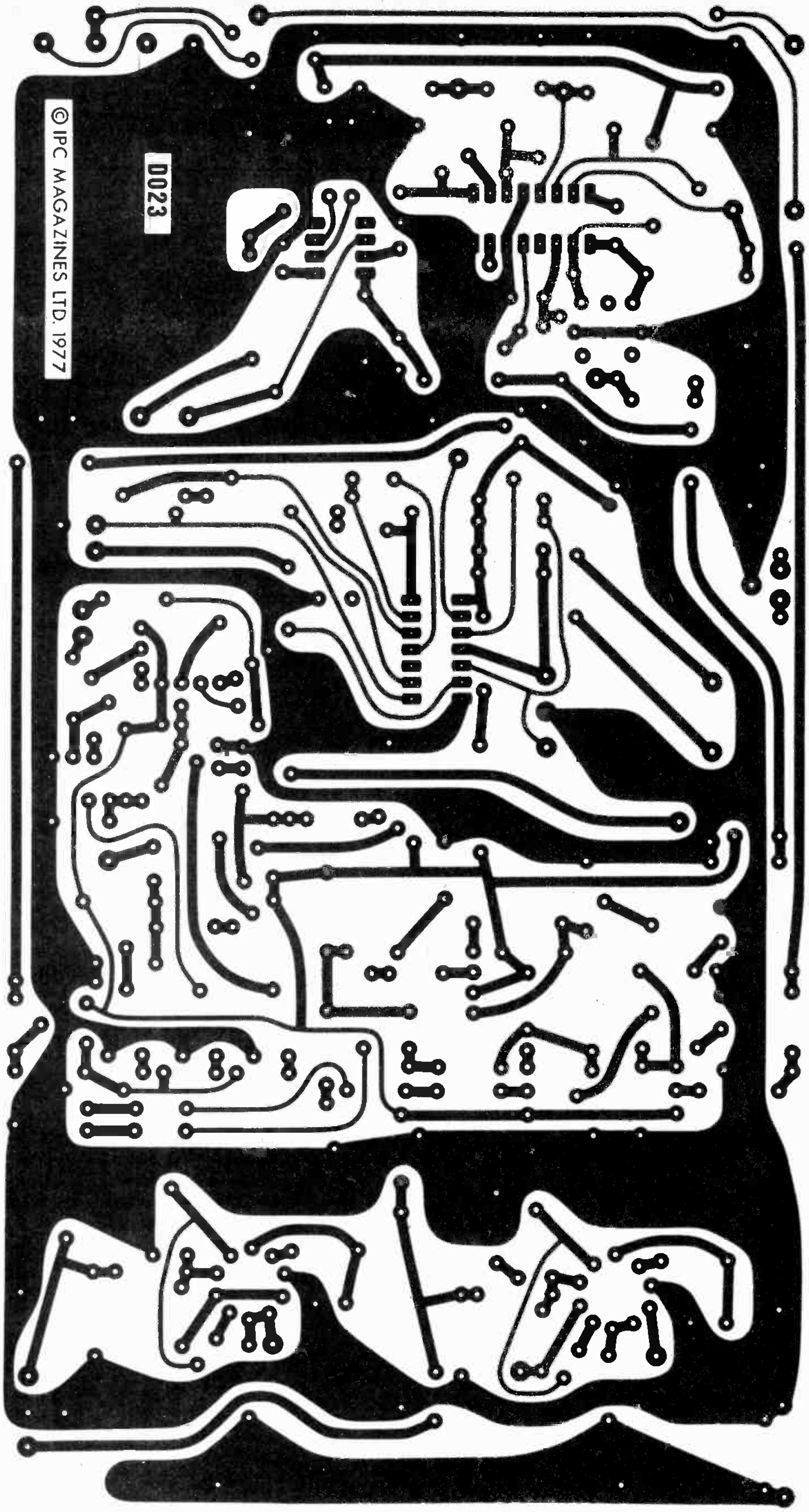


Fig. 4: All the circuits of Figs. 1, 2 and 3 are mounted on the main PCB. The eight touch buttons and the touch selection circuit shown above are mounted on two smaller boards mounted behind the front panel.

inverts the action of that circuit so that the system as a whole acts as a window voltage detector, providing indications as to whether the tuning indicator drive voltage from pin 7 on IC4 is above, below, or in the window. Only in the latter state is the tuner correctly tuned to a station. Tr6 is driven by a signal strength level detector from the bottom half of the circuit so that when that detector is switched off, Tr6 is off and both tuning LEDs are extinguished. This circuit also provides the mute drive voltage mentioned earlier. When Tr14 is on the mute drive falls to about 1V and the audio is not attenuated. S2 is fitted to the rear of the tuner chassis and may be switched either to auto (when the mute action is as described) or to "mute off" when the audio output is never attenuated, regardless of the signal conditions. The other two level detectors in the bottom half of Fig. 3 provide the signal strength drive to LEDs 11 and 12.

TOUCH SELECTION

All the circuitry so far described is mounted on PCB1 (Figs. 5a and 5b) which lies flat in the bottom of the chassis. Two more PCBs house the touch selection circuitry and they are mounted vertically, just behind the front panel and about ¼in. apart. PCB3 is nearer the panel and on this are etched the eight touch "buttons", PCB2, behind PCB3, houses all the circuitry shown in Fig. 4, namely the touch selection ICs, the tuning presets and the AFC override circuitry.



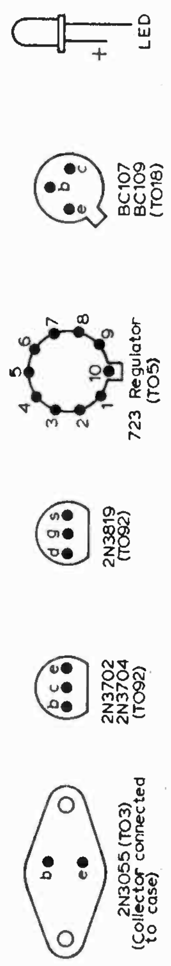


Fig. 5a: The foil layout for the main board PCB1 is shown here full size together with the leadout identification for the transistors, voltage regulators and LEDs.

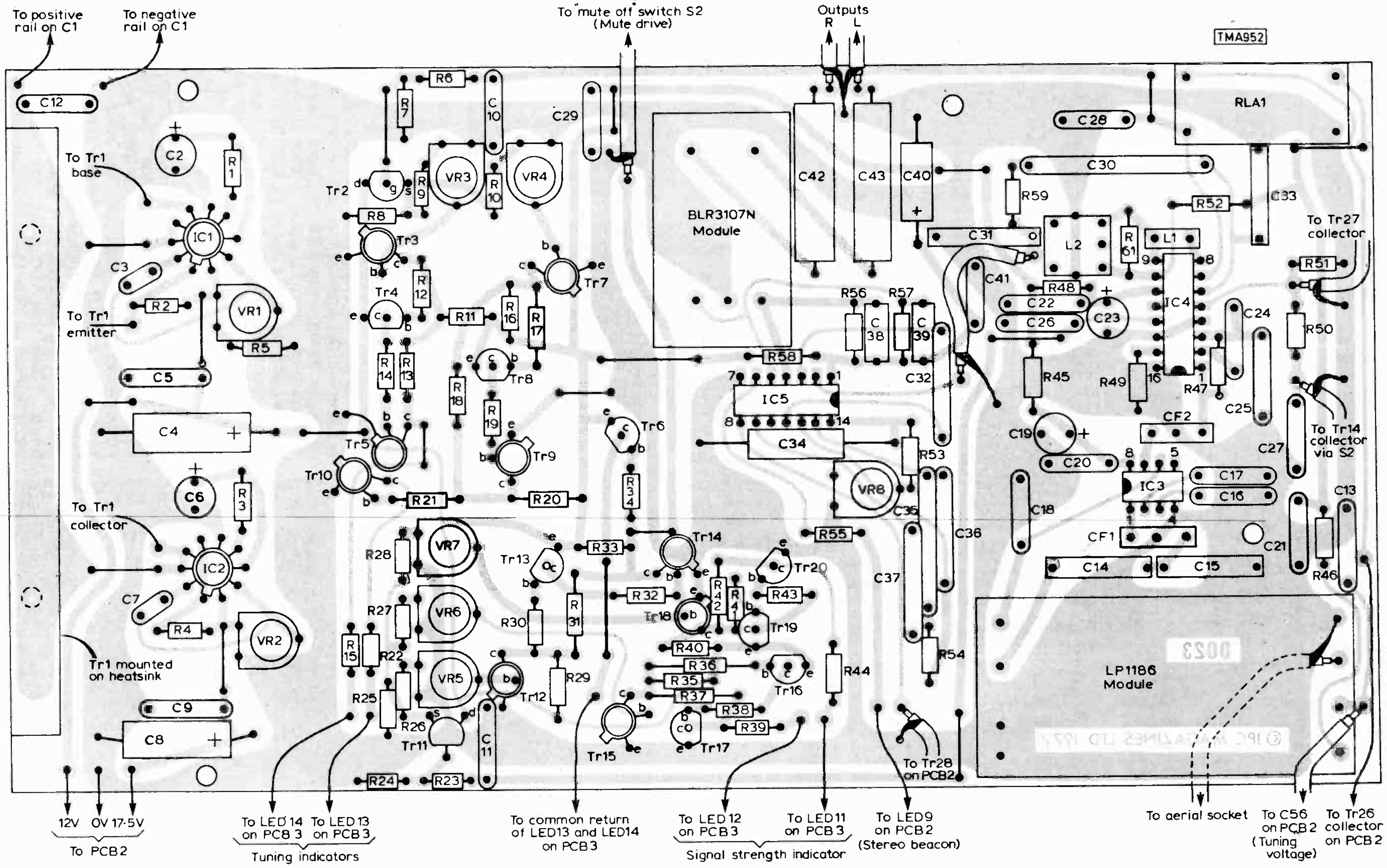


Fig. 5b: Component layout on top of the main PCB. Details of the Tr1 heatsink and reed relay assembly will be shown next month. The IF filters CF1 and CF2 may be mounted either way round. Reference to the photograph of the tuner on page 947 may be helpful when assembling this PCB. Care must be taken if using a reed relay other than the one shown to ensure that the contacts of the relay and the operating coil connections go to the correct points on the PCB.

★ components list

Resistors

R1 2·7kΩ	R27 22kΩ	R53 16kΩ
R2 2·2Ω(½W)	R28 22kΩ	R54 1kΩ
R3 2·2kΩ	R29 33kΩ	R55 820Ω
R4 100Ω	R30 2·2kΩ	R56 4·7kΩ
R5 5·6kΩ	R31 1MΩ	R57 4·7kΩ
R6 100kΩ	R32 2·2kΩ	R58 150Ω
R7 33kΩ	R33 10kΩ	R59 15kΩ
R8 2·2kΩ	R34 47kΩ	R60 22kΩ
R9 10kΩ	R35 33kΩ	R61 3·3kΩ
R10 10kΩ	R36 2·2kΩ	R62—R69 10MΩ
R11 33kΩ	R37 1MΩ	R70—R77 820Ω
R12 2·2kΩ	R38 2·2kΩ	R78—R85 3·3MΩ
R13 1MΩ	R39 910Ω	R86 150kΩ
R14 2·2kΩ	R40 33kΩ	R87 470kΩ
R15 680Ω	R41 2·2kΩ	R88 15kΩ
R16 33kΩ	R42 1MΩ	R89 330kΩ
R17 2·2kΩ	R43 2·2kΩ	R90 10kΩ
R18 1MΩ	R44 910Ω	R91—R98 47kΩ
R19 2·2kΩ	R45 150Ω	R99—R106 100kΩ (2%)
R20 10kΩ	R46 220kΩ	
R21 2·2kΩ	R47 330Ω	R107 10kΩ
R22 680Ω	R48 120Ω	R108 22kΩ
R23 100kΩ	R49 10kΩ	R109 10kΩ
R24 2·2MΩ	R50 470kΩ	R110 10kΩ
R25 2·2kΩ	R51 470kΩ	R111 2·2kΩ
R26 22kΩ	R52 4·7kΩ	R112 820Ω

All resistors ¼W 5% carbon except where indicated otherwise.

VR1, VR2 10kΩ pre-set
VR3, VR4 4·7kΩ pre-set
VR5—VR7 10kΩ pre-set
VR8 4·7kΩ pre-set
VR9 4·7kΩ lin. carbon pot.
VR10—VR17 20-turn cermet trimpots all 50kΩ.
Presets are miniature type, horizontal mounting.

Capacitors

C1 4700μF 40V	C27 0·047μF*
C2 10μF 25V	C28 0·01μF*
C3 470pF ceramic plate	C29 0·022μF*
	C30 1μF*
C4 220μF 25V	C31 100pF mica
C5 0·047μF*	C32 0·22μF*
C6 10μF 25V	C33 120pF mica
C7 100pF ceramic plate	C34 470pF polystyrene
	C35 0·47μF*
C8 100μF 25V	C36 0·22μF*
C9 0·047μF*	C37 0·22μF*
C10 0·01μF*	C38 0·01μF*
C11 0·01μF*	C39 0·01μF*
C12 0·1μF*	C40 10μF 25V (axial leads)
C13 0·22μF*	
C14 250pF mica	C41 0·047μF*
C15 300pF mica	C42 10μF non-polarised 25V
C16 0·01μF*	
C17 0·01μF*	C43 10μF non-polarised 25V
C18 0·01μF*	
C19 10μF 25V	C45—C52 560pF ceramic plate
C20 0·047μF*	
C21 0·01μF*	C53 0·01μF*
C22 0·047μF*	C54 100μF 25V
C23 10μF 25V	C55 0·01μF*
C24 0·01μF*	C56 0·1μF*
C25 0·022μF*	C57 0·01μF*
C26 0·01μF*	C58 0·01F*

* C280 polyester. C44 is omitted

A set of three PCB's can be obtained from the PW Readers PCB Service, see ad. on page 956. Semiconductors are available from Chromasonic Electronics, A Marshall Ltd., Watford Electronics, etc.

Semiconductors

IC1, IC2 723 regulators (TO5 can)
IC3 μA753
IC4 CA3089E
IC5 MC1310P
IC6 SAS560
IC7 SAS570

Tr1 2N3055	Tr15 BC107
Tr2 2N3819	Tr16 2N3702
Tr3 BC107	Tr17 2N3704
Tr4 2N3702	Tr18 BC107
Tr5 BC109	Tr19 2N3702
Tr6 2N3702	Tr20 2N3704
Tr7 BC107	Tr21 2N3702
Tr8 2N3702	Tr22 2N3702
Tr9 BC109	Tr23 BC109
Tr10 BC109	Tr24 BC109
Tr11 2N3819	Tr25 BC109
Tr12 BC107	Tr26 2N3702
Tr13 2N3702	Tr27 2N3704
Tr14 BC109	Tr28 2N3704

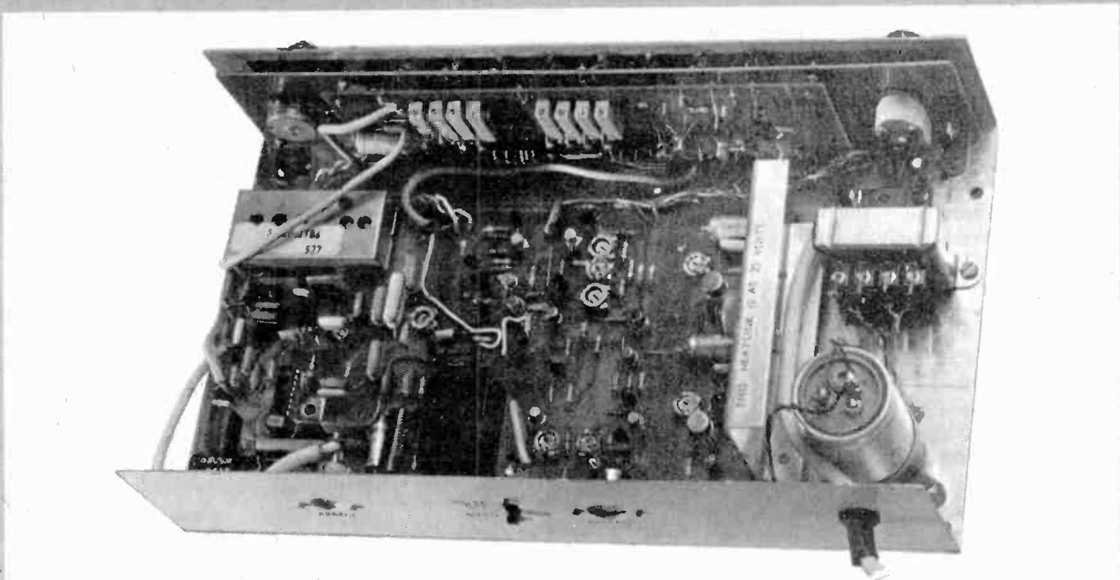
D1 to D10 1N914
D11 to D14 1N4001

LED1 to LED14 (GP, 0·2″ red, with clips)
Diodes for DIL Sockets:—1N914's

Miscellaneous

Tunerhead, (Mullard LP1186).
L1, 22μH choke (Ambit)
L2, 10·7MHz tuned circuit type KACSK-586HM (Ambit)
RLA Relay, reed type miniature, 12V 1kΩ, normally open.
Pilot filter, type BLR-3107 (Ambit).
CF1, CF2, IF Filters CFSA10·7 (Ambit) specify colour code as 'blank', or Vernitron FM4 (Home Radio).
T1, mains transformer 240V/0-20V + 0–20V 150mA (6VA). (Doram 980-704).
S1, Switch, DP mains on-off, rotary.
S2, Switch, SP on-off, miniature slide.
Coaxial socket.
DIN socket, 5-pin 180°.
Aluminium sheet, 18SWG
300 x 180mm ($11\frac{13}{16}$ x $7\frac{1}{16}$in.)
300 x 90mm ($11\frac{13}{16}$ x $3\frac{1}{2}$in.)
Mounting clip, vertical, for C1.
Mains cable and grommet.
Plywood and veneer for sleeve.
Rubber feet, 4 off.
Panel knobs, 2 off.
Angle brackets for sleeve, 6 off.
DIL1, DIL2 16-pin IC sockets.

Construction of the touch selection unit is simplified by the use of two ICs, SAS560 and SAS570, Fig. 4, which are purpose-built for this type of application. They have four high impedance inputs and provide the same number of tuning voltage and LED drive outputs. Any one station is selected by placing a finger on the appropriate pair of contacts, whereupon the tuning and LED voltages appear at the corresponding pins. By using a high tuning voltage (17·5V) and dropping resistors R99 to R106, a fine tune control VR9 on the front panel can be incorporated so that it gives approximately the same range of adjustment at the extremes of the FM broadcast band. Diodes D1 to D8 ensure that those tuning presets (VR10 to VR17) not being fed with the tuning supply voltage are isolated from the one which is. Each electronic "button" has three contacts; one is an earth link (via R86), one is connected to an input on IC6 or IC7 and one is connected to the base of Tr21. This transistor forms the input to a circuit which switches out the AFC (assuming it is on) when the contact is bridged to earth by a finger. When the AFC is on, the tuning indicator LEDs remain on over the whole range for which the



General view inside the finished Touch Tuner. The two PCBs behind the panel carry the touch buttons and selection circuits. The tunerhead is at top left with the audio output filter at bottom centre. At the right is the Tr1 heatsink, mains transformer and smoothing capacitor.

COLLATED COMPONENTS LIST

Resistors ¼W 5% carbon, ex 2·2Ω

2·2Ω ½W	1	2·7kΩ	1	100kΩ 2%	8
100Ω	1	3·3kΩ	1	100kΩ	2
120Ω	1	4·7kΩ	3	150kΩ	1
150Ω	2	5·6kΩ	1	220kΩ	1
330Ω	1	10kΩ	9	330kΩ	1
680Ω	2	15kΩ	2	470kΩ	3
820Ω	10	16kΩ	1	1MΩ	5
910Ω	2	22kΩ	5	2·2MΩ	1
1kΩ	1	33kΩ	6	3·3MΩ	8
2·2kΩ	15	47kΩ	9	10MΩ	8

Pre-set pots, miniature, horiz.				
4·7kΩ	3		10kΩ	5
Pot. linear carbon			4·7kΩ	1
Trimpot, 20 turn Cermet			50kΩ	8

Capacitors

Mica	100pF	1		0·1µF	2
	120pF	1		0·22µF	4
	250pF	1		0·47µF	1
	300pF	1		1µF	1
P'sty	470pF	1	**Elec**	10µF 25V	5
Ceramic	100pF	1		10µF 25V NP	2
	470pF	1			
	560pF	8		100µF 25V	2
C280	0·01µF	15		220µF 25V	1
	0·022µF	2		4700µF 40V	1
	0·047µF	6			

Semiconductors

IC's	723 (T05)	2		2N3819	2
	µA753	1		BC107	5
	CA3089E	1		BC109	7
	MC1310P		**LED**	GP 0·2" Red with clip	14
	SAS560	1			
	SAS570	1			
Tr's	2N3055	1	**Diodes**		
	2N3702	9		1N914	10+
	2N3704	4		1N4001	4

station is pulled into tune. Thus to tune the station accurately the AFC must be temporarily defeated, and this is a convenient way of achieving it.

We now come to the two DIL sockets, Fig. 4. Conventional tuners have a row of switches on the front panel, controlling the action of such functions as the stereo defeat, the mute circuitry and the AFC. This tuner is exceptional in that the desired combination of these functions is preset for each station by the insertion of diodes in DIL1 and DIL2. Thus the desired arrangement is automatically switched in when the station is selected. So for Radio 2 (the station labelling is located between electrodes on Fig. 4) LED5 is illuminated; by connecting a diode across pins 1 and 16 on DIL 1 the AFC may be switched in for that station, providing base drive to Tr25 and to defeat the stereo and mute action a diode would be inserted across pins 2 and 15. Similarly diodes may be connected for other stations.

The mute and stereo defeat circuitry always act together since it is rare to require one without the other. Tr27 shorts pin 5 on IC4 to earth when turned on thus switching the mute circuit off, and likewise Tr28 shorts pin 8 on IC5 to earth which inhibits the decoding action of the stereo de-multiplexer IC.

It might be suggested that if tuning is all preset, there is no need for a mute circuit. However, when actually tuning, the interstation noise is very loud and best removed, in this case by the mute action. Secondly, when a station goes off the air that channel then is silent instead of producing 200mV of noise (unless of course the station is so weak that the mute had to be defeated to hear it).

IN PART 2, NEXT MONTH, WE DESCRIBE THE 'BUILD AND TEST AS-YOU-GO' PROCEDURE FOR CONSTRUCTING AND ALIGNING THE TOUCH TUNER. PLUS DETAILS OF THE BOARDS PCB2 AND PCB3 AND GENERAL ASSEMBLY INFORMATION

HOTLINES

ON RECENT DEVELOPMENTS

The melting pot

Things are hotting up in the solar energy field. Latest method is the subject of patents and looks quite ingenious. With a solar cell, sunlight is converted direct into electrical energy. In this newer approach, the sunlight is converted into electricity by chemical means.

First step is to take a solar furnace (a suitable container with a dirty great lens focussing the sun's rays into the centre of it). Into this furnace is pumped some stuff called Sulphur Trioxide—chemically educated associates tell me that it's also known as SO_3.

The Sulphur Trioxide gets hot and absorbs heat, and as it does so it separates by a process called dissociation. By pursuading the separated parts to pass through another chamber, they recombine to form Sulphur Trioxide again but in the process they give up the heat. The Sulphur Trioxide, now recombined and happy with life, is simply pumped back into the solar furnace for the next round of heat absorbtion and transfer.

Boom boom boom boom—SO_3.

Ion bullets

Remember Jan's story about I²L, well I see that this new process involves a thing called ion implantation. To achieve this, the semiconductor substrate is prepared and set up inside a chamber. Then ions, tiny particles of the desired impurity, are 'fired' by an electronic machine gun at the substrate. If you were to look at the whole shooting match under a "times umpteen million" microscope, you'd see the lattice structure of the atoms in the substrate surface. And along, at great speed, would come these ions. Depending upon how you angle the substrate and thereby the lattice, will depend on wether the ions go straight into the lattice without striking any of the individual member atoms which make up this lattice, or wether the ions will collide with lattice atoms. If they do they will be slowed down and will not penetrate so far into the substrate. Thus ion implantation is a very precise method of doping semiconductors and this process is used in the manufacture of this new I²L. Incidentally, the manufacturers are calling it "Substrate-fed logic" or Schottky I²L.

Probing power

New products are launched onto the market by their hundreds every month (some people argue that it's hundreds every week in electronics). Two which caught my eye last month might interest readers. One was a logic probe which allows one to prod round a logic circuit and find out what's happening. It's called the Catch-a-Pulse and will inform on six states; positive-going pulses, negative-going pulses, square waves, a logic one, logic nought, and no signal. Fountain-pen shaped it looked a useful device but most impressive was the price in the U.S.—just $32.

The second device is a transistor: and what a transistor. It has the impressive name of STC9160 and the even more impressive power handling capability of 500W. This transistor is housed in a TO-3 package and is described by its manufacturer as a 50A device. It's quick, too. It will turn on in just 3·5 millionths of a second.

We've come a long way from those little "red-spot" transistors.

Small talk

If there ever was such a word as "Littlerer" it would surely apply to a new development at the research labs of a British manufacturer. Previously, I've mentioned a semiconductor technology called injection logic or I²L. What the British company has done is to adopt a significant variation of I²L with the result that the packing density—how many transistors can be got in a given size—has been increased some three times. At the latest head count they had managed to squeeze some 800 semiconductor gates into an area of 1mm x 1mm. Just get a ruler and look at one lone millimetre. Better still draw a 1mm square on a piece of paper and then imagine 800 transistors inside that. See what I mean about "littlerer"?

Spot-on

Yet another interesting device mentioned at the Washington conference was a stable reference voltage source. This one is the brainchild of an American company and is still at the laboratory stage but it looks extremely promising. It employs a short channel MOSFET in what's called the punchthrough mode (don't even ask!) What is important is that when persuaded to supply a reference voltage at just over 3·8V, this device held the voltage stable to within ±0·0005V. Even more important, it held the voltage to within that 0·0005V over the temperature range of 25°C to 50°C.

Perhaps the government could have a whip round and purchase one for the British economy?

4-layer switch

What about getting a Thermosenstor for Easter? I didn't believe it either but it cropped up at the International Electron Devices Meeting in Washington recently. It's basically a temperature-sensitive switching device and it's the handywork of a Japanese company who gave a paper on it at the conference. The theory of it is quite horrendous (I reckon a degree in Venusian physics is required to understand it) but in simple terms it is a pnpn semiconductor, a four-layer device. If it is forward biased it can then switch on at a predetermined temperature. The precise turn-on temperature is decided by the value of a solitary resistor which is wired in parallel with the emitter of the Thermosenstor. The temperature switching range extends from 50°C up to 150°C.

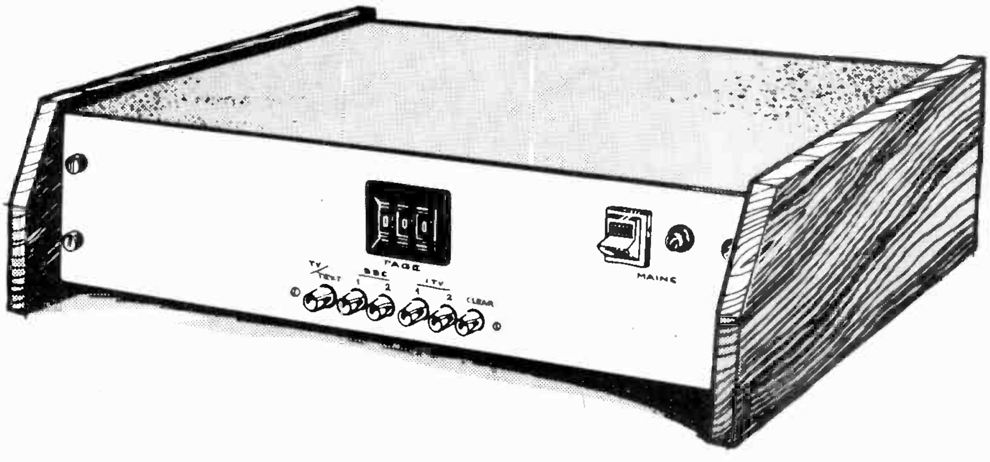
Ginsberg

in next month's issue

TELEVISION

MARCH issue on sale February 21st.

The "TV" TELETEXT DECODER



Have you seen Ceefax/Oracle yet? By building the *Television* Teletext decoder you could soon be watching these services in your own home. It's designed to work with any 625-line receiver, either monochrome or colour, and has the advantage that you don't need to modify your domestic TV set in any way – just plug the decoder's output into the aerial socket. A Teletext decoder is complex, but to make assembly easy this design uses plug-in printed boards and a mother board, while the very latest receiver techniques are used in order to simplify alignment. The unit has its own mains power supply.

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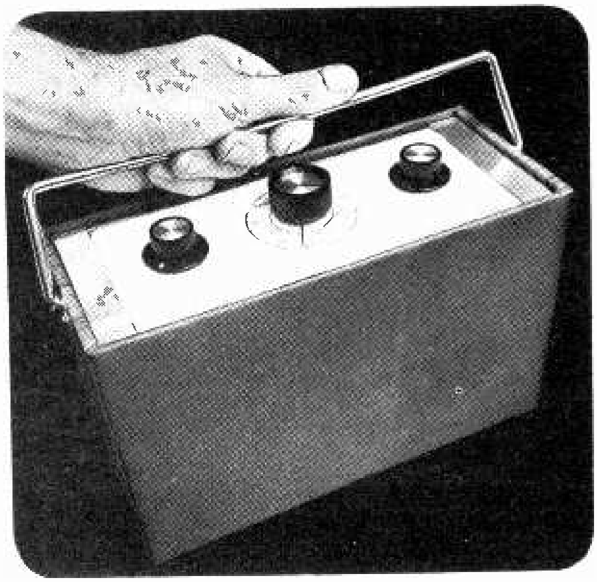
EASYTUNE MW-LW Receiver

F. G. RAYER



THIS receiver uses three transistors and an audio IC in a circuit which is capable of very good results. With the usual form of receiver tuning, signals at the high frequency end of the medium wave band are crowded together and tuning is critical. As an aid to operation on these frequencies high-frequency bandspread is fitted, in addition to long wave and medium wave coverage. This provides three bands, approximately as follows:

Long Wave: 165 to 270kHz.
Medium Wave: 550 to 1525kHz.
Bandspread: 1475 to 1850kHz.

The receiver is not a miniaturised design which simplifies wiring and construction to some extent.

Receiver Circuit

The circuit is shown in Fig. 1 where L1 and L2 are the medium wave and long wave sections of the internal ferrite rod aerial. Base coupling to Tr1 is via L3 and a tapping on L2. Coil L4 is the oscillator coil, common to long and medium waves. For LW coverage L1 and L2 are in series, VC1 with integral trimmer TC1 being for aerial tuning. Switch S2 introduces C3 and TC4, loading the oscillator coil

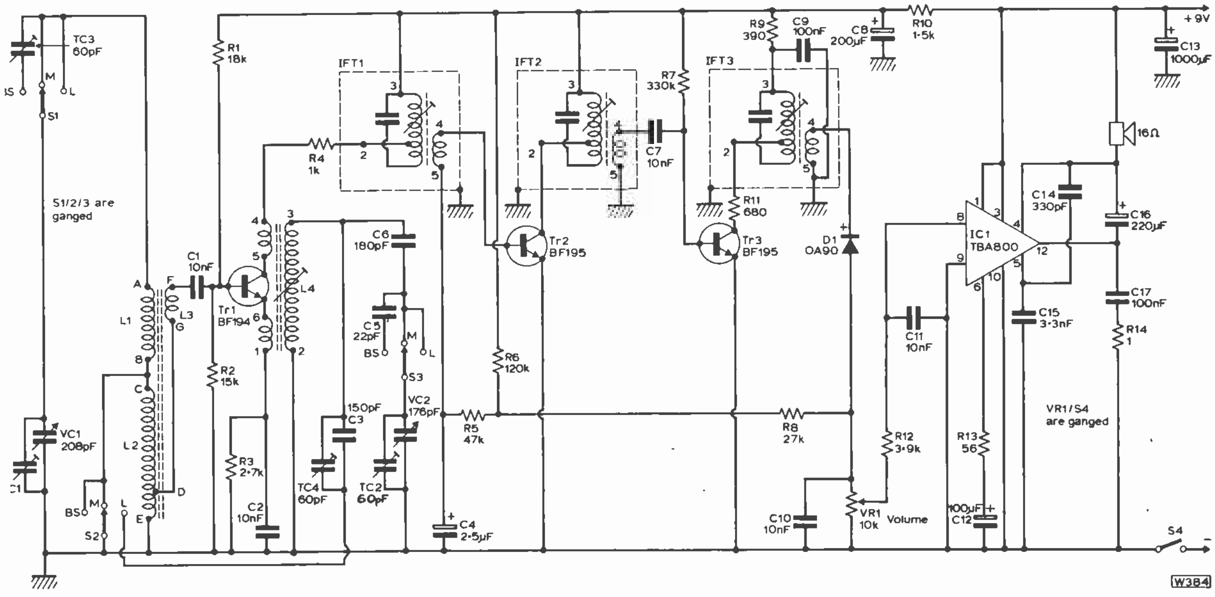


Fig. 1. Complete circuit diagram for the Easytune medium and long wave receiver. The third waveband spreads out the high frequency end of the medium wave band where congestion of stations is prevalent.

★ components list

Resistors

R1	18kΩ	R8	27kΩ
R2	15kΩ	R9	390Ω
R3	2·7kΩ	R10	1·5kΩ
R4	1kΩ	R11	680Ω
R5	47kΩ	R12	3·9kΩ
R6	120kΩ	R13	56Ω
R7	330kΩ	R14	1Ω

All ¼ or ⅛W 5%
VR1/S4 10kΩ log pot with switch

Capacitors

C1	10nF	C10	10nF
C2	10nF	C11	10nF
C3	150pF	C12	100µF 6V
C4	2·5µF	C13	1000µF 10V
C5	22pF	C14	330pF
C6	180pF 5%	C15	3·3nF
C7	10nF	C16	220µF 10V
C8	200µF 10V	C17	100nF
C9	100nF	TC3/4	60pF trimmers

VC1/2 208/176pF, slow motion, with trimmers (Jackson 00)

Semiconductors

Tr1	BF194	D1	OA90
Tr2/3	BF195	IC1	TBA800

Inductances

L1/2/3 MW/LW ferrite rod aerial (Denco FR5)
L4 Oscillator coil (Denco TOC1)
IFT1/2 IF transformer (Denco IFT13) IFT3 (Denco IFT14)

Miscellaneous

Speaker 16Ω 3½in. dia., impedance not critical. Battery 9V and terminal clips. Knobs. Material for cabinet and covering. 10 × 4in. flanged plate (Home Radio, universal chassis member). Handle. Plastic feet. Two brackets, home made. S1/2/3 3-pole 3-way single wafer switch

for suitable coverage. This coil is tuned by VC2, TC2 being part of the ganged capacitor.

For MW reception S2 shorts out L2 and C3/TC4 are out of circuit. C6 is the oscillator coil padder. For bandspread reception, S1 places TC3 in series with VC1 and S3 places C5 in series with VC2. This results in a narrow frequency coverage for the full rotation of VC1/2. Switch S2 shorts out L2 as for ordinary MW tuning.

Silicon transistors are used for the self-oscillating mixer Tr1, and the two IF amplifiers Tr2 and Tr3. Diode D1 is the detector also providing an automatic gain control voltage for Tr2 through R8 and R5.

The required audio level is provided by the volume control VR1. The IC provides audio, driver and push-pull output stages, with diode compensation, and operates the loudspeaker directly. This audio IC has a low standing current and is economical while giving excellent volume from a 9V supply. S4 is the on/off switch incorporated in the audio gain control.

The three IF transformers are pre-tuned and there should be no particular difficulty in aligning the receiver even if no signal generator or other instrument is available.

Circuit Board

The board is approximately 127 x 70mm (5 x 2¾in), Fig. 2. The first step is to drill holes for TC4, L4 and the three IFTs. Position them so that the tags will come as shown in Fig. 3. A coloured spot marks pin 4 of L4. A $^{3}/_{32}$in drill is suitable here, with a $^{1}/_{16}$in drill for the can tags of L4 and the IFTs. No force should be used to fit these items and if necessary holes may be adjusted to give an easy fit by employing a small file.

It is as well to leave the transistors and IC1 off until later. Underneath wiring is shown in Fig. 3. Probably the simplest way is to begin by wiring the earth line to the can tags, using 24SWG tinned copper wire. Follow by placing resistors and capacitors as in Fig. 2, then turn the board over and shape and solder the wire ends, cutting off any excess leads. Sleeving is put on leads which cross or run near each other or near joints and tags. There is plenty of space for components but reasonable care is necessary to make a sound job here.

If necessary check resistor values as they are inserted. The electrolytic capacitors must be placed with the polarity shown. If each connection and component is marked in coloured pencil as completed it is unlikely that anything will be omitted.

Semiconductors

The pins of the transistors are placed as in Fig. 3 and leads are soldered to them. Avoid lengthy heating of these joints in particular. The iron should be at its full temperature and should be applied to the cored radio grade solder, which is held on the joint. The solder should flow in a second or so, and the iron is then removed at once.

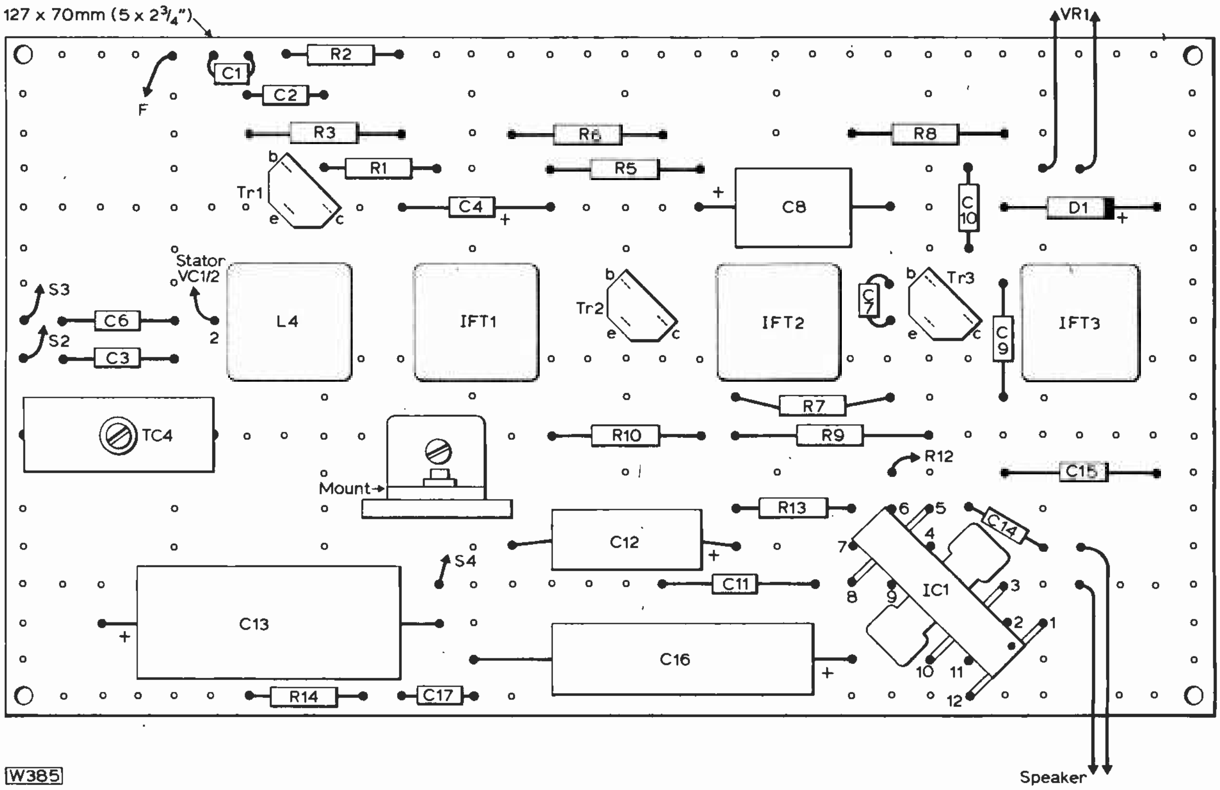
Shape the ends of D1 to reach pin 4 and R8. Be sure this component is fitted with the polarity correct. Positive on the diode is indicated by a coloured band. If this diode is reversed the AGC action is upset.

The pins of IC1 are located as in Fig. 2 and spaced to fit the 0·15in matrix of holes. Bend the heat sink fins up slightly to clear the board and C14. Only pin 1 is marked on the actual IC. These pins come close together and they are small so a little care is needed when soldering them to connections, as in Fig. 3. Unused tags must not touch other connections or joints.

Wiring

Leads can be provided by fitting lengths of thin coloured flex or by inserting Veropins, which will take leads running to the appropriate points. A lead will run from C1 to F on L3, another from C3 and C6 to sections S2 and S3 of the bandswitch and a wire will run from 2 on the oscillator coil to the frame tag of VC1/2. In the audio section, D1 negative and an earthing lead from pin 5 of IFT2 run to VR1. Resistor R12 is soldered to the rotor tag of VR1 and is wired to C11 and pin 8 of IC1. Twin leads are provided from pins 3 and 4 of IC1 to go to the loudspeaker.

All these leads can be several inches long and arranged to come from the board as in Fig. 2 so that they can be readily identified later.



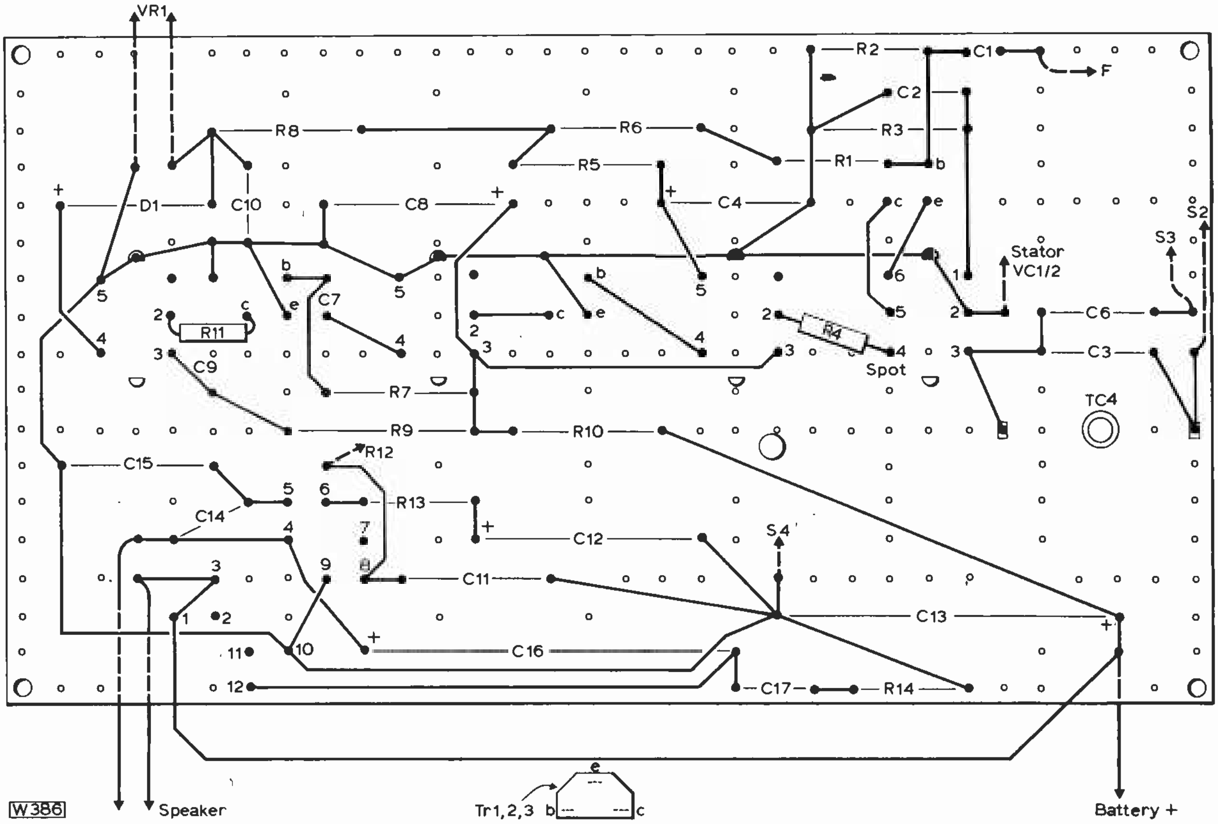
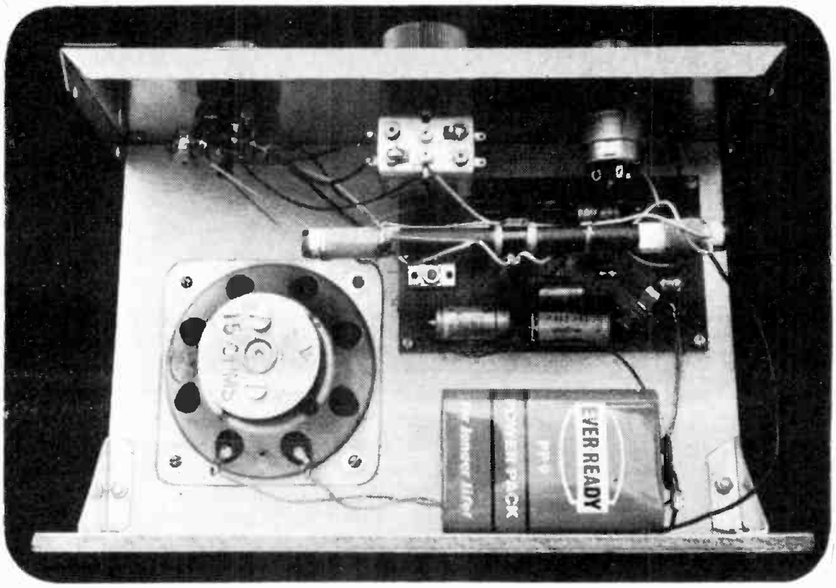


Fig. 2: at the top, shows the top of the veroboard and layout of components. The board size is 127 x 70mm (5 x 2¾in.). Fig. 3: at the bottom, illustrates the wiring necessary under the board. In many cases the component lead is sufficiently long to make a connection.



General view of the finished receiver. The details of the bracket holding the ferrite rod aerial can be seen in Fig. 2.

Sub-assembly

This assembly allows the receiver to be made up as a complete working unit while all connections and the underside of the circuit board are easily reached. Cut a piece of 6mm plywood 250 x 160mm ($9\frac{7}{8}$ x $6\frac{1}{4}$in). At the right, 63mm ($2\frac{1}{2}$in) from the right edge and 63mm ($2\frac{1}{2}$in) from the bottom, mark a centre, and draw a 75mm (3in) diameter circle. Cut out this part to take the speaker. If a speaker of different size is used, cut this aperture to suit the dimensions of its cone.

Position the circuit board approximately 12mm ($\frac{1}{2}$in) from the left edge and a similar distance from the top of the plywood. Mark round the circuit board with a pencil. This part is now cut out, but corners approximately 16mm ($\frac{5}{8}$ x $\frac{5}{8}$in) and of triangular shape are left so that the circuit board can be secured by four woodscrews driven through the holes in Fig. 2, and into the wood. The circuit board is fitted with the IFTs towards the top and IFT3 at the edge. It is then possible to reach all connections, etc. under the board if this should prove to be necessary.

A piece of 6mm plywood 250 x 95mm ($9\frac{7}{8}$ x $3\frac{3}{4}$in) is fitted to the bottom of the assembly by two right-angled brackets. This acts as a shelf for the battery and allows the receiver to stand upright when out of its case, or to rest on its back or either end. The top panel is a 254 x 100mm (10 x 4in) flanged "universal chassis member." Using a centre-line, punch a 16mm ($\frac{5}{8}$in) hole in the middle for VC1/2. At 73mm ($2\frac{7}{8}$in) distance from this centre, punch holes for the bandswitch and VR1.

Place the top of the plywood inside the front flange and drill flange and wood for three countersunk 6BA bolts which will secure these parts together. VC1/2 is fitted by means of three countersunk 4BA bolts. This component is set back about 10mm ($\frac{3}{8}$in) from the panel to bring the tuning knob lower (the spindle cannot be cut short due to the integral reduction drive). This requires spacers, or extra nuts, locked against the panel and capacitor. The ends of the bolts must on no account project beyond the thickness of the front capacitor plate.

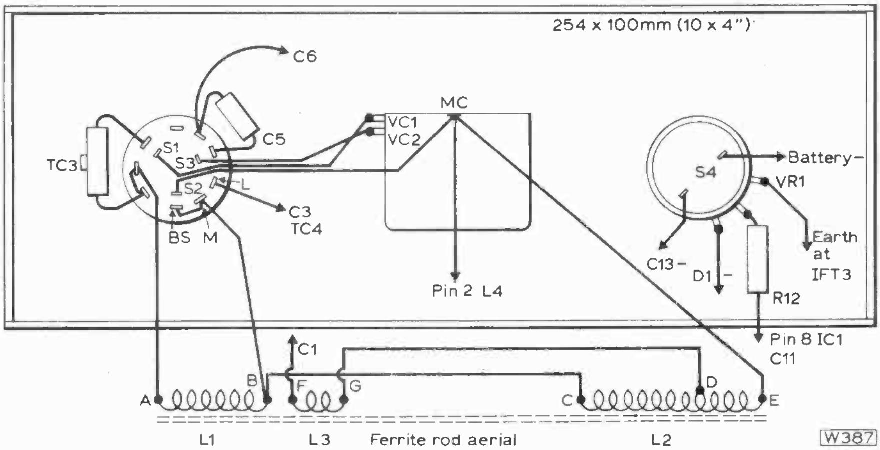


Fig. 4: Arrangement of the components on the front panel and wiring between the range switch and the ferrite rod aerial, and between the volume control and the board.

Fig. 4 shows the panel and connections to the circuit board can now be fitted. The trimmers TC1 and TC2 are provided on the ganged capacitor, so are not shown separately. TC3 is soldered directly to the tags of S1 as shown. Capacitor C5 is mounted on S3.

Ferrite Aerial

The aerial can be mounted by cutting a strip of paxolin about 75mm (3in) long and securing it by a small bracket, Fig. 2. The rod is then bound to the top of the paxolin. An alternative method is to cut a piece of hardwood or insulating material about 63mm ($2\frac{1}{2}$in) long from material about 12mm ($\frac{1}{2}$in) wide and 9mm ($\frac{3}{8}$in) thick. This can be tapped for a bolt to secure it to the board or drilled for a self-tapping screw. At the top, a 'V' is filed to take the rod which is held with adhesive and thread passed round the rod and through a hole in the mount.

Coils L1 and L3 are supplied wound on one former. Place this so that L3 is towards the middle of the rod, Fig. 4. Connect the beginning of L1, lead A, to S1 and wire F of L3 to C1. L2 is the largest winding, on a separate former. The tapping D is electrically near the end E. This can be seen by examination. Place L2 on the rod in such a way that the direction of rotation of the winding A to B is followed on by C to E. If this is not done LW alignment is impossible and L2 must be taken off the rod and placed the other way.

Point G of L3 is then wired to tapping D. Points B and C are connected together and to S2. Point E of L2 goes to the frame, MC, of VC1/2. These leads should be long enough to allow a little movement of the coils on the rod. Connections are best made with quite thin wire and sleeving is put on all the leads.

IF Alignment

The IFTs are aligned by the maker and it is better not to touch these until proper results are obtained. They may then be adjusted a little as necessary, using a proper trimming tool, such as that available from the maker. A wedge-shaped blade is likely to break the cores.

To adjust the IFTs tune in a weak signal, with VR1 turned up near maximum, and rotate each core for best results. Only a small movement should be necessary. If equipment is available a signal generator may be used, and output observed with an output meter. This allows more precise adjustment than does aligning the IFTs by ear. But despite this, perfectly satisfactory results should be obtainable without instruments. Once the IFTs are aligned, leave them alone, as they do not need touching when trimming the aerial and oscillator circuits.

RF Alignment

Trimmers TC1 and TC2 should be very slightly unscrewed. Switch to MW. Check that the medium wave coverage is from approximately 550kHz to 1525kHz. If there is much error at the LF end of the band rotate the core of L4 to correct this. Should there be considerable error at the high frequency end of the band, adjust TC2 as necessary. Subsequent adjustments depends on the positions of L4 core and trimmer TC2. This means that if any change is made to the settings of these, later adjustments will be upset. So the correct positions for L4 core and TC2 must be found first, as shown by correct MW coverage, with the bandswitch in its central position.

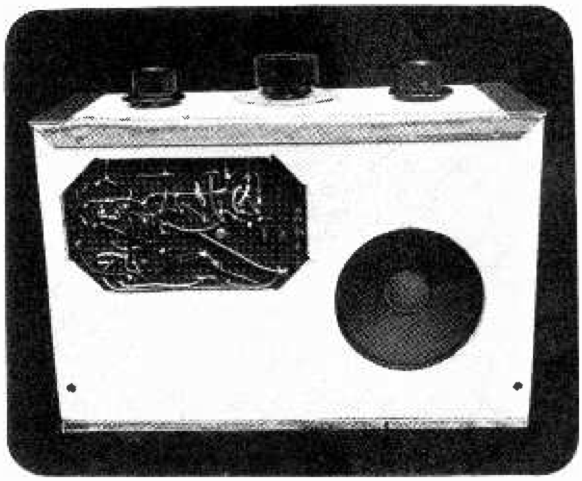
Tune in a weak transmission near the LF end of the MW band and move L1 on the rod for best volume. Then tune to a signal around 1500kHz and adjust TC1 for best volume. As these adjustments influence each other, repeat them a few times.

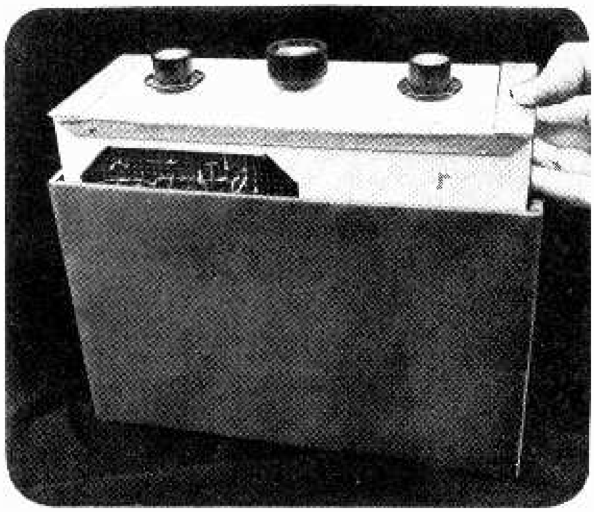
Switch to LW, set VC1/2 half closed and rotate TC4 until the 200kHz BBC Radio 2 is heard. Then tune to a signal near the LF end of this band, one or more foreign stations should be audible and move L2 on the rod for best results.

If these adjustments are difficult to achieve check wiring to L2 and its "sense" upon the rod, and also, if necessary, the setting of the core of L4.

Bandspread Adjustment

A signal should be tuned in around 1500kHz, VC1/2 nearly two-thirds closed, and TC3 should be rotated for best results. All the trimming adjustments can, of course, be made with the aid of a signal generator. When using actual transmissions for this purpose, avoid very strong signals. These will operate the ACG system and its action will mask adjustments so that a critical setting is not found easily. Distant signals will be subjected to





The top photograph shows the cutout in the base which enables the circuit to be worked on by merely pulling the set out of the cabinet. In the view at the bottom the set is lowered into its cabinet, when the speaker should align with the hole in the cabinet, shown in Fig. 5.

fading, especially on the higher frequencies, and this may make adjustment difficult. So choose a local transmission and carefully orientate the receiver for a low level of signal. Check again through each band to get best results..

Cabinet

Construction of the cabinet is shown in Fig. 5. The receiver panel or top is assumed to be 254 x 100mm (10 x 4in) so it is essential that the cabinet will clear this inside. Bearing this in mind the dimensions given are correct. The sides are of plywood while the front and back are hardboard. Glasspaper all meeting surfaces smooth and wipe away all dust. The sides are then secured to the bottom, using adhesive and a few panel pins. A 100mm (4in) diameter opening is cut in the front matching the

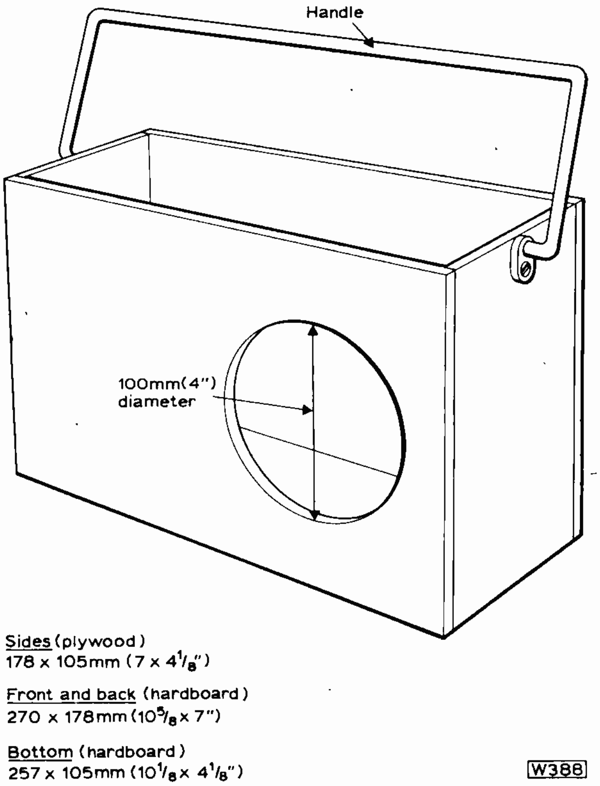


Fig. 5: Dimensions of the cabinet and material required for its construction.

position of the speaker. The sides and bottom edges and front are smeared with adhesive, placed together and fixed with pins. The case is then turned over and the back similarly fitted. When the adhesive is dry, the exterior can be sanded.

The back and front are covered with fabric secured with adhesive along the bottom of the case, at each end, and inside at the top, drawing the material taut. Any adhesive on the front of the case may penetrate the fabric and spoil the appearance.

Wood-grained self-adhesive material is then cut to cover the sides and bottom. This is 100mm (4in) wide and overlaps into the top of the case. Four small feet are screwed on the bottom. The handle was pivoted in two small flat plates, screwed to the sides of the case. A flexible handle could be made from a length of material, folded and sewn, to match the case.

The receiver panel can be provided with a card scale, calibrated in frequencies with the aid of a signal generator, or with station names marked. A straight wire can be soldered to the spindle of VC1/2 or a dial can be cut from Perspex and fitted to the spindle.

The bare aluminium was covered with self-adhesive material and contrasting strips cemented on at each end. There is a great deal of latitude, here, for individual finishes to be used.

KINDLY NOTE!

CHROMACHASE 4

December 76/January 77

Several readers have commented on the fact that the diode matrix in this project is unsatisfactory and many of them have suggested solutions. Although each solution appears to solve the problem each varies from the others.

However, common to all is the correction to D8. As it is used in the article it prevents any operation except Clock Reverse. The removal of this diode will enable the unit to function in all modes except Auto.

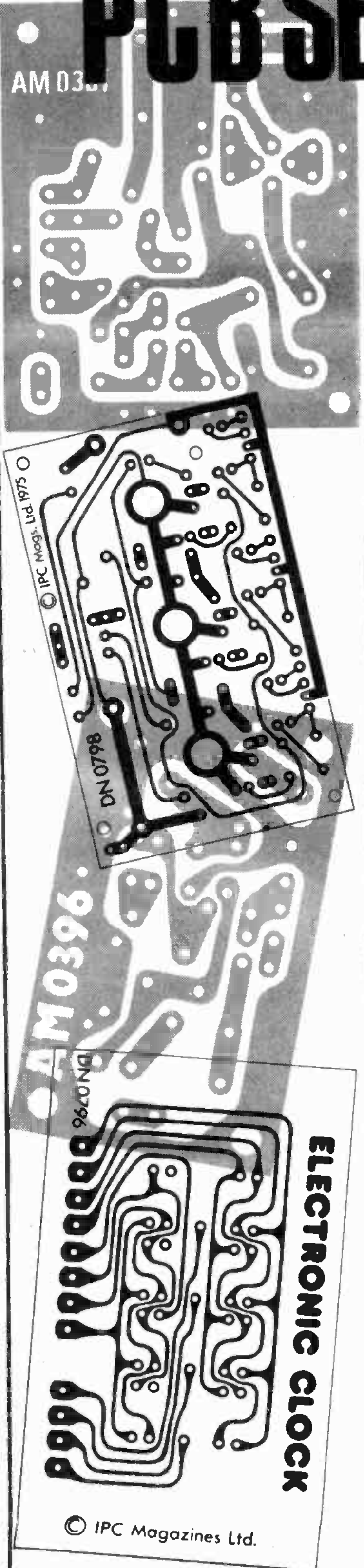
We are trying all the readers' recommendations as well as some of our own and will publish our findings as soon as they are clear.

OSCILLOSCOPE CALIBRATOR

January 77

In the components list R12 should be 100kΩ and not 100Ω.

PCB SERVICE FOR READERS



All boards, except SRBP, are glassfibre, drilled and roller-tinned

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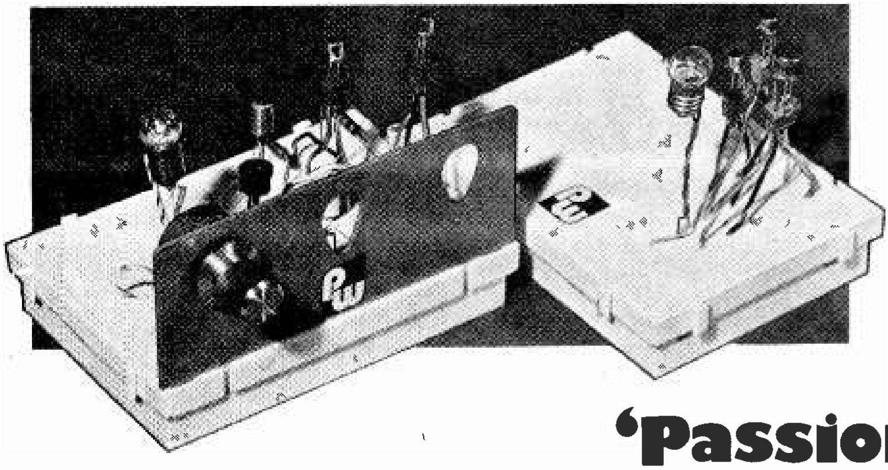
S-DeCnology



DAVID GIBSON

THIS MONTH

'Passionometer'

THIS month's S-DeCnology circuit will be good news for those who have bought an S-DeC and have constructed any of the previous projects in this series. Good news because this project need not cost you a single penny more. All the components have been used in earlier projects so all you need to do is unplug them from your S-DeC and use them yet again.

With St. Valentines Day so close, it seemed a topical idea to build an emotion meter or "Passionometer".

In practice, operation is very simple, with one person holding the end of a piece of wire, while a second person holds the end of another piece of wire. The couple can then hold hands, with their remaining free hands, and depending upon the "passion" involved, the bulb will light slowly from dim to full brilliance.

Super alpha configuration

Referring to the circuit in Fig. 1 the two BC109 transistors are wired in a super alpha configuration. This circuit arrangement gives a very high gain indeed. If one connected a resistor between the base and the positive rail of an ordinary single n-p-n transistor, its value could be quite high, the actual ohmic value depending upon the circuit configuration and other component values. However, because of the very high gain involved when using the two transistors as shown, the resistance between the base of Tr1 and the positive rail can be quite high and the transistor combination will still conduct sufficiently to pass enough current in Tr2 to light the bulb LP1. The numbered holes shown on the circuit diagram in Fig. 1 indicate the hole numbers on the S-DeC into which the particular lead is plugged. Almost any n-p-n transistors can be used for Tr1 and Tr2 but the BC109s were selected because they were already to hand from earlier projects in this series. The circuit works by using the body resistance of the two people involved. This body resistance has really been substituted for the base resistor referred to earlier. If you look at Fig. 1 you will see that holding the wires connected to

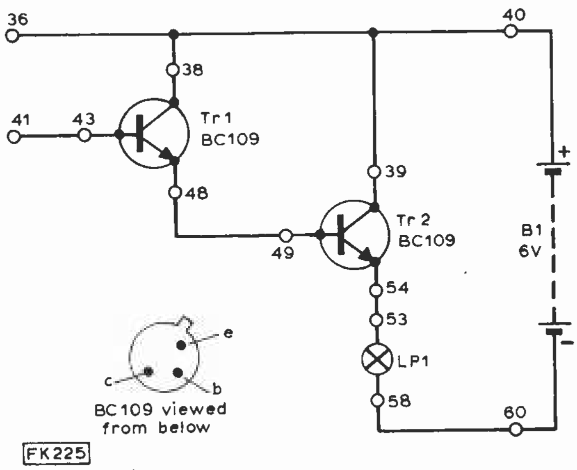


Fig. 1: Circuit diagram of this months project. All components can be taken from past S-DeC projects, which means no further expense.

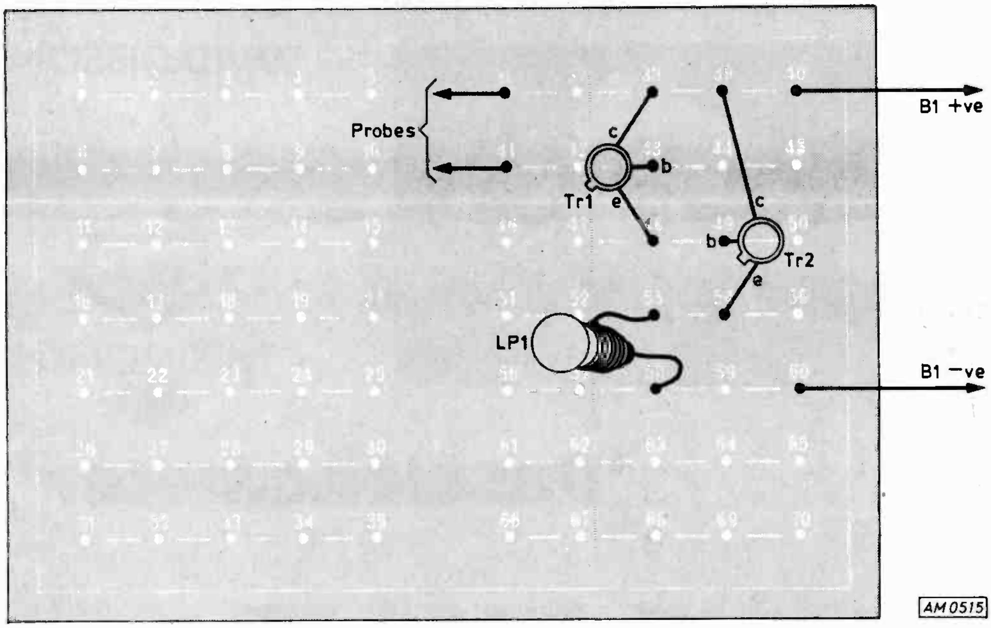
you will need .....

Tr1 BC109
Tr2 BC109
L1 6V 100mA cycle bulb
B1 6V battery
One S-DeC.

S-DeC holes 36 and 41 will complete the base to positive rail circuit via the resistance of the bodies.

With fairly dry hands the bulb will probably not light at all. But if one waits for a few moments the fingers will perspire slightly and this "wetness" will

vincing version then you might consider purchasing a meter. It would be necessary to remove the dial and recalibrate it with segments labelled "Cold, Cool, Warm, Hot, Passionate and Danger". By simply connecting the meter in series with the bulb LP1

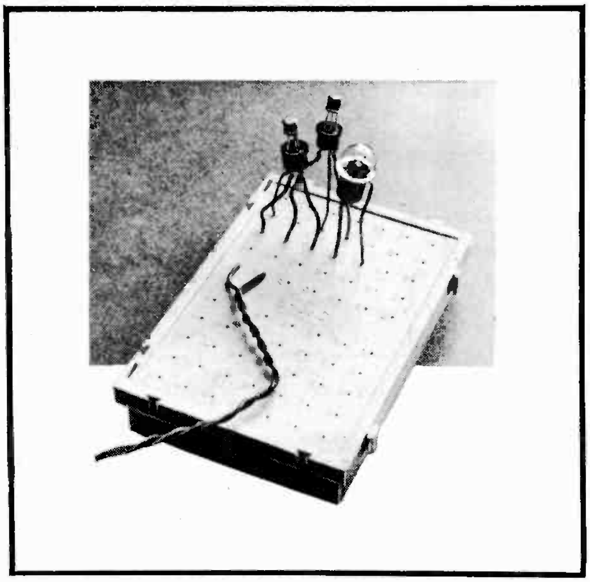


Drawing of the S-DeC shown full size. If a meter is used as well as a lamp, it should be connected to holes 59 and 64.

improve the conducting properties of the skin by lowering its resistance thus causing the bulb to start glowing.

Metered

As described, the "Passionometer" is very simple, cheap and will cause a lot of fun at any party. If you wish to make a more sophisticated and con-



Photograph showing the actual 'Passionometer'. As can be seen only three components are needed to complete this simple circuit.

it would read the current drawn by the bulb. Thus as the bulb started to glow brighter so the meter would read a higher "passion" score. A 6V 100mA bulb together with a 6V battery was found to be optimum, trading acceptable brilliance against reasonable circuit action.

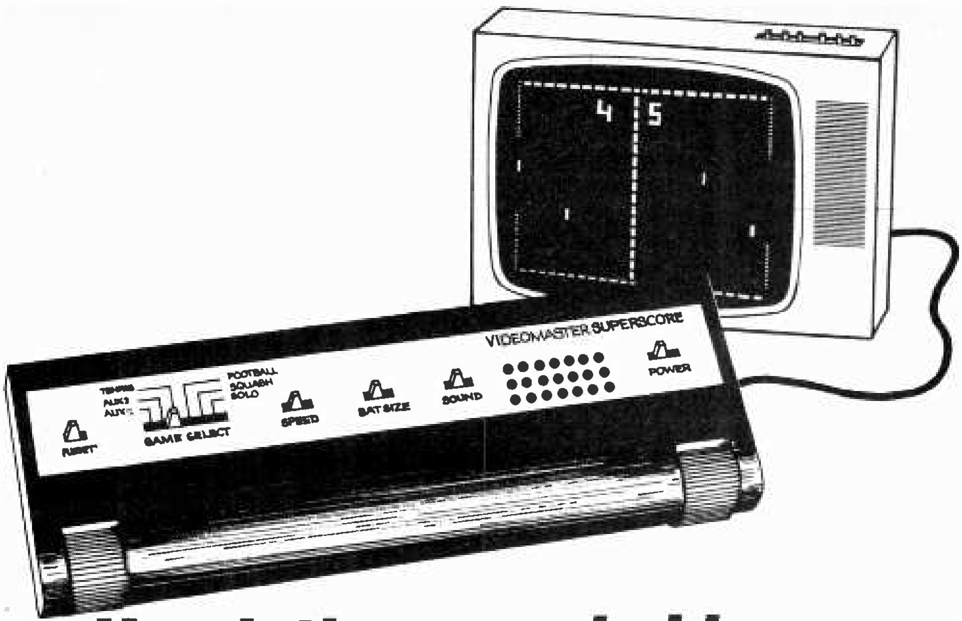
For those considering making the "meter version", the meter must be capable of reading 100mA FSD (full scale deflection). On test, simply plug the meter into S-DeC holes 59 (positive side of the meter) and 64, and transfer the battery negative lead from S-DeC hole 60 to hole 65. The probes were simply the free ends of two wires which were plugged into holes 41 and 36 on the S-DeC.

No guarantee

That's all there is to this months' circuit. Of course, I cannot guarantee that the device will indicate passion with any accuracy nor will it measure emotion—but you can have an awful lot of fun trying to prove me wrong!

Next months' S-DeC circuit again uses many of the components already employed in earlier projects. It can also be used at a party, or for more serious applications. Basically a miniature pocket stroboscope, it is simple and easy to build. It can be employed to give the stroboscopic motion-freezing effect commonly found at Disco's these days. It can also be used for more serious things such as splitting an apparently continuous stream of water from your tap into thousands of tiny crystal droplets.

The S-DeC project after that is even more fascinating . . . but I'll tell you about that in next months' Practical Wireless.



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ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

ALTHOUGH I haven't seen one yet I gather that we radio amateurs in the UK are to get a nice, new, shiny, and more expensive, licence from the Home Office as we renew our 'tickets'. Seems all the odd bits of paper separately authorising one to operate /T, /M and various odd modes not in the normal licence have all been abolished, and high time too. It is opportune to mention that the RSGB was fully consulted on the new licence at all stages and no doubt they have obtained every advantage for us that they could.

The three world regional organisations that make up the International Amateur Radio Union have reached agreement on the radio frequency allocations to be sought for the Amateur Service at the World Administrative Radio Conference to be held in 1979. Such early agreement augurs well for our cause but whether we amateurs get all that's being asked for will largely depend upon how we'll each national society presents its case to its own administration.

We should count ourselves as being very lucky to have the RSGB behind us considering the very high esteem in which it is held by our authorities but, regrettably, the opposite is the case in many other countries where commercial interests and politics decide such matters. Whatever happens at the WARC at least we shall know that the RSGB did its best on our behalf.

I wish it were possible for me to check back and see how long it takes someone writing in as a 'first timer' to go on and get his amateur radio licence. **Jim Oram**, just moved to a new QTH in Basingstoke, has been a SWL for about a year now and has joined the Basingstoke ARS. He hopes to take the RAE next May and while I am sure that we all wish him all the best I feel that he is being a trifle optimistic. However, have a go, Jim! The experience of taking the exam is worth its weight in gold, pass or fail. Jim has a Heathkit GR64 and expects to really get into the DX when he gets his new aerial up.

Alan Doherty BRS34968 is now in the peace and calm of Rotorua in New Zealand, at least until March next year when he is due to return to Northern Ireland. He has managed to listen around the bands using two old valved radios, one as a BFO, so that he can copy SSB. Alan visits local ZL1QC who runs an FT401 and uses a Zepp aerial system, so he doesn't feel too home sick!

In Holyhead **John Higginbotham** now has a nice new FR100B which puts his old receiver to shame. He is also talking about an FL200 Tx and a linear, so obviously John is not too far off getting his RAE. Don't forget the Morse exam OM, you'll need it if you are going to use all that gear! The only QRM being suffered by John at the moment is that caused by exam worries! Newcomer **Bob Harvey** of Oxford is 15 and has got under way on the SW bands with a Codar Mini-Clipper but feels he could do with something more ambitious. Perhaps Father Christmas came up trumps OM? Anyway, Bob added an audio amplifier and a large dial which he calibrated himself, and with a 32ft. aerial he started to hear things. Bob, too, has made contact with his local ARS and looks forward to starting an RAE course soon.

Anent the misfortunes of **Robin Bayley** of Allrighton whose local RAE course collapsed, he heard from G4FGR who put him on to another course so let's hope it all proves worthwhile for Robin. He now has an Eddystone EC10 which enables him to copy CW and SSB from 15 to 80m, using a long wire. Readers often refer to a 'long wire' aerial but I wonder if that is really what they mean. In this sense it should mean that the aerial is long in terms of the wavelength which would mean 275 odd feet to be a couple of wavelengths on the 40m band! I don't think that many readers can go to that sort of garden! Most aerials are much shorter which is why it is so essential to employ an aerial tuning unit to make up the length electrically.

In Harrogate **Steve Cottis** A8961 reports new countries with VP5, 5W1, VQ9 (Chagos Is) and FR7 all on 80m. He finds 20m closing down around dusk although the DX is still there after the Europeans have gone. **Brian Harrison** found something for the log on most bands down in Hastings, including rare KX6MU on 20m SSB. FO8EB is another that is quite rare and a worthwhile at any time on any band. **Arnold Silverwood** won't mind if I call him a 'first timer'. He lives in Nottingham and has built himself an HAC receiver and is starting to understand some of the amateur 'language'. While his set can be made to give quite good results I have pointed out to Arnold that there are more sophisticated sets around, and that he shouldn't write off our hobby too soon, if he feels he is not getting results!

A very interesting club magazine that comes my way each month is TARS TALK, the 'voice' of the Torbay ARS, edited by F. Bolton G3VTQ. Besides

ON THE AIR

all the usual club chatter there are a couple of small but interesting articles in the November issue on Roof Space Aerials and Receiver Drift. At present, meetings are held at Bath Lane, Torquay (rear of 94 Belgrave Road) but more suitable accommodation is being investigated. Anyone interested in joining the TARS is recommended to contact the Secretary, M. Yates G3UIQ at 23 Waverley Road, Newton Abbott, Devon.

In Hastings, **Jesse Luxton** G8GMI is not bothering too much about VHF but concentrating on getting his code up for the examination. Unfortunately Jesse had a stroke in 73 which he feels has not helped at all. He recommends PA0AA for slow morse as they run a course over the air and suggests getting their booklet from PO Box 2083, Eindhoven, Holland for 6 IRC's.

Andy Grendon of Dun Laoghaire, Co. Dublin has really got going since I wrote to him recently. He joined the IRTS and is now EI508 and attending Morse classes while a Heathkit SW717 helps him to cover the HF bands. He is in a built-up area and has little space for aerials. A 30ft end-fed suffices for the moment.

Log Extracts

R. Bayley:— 80m CW VS6DO ZL2BFU ZS2PR **40m CW** CT2BP EA9FD K8CCV VE1AF **20m** CR6LF FP8DH HK0COP TG9TI VP8AA **15m** AP2AD DU1DBT VK3XI ZP5CD

A. Doherty:— In New Zealand 20m DL8NU EA3AEA EA6CK SV1BR

S. Cottis:— 80m A4XGB FP8DX (QSL K9OTB) JA6YDG WA6EGL/VQ9 (Chagos Is) **20m** CX7BV FP8ZZ FR7BI HK1CMX VP2GMB 5W1AB **15m** A9XBD JY9CR VP5A YV2AMM **10m** ZS1EZ

B. Harrison:— 80m ZC4FS HP1YV 7X2HM **20m** DU2EL KX6MU 9D5A (Iran) **15m** PY0ZAE (Trinidade Is)

All SSB except where indicated otherwise.

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy

TRANSATLANTIC DX dominates the scene this month, reception on this path being better than it has been for several years. Reader's logs show stations not normally heard while others, trying this path for the first time, are able to report success. **Laurence Bennett** writes from Bristol "at long last, mainly through help from your column, I have heard and verified my first transatlantic DX catches. Here is my complete North American log to date". Many thanks for the bouquet, Laurence. The receiver is a Trio 9R59DS connected via an aerial tuning unit to a 68ft longwire aerial and the log consists of three stations from Newfoundland, CBN on 640 kHz, CKVO on 710, CJON on 930 plus four in New York City, WOR on 710, WCBS on 880, WINS on 1010 and WNEW on 1130. DXers who have still to hear North America should try after midnight for one of these stations, and if the path is open then at least one should be heard.

Laurence raises an interesting point when he says "I managed to hear both WOR and CKVO on 710 at the same time which resulted in a jumble which was difficult to resolve". DX signals on the MWs are usually subject to slow fading, the cycle often lasting a minute or two. This is typical of E layer reception which is quite different from the fast fading experienced on the short waves and, occasionally, at the high frequency end of the medium waves, where the F layer is the part of the ionosphere responsible for propagation. The technique on the medium waves is to stay tuned to a channel for several minutes when hopefully DX will appear out of the noise or, in the case of WOR and CKVO, either one will become dominant long enough for an identification to be heard.

Simon Knott who lives in Cambridge reports two instances of DX on a channel normally occupied by a North American "local". Using a Trio 9R59 and a 48in loop he heard CFRB in Toronto as well as WINS on 1010kHz and on 930kHz which is normally the domain of CJON he logged CFBC Saint John City in New Brunswick. CFBC sent a QSL after a month and Simon asks if this station has been logged by anyone else recently. CFBC is something of a rarity in the UK because of the directional aerial used at the transmitter. This produces a null towards the north east which protects CJON from interference within its service area but, unfortunately, DXers in Europe as well are prevented from receiving its signal. Simon refers to CBM Montreal on 940kHz which he hears occasionally. CBM has an omnidirectional aerial which presents a rather weak signal to any European DXer who is patient enough to sit on the channel when the path to North America is open.

Derek Taylor (Preston) is still trying to identify a US station on 1390kHz. Although he taped the identification it sounds different every time he plays it! WCSC in Charleston, South Carolina, is a likely candidate here, the writer having heard it several times and the other possibility is WEGP Presque Isle in Maine. Derek who uses a Realistic DX160 and loop also reports hearing WJR Detroit on 760 at 0109, WHAS Louisville Kentucky on 840 together with All India Radio outlets in Bikaner on 1330 (at sign-on at 0100) and Gwalior on 1390 at 0125, Radio Antilles, Montserrat on 930 at midnight, Radio Victoria in Aruba NWI on 960 at 0040 and WMDD in Puerto Rico on 1480 at 0310. Puerto Rico, although in the Caribbean, is one of the states of the USA and consequently US callsigns are used. Surprisingly, there are 52 medium wave stations operating in Puerto Rico and since the language can be Spanish or English it is very confusing for the DXer. Other Puerto Ricans heard in the UK are WKAQ Radio on 550, WKVM in San Juan on 810, WHOA Radio Capital in Hato Rey on 870 and WUNO (Radio Uno) on 1320.

Steve Whitt (G8KDL) who DXes in London with a Chapman S6BS communications receiver, PW loop and differential amplifier (*Practical Wireless*, April 1973) has been experimenting. He replaced the

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2N698	62p	2N2924	15p	2N3794	20p	2N6123	43p	BC109	15p
2N699	55p	2N2926	12p	2N3819	36p	2N6126	45p	BC113	17p
2N706	24p	2N3019	55p	2N3820	38p	40361	45p	BC115	19p
2N706A	12p	2N3053	30p	2N3823	75p	40362	48p	BC116	19p
2N708	21p	2N3054	60p	2N3904	21p	40363	1·20	BC116A	20p
2N709	50p	2N3055	70p	2N3908	22p	40406	58p	BC117	22p
2N718	27p	2N3390	25p	2N4036	67p	40407	45p	BC118	16p
2N718A	50p	2N3391	25p	2N4037	55p	40408	65p	BC119	30p
2N720A	80p	2N3391A	25p	2N4058	20p	40409	65p	BC121	45p
2N914	35p	2N3392	16p	2N4060	20p	40410	65p	BC132	30p
2N916	30p	2N3393	15p	2N4061	17p	40411	2·85	BC134	15p
2N918	38p	2N3394	15p	2N4062	18p	40594	75p	BC135	15p
2N929	25p	2N3439	88p	2N4126	17p	40595	86p	BC136	19p
2N930	28p	2N3440	64p	2N4289	20p	40673	73p	BC137	14p
2N1131	60p	2N3441	85p	2N4919	65p	AC126	37p	BC140	40p
2N1132	60p	2N3442	1·35	2N4920	70p	AC127	44p	BC141	45p
2N1613	35p	2N3638	16p	2N4921	50p	AC128	37p	BC142	30p
2N1711	37p	2N3638A	16p	2N4922	55p	AC151V	35p	BC143	30p
2N1893	30p	2N3639	30p	2N4923	70p	AC152V	50p	BC147	12p
2N2102	60p	2N3641	20p	2N5190	60p	AC153	49p	BC148	12p
2N2218	33p	2N3702	17p	2N5191	70p	AC153K	55p	BC149	13p
2N2218A	37p	2N3703	16p	2N5192	75p	AC176	40p	BC153	27p
2N2219	30p	2N3704	15p	2N5195	90p	AC176K	60p	BC157	12p
2N2219A	32p	2N3705	15p	2N5245	35p	AC187K	55p	BC158	12p
2N2220	35p	2N3706	16p	2N5294	40p	AC188K	55p	BC159	14p
2N2221	22p	2N3707	18p	2N5295	40p	AD161	85p	BC160	50p
2N2221A	26p	2N3708	16p	2N5296	40p	AD162	85p	BC161	50p
2N2222	25p	2N3709	18p	2N5298	40p	AF106	55p	BC167	12p
2N2222A	25p	2N3710	16p	2N5447	15p	AF109	75p	BC168	12p
2N2368	25p	2N3711	18p	2N5448	15p	AF124	65p	BC169	12p
2N2369	25p	2N3712	1·20	2N5449	19p	AF125	65p	BC170	16p
2N2369A	25p	2N3713	2·30	2N5457	22p	AF126	65p	BC171	14p
2N2646	75p	2N3714	2·45	2N5458	33p	AF127	65p	BC172	12p
2N2647	1·40	2N3715	2·55	2N5459	29p	AF139	69p	BC177	20p
2N2904	36p	2N3716	2·80	2N5484	34p	AF186	50p	BC178	20p
2N2904A	37p	2N3771	1·85	2N5486	38p	AF200	70p	BC179	23p
2N2905	37p	2N3772	2·00	2N6027	53p	AF239	74p	BC182	11p
2N2905A	28p	2N3773	2·90	2N6101	65p	AF240	98p	BC182L	14p
2N2906	28p	2N3789	2·90	2N6107	42p	AF279	80p	BC183	11p
2N2806A	25p	2N3790	3·10	2N6109	42p	AF280	85p	BC183L	14p

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ON THE AIR

2N3819 FETs in the differential amp with 2N4416s and the resistors with metal oxide types and obtained greater gain and less cross modulation. He says that conditions have been excellent and on some days (nights!) WINS on 1010 has been roaring in as early as 2230 causing interference to the Dutch station (Lopik) on 1007kHz. Steve finds North American stations excellent verifiers, he sends an International Reply Coupon with every report, and quotes from a letter from WBZ Boston (on 1030) which suggests that since they beam their signal on 270° he may have received them after their signal had circled the world! Unlikely, as propagation on the medium waves requires a path of darkness between transmitter and receiver.

More DX from **Michael Illingworth** of Christchurch who reports hearing KMOX in St Louis on 1120 with his Trio 9R59DS receiver. This is a really good catch which is only logged when reception is really good. Incidentally, US stations use one of two prefixes in their callsigns. Those beginning with the letter K are with one exception, KDKA, to the west of the Mississippi while those with the letter W are to the east. A callsign beginning with K means real DX from the UK.

An unusual request for identification comes from **Nick Hall-Patch** of Victoria, British Colombia, who, with a friend, heard an unidentified broadcast, in a transatlantic direction on 566kHz. It was at 0725 and consisted of a single short pip every 15 seconds. The station according to a law well known to medium wave DXers, faded out just before 0730 when of course Radio Eireann would have signed-on for the day. The writer had never noticed these pips before which only shows that one man's DX is another's QRM. (*BBC Radio 4 also uses them—AED.*)

Bob Bonsall of Buxton wants to buy a good radio that will pick up North American stations on the medium waves. Reports this month come from users of the Trio 9R59D/E, Realistic DX160 and Chapman S6BS. It would be a great help to readers starting the hobby if all logs were accompanied by full details of the receiver, aerials and any other gear in use. The time, in GMT, of any outstanding logging would also be invaluable.

SHORT WAVE BROADCASTS

by Derek Bell

THE Christmas season has slipped into history and one can collect together not only one's thoughts but the paperwork that floods in at this time! From Radio Havana there is the usual collection of those awful calendars, the size of a matchbox, printed with the dates, unrelentingly, in Spanish! Radio Havana is now asking for letters to be sent to Apartado 7026, Havana, Cuba, and is sending out a schedule which advises that broadcasts for northern Europe will be on 17885 between 2010 and 2140, a very sparse service, with more time devoted to English language broadcasts to north, central and south America on 17750, 11865, 11760, 11725, 9685 and 9525. Nearly 16 hours, in fact!

Alongside this there is the usual crop of "Happy New Year" cards from other similar countries who seem to ignore the fact that the countries they send them to also celebrate Christmas!

Tony Cook, at present living in Gibraltar, logs a few of the signals that whizz around the ether over the Rock. These are as follows: Radio Togo on 5048 at 2100, Morocco on 4650 at 1930, Radio Prague (African Service) on 5760 and 5350 at 1900. Tony asks for information on the HAC Mk 2 set. I must confess I do not know a lot about this set but perhaps other HAC users can answer Tony on the problem of why the reception goes "up the spout" when he connects the bandspread! Finally, Tony would like to know of any books on the subject of DXing and here I can help. Radio Nederland has a very wide range of pamphlets on all aspects of the hobby and their address is PO Box 222, Hilversum, Holland. These publications are all free.

Lawrence Bennett, from Bristol, takes me to task for the lack of Latin American and African stations in the column. Regular readers will remember that a few months ago, with the aid of a Latin American reader resident in London, we looked at the LA scene. However I can only report on the logs that I receive and if no one logs LA then I can't print it! It must be said that it is a long time since anyone sent in such a comprehensive list as Lawrence has and here are a handful of the "DXotics" that his Trio 9R59DS has pulled in via a longwire:—

Radio Difusoras, Venezuela	on 4890 at 2355
Radio Timbira, Brazil	on 4975 at 0430
Radio Sutatenza	on 5095 at 0045
Sierra Leone	on 3316 at 2153
Radio Banqui	on 5038 at 2200

Perhaps it's the thought of the very late nights that puts off the majority of DXers but it is a fact that Latin Americans are strictly for the birds, night owls that is.

M. G. Hayman has also a pet peeve and that is the fact that he waited for the arrival of his Codar Multiband 6 only to find that the firm had sent the order in two lots, and one parcel had got lost in the post! This must be a situation that drives the home-brew enthusiast right up the wall! Meanwhile he has to make do with his HAC Mk 2.

The final letter this month is from **V. Marland** who resides in Connahs Quay, Clwyd, who requests information on the way that a station report should be layed out. This is very simple, the station name first, then the frequency plus the time in GMT. It is not worth logging signal strength since this can vary enormously. Add some notes on the programme heard and any identification signal heard. Notes on interference to the station are sometimes helpful. If you enclose a couple of IRCs this will expedite a confirmation but don't be too impatient! For now I will wish you best 73s to you and yours.

ON THE AIR

VHF

by Ron Ham

THE sun has been very quiet during December; in fact the writer recorded only one burst of solar radio noise (midday December 8th) and that was the first since November 21st. **Alan Taylor,** G3DME, Crowborough, Sx, heard the "seashore sound," normally associated with solar noise, on the 10m band at 1747 on the 15th. Although the sun was set there could have been a large solar burst and Alan detected the radio signals as they came above the horizon. These reports are valuable and since Alan collects the International Beacon Project reports for the RSGB, any that you send to me will eventually end up with him.

At 0947 on Dec. 15th the writer heard the signal from the IBP Beacon in Cyprus (5B4CY 28·180MHz) and that was the first time for a month. An interesting observation came from **Walter Butt** GC2FZC, St Peter Port, Guernsey, who noticed that when he can hear DL0IGI and 5B4CY on 10m, conditions on the 2m band are above normal. What about it reaaers? The writer would like to hear a lot more about this.

Very soon the number of sunspots will increase as the new cycle gets underway, and **Derek Poulter** G3WHK, Morden, Surrey, a keen all-band DXer, wants to know how to observe these with a telescope. First of all Derek, **NEVER** look at the sun directly through a telescope or any other optical aid, it is **dangerous** to the eyes, in fact it is unwise to look at the sun at all. The technique is to point your telescope toward the sun and project its image on to a white card (shaded from the main sunlight) and pencil in the spots that you can see. Most basic astronomical books will show this.

Of course, you can always direct your 2m beam toward the setting or rising sun and listen around 143MHz (Quiet spot outside amateur band) for the "seashore sound" or "whooshing" which is the radio noise from a sunspot.

Although the atmospheric pressure was below 30·0″ for most of December it did rise sharply from 29·5″ at noon on the 8th to 30·0″ by noon on the 9th and continued to rise slowly reaching 30·4″ by noon on the 12th, and true to form, as this high pressure system moved southward, and the AP began to fall, there was a tropospheric opening.

During the late afternoon of the 14th, **Roy Bannister**, G8LXR, Lancing, Sussex, worked several French stations on 2m SSB and on the 15th Roy heard a PA0 and an ON come up on two. From his QTH at Newhaven, Sussex, **Alan Baker** G8LGQ, worked into the Midlands during the evening of the 14th and also noticed patterns on his TV screen, another sure sign that an opening is in progress. From midday until late evening on the 15th the writer was receiving a strong picture from Lichfield on Chan. 8 (189MHz) and around 2000 a 559 signal from the Sutton Coldfield beacon (GB3SC) on 70cm.

At 0930 on Dec. 5th, **Joost Berden** G3RND, Cowes, IOW, was taking his usual weather picture from the NOAA5 satellite as it passed over and was surprised to find that it's 137·50MHz signal was weak and fluttery for about five minutes, a long time in a pass. The satellite came in at 20°E for an overhead pass, but the signal did not become strong and steady until it was 65°N. At that time, Joost noted that conditions on 70cm were reasonable, he could hear GB3SC and during the previous evening he worked G3OSS in London for the first time, using SSB. There was definitely movement in the troposphere throughout both days, therefore it is possible that this region absorbed the satellite's VHF signal for a short time. The writer has known times when conditions were "up" on 70cm and flat on 2m.

Derek Poulter, G3WHK, has worked a lot of 2m DX by keeping an eye on the barometer and he makes a point of watching the late night weather map on BBC TV to see if there are any "highs" building up. Derek has moved QTH and just received planning permission for his new aerial array:—HQ1 mini-beam for 10/15/20, 4 element yagi for 70MHz, 2 x 6 element arrays for 2m, and something for 70cm, and all supported by a 40ft Versatower! Our readers will be looking for some good reports, Derek!

Another barometer watcher is that experienced VHF DXer, GC2FZC, who monitors the 2m beacons GB3CTC and GB3VHF daily and relates their signal strengths to the prevailing atmospheric pressure. He also has a regular Sunday morning sked with G3IEA and G8DOJ, both in Torquay, and they seldom miss out. In fact the sked with G3IEA has been going on for some 15 years!

Don't forget, if anything unusual occurs on the VHFs the writer will be pleased to have the details. After all, it is your observations that help to put a particular propagation event into its proper perspective.

Late Note: A slight change in the prevailing high pressure during the evening of 23rd December caused a predominantly N/S opening which upset UHF TV and provided some good DX on both 2m and 70cm. Between 1900 and 2200 the writer received 599 signals from beacons GB3SC (432·890MHz) and GB3EM (432·910MHz). At 2117 a 59 signal from G3DY in Northants, while on Ch. 8 (189MHz) a strong picture was received from the IBA transmitter at Lichfield. For most of the evening the 2m band was open from France through to northern-G.

BROADCAST BANDS
Short Wave Reports by the 15th of the month to Derek Bell, c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD.
Medium Wave Logs to Charles Molloy, 132, Segars Lane, Southport, PR8 3JG.

AMATEUR BANDS
Logs covering any amateur band/s in band/alphabetical order by the 25th of the month to **Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey, KT21 2TW.**

VHF
Reports on VHF matters to Ron Ham, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

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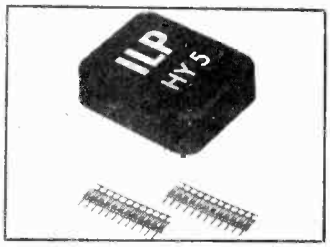

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APPLICATIONS: Medium Power Hi-Fi systems—Low power disco—Guitar amplifier
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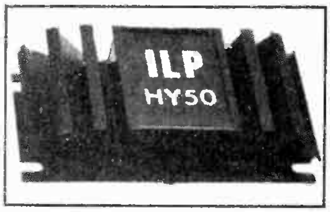

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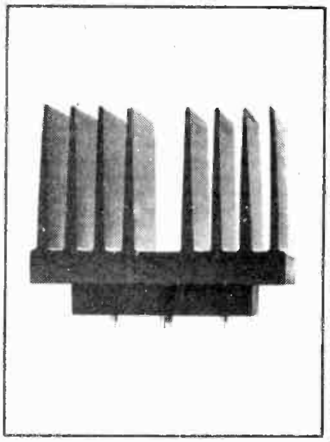
FEATURES: Very low distortion—Integral heatsink—Load line protection—Thermal protection—Five connections—No external components
APPLICATIONS: Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ
SPECIFICATIONS
INPUT SENSITIVITY 500mV.
OUTPUT POWER 60W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 60W at 1kHz
SIGNAL/NOISE RATIO 90dB FREQUENCY RESPONSE 10Hz-45kHz —3dB SUPPLY VOLTAGE ±35V
SIZE 114 50 85mm
Price £14.40+£1.16 VAT P&P free.



HY200
120 Watts into 8Ω

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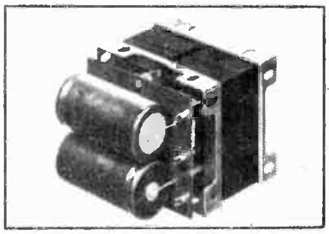
FEATURES: Thermal shutdown—Very low distortion—Load line protection—Integral heatsink—No external components
APPLICATIONS: Hi-Fi—Disco—Monitor—Power slave—Industrial—Public Address
SPECIFICATIONS
INPUT SENSITIVITY 500mV
OUTPUT POWER 120W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·05% at 100W at 1kHz.
SIGNAL/NOISE RATIO 96 dB FREQUENCY RESPONSE 10Hz-45kHz—3dB SUPPLY VOLTAGE ±45V
SIZE 114 100 85mm
Price £21.20+£1.70 VAT P&P free.

HY400
240 Watts into 4Ω

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω! It has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.
FEATURES: Thermal shutdown—Very low distortion—Load line protection—No external components.
APPLICATIONS: Public address—Disco—Power slave—Industrial
SPECIFICATIONS
OUTPUT POWER 240W RMS into 4Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·1% at 240W at 1kHz
SIGNAL NOISE RATIO 94dB FREQUENCY RESPONSE 10Hz-45kHz —3dB SUPPLY VOLTAGE ±45V
INPUT SENSITIVITY 500mV SIZE 114 x 100 x 85mm
Price £29.25+£2.34 VAT P&P free.



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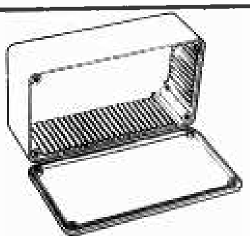

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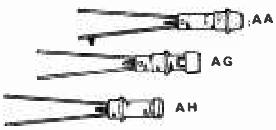

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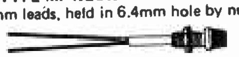

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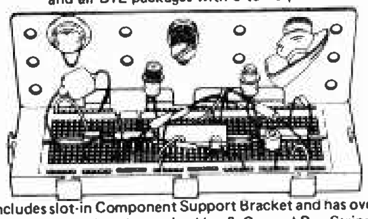

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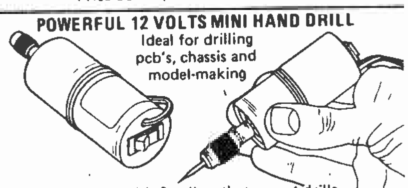

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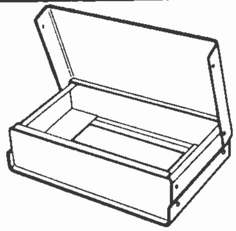

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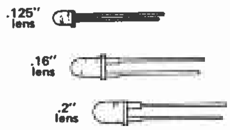

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Red, Blue, Green, Amber, Clear, Opal, Orange
Price 25p each (See P.P. Note below)

Quantity quotations on request.

SOUTHERN VALVE COMPANY

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New Barnet, Herts. Tel: 01-440 8641

"QUALITY" Valves—90 day guarantee. ALL NEW & BOXED VALVES (Incl. tax)—many makes. Radio Societies, trade etc. welcome.

AZ31	80p	PCC85	44p	PY801	41p
DY86/7	36p	PCC88	62p	UBF89	47p
DY802	42p	PCC89	50p	UCC85	46p
EB91	18p	PCC189	53p	UCH42	72p
ECC81	35p	PCF80	40p	UCH81	42p
ECC82	35p	PCF82	50p	UCL82	42p
ECC83	34p	PCF86	58p	UCL83	58p
ECC85	40p	PCF200	95p	UF41	68p
ECC88	48p	PCF801	50p	UF89	42p
ECH42	72p	PCF802	55p	UL41	78p
ECH81	36p	PCF805	£1·40	UL84	44p
ECH83	82p	PCF806	50p	UY85	38p
ECH84	58p	PCF808	£1·40	U25	72p
ECL80	58p	PCH200	77p	U26	60p
ECL82	47p	PCL82	37p	U191	60p
ECL83	68p	PCL83	50p	6/30L2	70p
ECL86	50p	PCL84	47p	6BW7	68p
EF80	30p	PCL85 }	62p	6F23	60p
EF85	37p	PCL805 }		6F28	75p
EF86	50p	PCL86	50p	6V6	47p
EF89	36p	PCL200	£1·30	6L6 (near	99p
EF183	37p	PD500	£2·25	equiv KT66)	
EF184	37p	PFL200	78p	20L1	80p
EH90	56p	PL36	70p	20P4	85p
EL34	99p	PL81	50p	30C1	40p
EL41	58p	PL81A	54p	30C15	78p
EL84	38p	PL82	38p	30C17	80p
EL509	£2·25	PL83	46p	30C18	£1·40
EM84	50p	PL84	46p	30F5	60p
EY51	47p	PL500 }	85p	30FL1 }	97p
EY86/7	38p	PL504 }		30FL2 }	
EZ40/1	53p	PL508	£1.10	30L1	40p
EZ80	35p	PL509	£2·00	30L15	78p
EZ81	30p	PL519	£2·80	30L17	72p
GY501	£1·10	PL802	£2·00	30P12	75p
GZ30	45p	PY33	52p	30P19	70p
PC86	63p	PY81/3	41p	30PL1	£1·40
PC88	63p	PY88	41p	30PL13	75p
PC97	40p	PY500 }	110p	30PL14	85p
PC900	49p	PY500A }		30PL15	85p
PCC84	40p	PY800	41p	30P4MR	90p

We offer return of post service. Post free over £15·00. Postage: 1st valve 9p, extra valves 6p, Max. 75p. Most types available, *send sae for lists.* Discount Prices. All prices subject to alteration without notice due to market fluctuations etc. *Telephone enquiries welcomed, sae with enquiries* PLEASE!. C.W.O. ONLY. No C.O.D. Export enquiries welcomed. VAT invoices on request. Mail order only. (LARGE valves 2p extra).

INTERLOCKING PLASTIC STORAGE DRAWERS

Newest, neatest system ever devised for storing small parts and components: resistors, capacitors, diodes, transistors, etc. Rigid plastic units interlock together in vertical and horizontal combinations. Transparent plastic drawers have label slots. ID and 2D have space dividers. Build up any size cabinet for wall, bench or table top.

AS SUPPLIED TO POST OFFICE, INDUSTRY & GOVERNMENT DEPTS.

SINGLE UNITS (1D) (5ins × 2½ins × 2½ins). £2·50 DOZEN.
DOUBLE UNITS (2D) (5ins × 4½ins × 2½ins). £4·40 DOZEN.
TREBLE (3D) £4·20 for 8.
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Dept. B, 35 Grosvenor Road, Twickenham, Middx. Tele. 01-891 1923

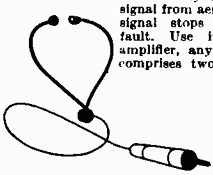
DRILL CONTROLLER

Electronically changes speed from approximately 10 revs to maximum. Full power at all speeds by finger-tip control, Kit includes all parts, case, everything and full instructions. **£3·45** including post & VAT. Made up model **£1·00** extra.

MAINS TRANSISTOR PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: main transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only **£1·50** VAT & Postage 50p.

RADIO STETHOSCOPE



Easiest way to fault find, traces signal from aerial to speaker, when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything. Complete kit comprises two special transistors and all parts including probe tube and crystal earpiece, **£2·95**, twin stetho-set instead of earpiece. £1·00 VAT and postage incl.

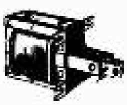
MICRO SWITCH BARGAINS

Rated at 5 amps 250 volts, ideal to make a switch panel for a calculator and for dozens of other applications. Parcel of 10 for **£1·00**, VAT and post paid.

MOTORISED DISCO SWITCHES

With six 10 amp changeover switches. Multi adjustable switches are rated at 10 amp each so a total of 2000w's can be controlled and this would provide a magnificent display. For mains operating **£4·25** post & VAT Paid. Ditto 9 switch **£4·95** Post & VAT Paid. **DITTO BUT 12 SWITCH £5·75 POST & VAT PAID.**

MAINS OPERATED SOLENOIDS



Model TT2—small but powerful 1in. pull—approx. size $1\frac{1}{4} \times 1\frac{1}{4} \times 1\frac{1}{2}$in., **£1·00**

Model 4001/—$\frac{1}{2}$in. pull. Size $2\frac{3}{4} \times 2 \times 14$in. **£1·50**

Model TT1—$1\frac{1}{2}$in. pull. Size $3 \times 2\frac{1}{2} \times 2$in. **£3·50**

Prices include VAT & postage.

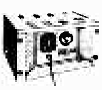
SOUND TO LIGHT UNIT

Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450W). Unit in box all ready to work. **£7·95** plus **95p** VAT & Postage

RELAY BARGAIN

Type 600 relay with twin 500 ohm coils which may be joined in series or parallel thus relay will operate off voltages between 5 and 30 volts DC. Price **44p** each, 10 for **£4** post and VAT paid.

BATTERY CHARGER



Famous Atlas in metal case with meter, output lead, terminated by crocodile clips. For 6 or 12V charging simply by changing plug on front panel. Ready built new and still **£2·95** plus £1 Post & VAT

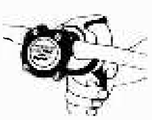
MULTISPEED MOTORS

Six speeds are available 500, 850 and 1,100 r.p.m. and 7,000, 9,000 and 11,000 r.p.m. Shaft is $\frac{1}{4}$ in. diameter and approximately 1 in long. 230/240v. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx, 2 in. dia × 5 in. long. Price **£2·00** including Post & VAT.

SWITCH TRIGGER MATS

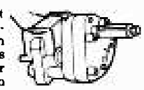
So thin is undetectable under carpet but will switch on with slightest pressure. For burglar alarms, shop doors, etc. 24in × 18in **£2·33**. Post & VAT 60p.
13in × 10in **£1·85**. Post & VAT 50p.

ROTARY PUMP



Self priming, portable, fits drill or electric motor, pumps up to 200 gallons per hour depending upon revs. Virtually uncorrodable, use to suck water, oil, petrol, fertilizer, chemicals, anything liquid. Hose connectors each end. **£2·00** Post Paid.

SPIT MOTOR WITH CARTER GEAR BOX

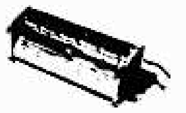


Probably one of the best spit motors made. Originally intended to be used in very high priced cookers however this can be put to plenty of other uses, for instance your garden barbeque or to drive a tumbler for stone polishing; in fact, there are no ends to its uses. Normal mains operation. **£3·25** including POST & VAT.

MULLARD UNILEX

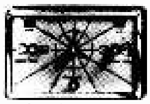
A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost any one in easy-to-assemble modular form and complete with a pair of Goodmans speakers this should sell at about £30—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only **£14·00** including VAT and postage.

TANGENTIAL HEATER UNIT



This heater unit is most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. Comprises motor, impeller. 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only needs control switch. **£5·83** plus VAT & post **£1**. 2kW Model as above except 2kW **£4·25** plus VAT & post 75p. Don't miss this. Control Switch **44p**. P. & P. 40p.

ISA ELECTRICAL PROGRAMMER



Learn in your sleep: Have radio playing and kettle boiling as you wake—switch on lights to ward off intruders—have a warm house to come home to. All these and many other things you can do if you invest in an electrical programmer Clock by famous maker with 15 amp. on/off switch. Switch-on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price **£2·95**, VAT & Postage 60p, or with glass front, chrome bezel, **£1·50** extra.

ROOM THERMOSTAT

Famous Satchwell, elegant design, intended for wall mounting. Will switch up to 20 amps at mains voltage, covers the range 0·30°C Special snip this month **£2·50**, post and VAT paid.

SMITHS CENTRAL HEATING CONTROLLER

Price **£7·50** including VAT and postage.

RANDALL CENTRAL HEATING CONTROLLER

Price **£6·50** including VAT and postage.

THIS MONTH'S SNIP

250 WATT TRANSFORMER

Heavy duty power transformer which can be used for many purposes. Rated at 250 watts it is very well built with frames for upright mounting and is varnish impregnated. Its primary is for 230/240 volts 50 cycles, it has four secondaries each 10v very high current windings. Just a few of the circuits it can power are 10·0–10v at up to 12 amps, 20·0–20v at up to 6 amps; single 10v at 25 amps; single 20v at $12\frac{1}{2}$ amps; single 30v at 9 amps, single 40v at 6·5 amps. The transformer can be used for power circuits (charging, etc.) or for amplifiers, there being an earth screen between primary and secondaries. A transformer like this today would cost at least £15 from the makers, however, we are making a special offer at **£5·95** Post & VAT Paid. Grab some while you can, our stock may not last long.

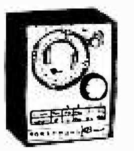
AEROSOL RELEASE LUBRICANT

Dry Film Lubricant. In aerosol can for easy application and for putting lubricant into places where the normal oil can cannot reach. Home and everyday uses. We have purchased a large quantity of these from the Liquidator and are able to offer them to you for about half of the original list price. **88p** per 8oz can or 12 cans for **£5** Post & VAT Paid. The lubricant is I.C.I. fluon L169.

MAINS RELAYS

With triple 10 amp changeover contacts—operating coil wound for 230 volts AC, chassis mounting, one screw fixing, ex unused equipment **60p** each, 10 for **£5** post and VAT paid.

HORSTMANN 24-HOUR TIME SWITCH

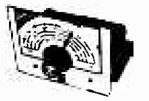


With 6 position programmer. When fitted to hot water systems this could programme as follows:

Programme	Hot Water	Central Heating
0	Off	Off
1	Twice Daily	Off
2	All Day	Off
3	Twice Daily	Twice Daily
4	All Day	All Day
5	Continuously	Continuously

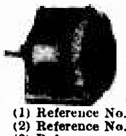
Suitable, of course, to programme other than central heating and hot water, for instance, programme upstairs and downstairs electric heating or heating and cooling or taped music and radio. In fact, there is no limit to the versatility of this Programmer. Mains operated. Size 3in × 3in × 2in deep. Price **£5·50**. 80p Post and VAT. as illustrated but less case

SHORTWAVE CRYSTAL SET



Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 31, 29 metre bands. Kit contains chassis front panel and all the parts **£1·90**—crystal earphone **55p** including VAT and postage.

PAPST MOTOR



West German make, these fine motors are noted for their performance and reliability. Special features are the rotating heavy outer which acts as a flywheel to eliminate wow and flutter and switchable reversing.

We have four types in stock, all 1350 revs., including starting capacitor.

(1) Reference No. KLZ 20.50-4, 230 volts 50HZ, price **£5·50**
(2) Reference No. KLZ 32.50-4, 230 volts 50HZ, price **£6·50**
(3) Reference same as above, 115 volts 50HZ, price **£2·50**
(4) Reference same as above, 110 volts 60Hz, price **£2·50**

Post and VAT 80p each extra.

TERMS: Where order is under £6 please add 50p surcharge to offset packing expenses

J. BULL (ELECTRICAL) LTD.

(Dept. P.W.), 103 TAMWORTH ROAD, CROYDON CR9 1SG.

ITS FREE!

Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived—often bargains which sell out before our advertisement can appear—its an interesting list and its free—just send S.A.E. Below are a few of the Bargains still available from a recent list.

Remember 7.029? Electricians of the old school most certainly will, and will agree it has greater current capacity (20 amps against 13 amps) and being stranded it will not break so easily and being larger it is easier to use. A fortunate buy enables us to offer 3 core 7·029 cheaper than we could offer 3 core 2·5mm. If you are contemplating installing a ring main, an immersion heater, storage heaters or fires, then you should definitely buy some of this cable. It is p.v.c. covered, correctly colour coded and up to all British standards; in fact, was made by one of our most famous cable companies. Price **£9·50p** + 76p per 100 metre coil. Carriage £2·50 + 20p.

For lighting we offer 3 core 1·5mm at only **£5·50p** + 44p per 100 metres. Post £1·50 + 12p.

Isolation Transformer. Very high current 416 amps, primary 0·260 volts, last 60 volts in 10 volt steps so this transformer can be used to step up voltages for instance at the end of a long cable run. Secondary, centre tapped 120v.-0.120v so this transformer will isolate and step down or will isolate at normal mains in and normal mains out or finally it will isolate and step up. A big transformer completely enclosed in sheet steel box weighing about 300 lbs. Price **£100** + **£8**. Carriage at cost but we would prefer you to collect this.

5 Bank Switch Panel. This is a Government Surplus item so it is very well made and contains switches which will break 15 amps *DC*. The 5 switches are completely separate so may be used to control separate circuits or they may be ganged together to bring in 5 heaters in parallel suitable for mains or battery work. Size of the switch is approximately $5\frac{1}{4} \times 1\frac{3}{4} \times 1\frac{1}{4}$ and operation is by nickle plated toggles. Price **75p each + 6p.** Post 20p + 2p.

Cooling Thermostat. The normal thermostat switches off as the temperature in the room rises. It is, therefore, suitable for controlling electric room heating. We have a similar stat but with contacts which switch on as the temperature rises. These are for air conditioning or cooling circuits. Contacts again rated at 20 amps and these have changeover contacts so they can be used for cooling or heating or both but as their original function was intended for cooling they are set and calibrated for 12-40°F. Price **£3·50p + 28p.**

Flash Ernie is the name we have given to our latest disco light display because it is a random flasher and is very effective especially with coloured bulbs. Kit consists of motorised stud switch, master control switch, anti spark caps, 9 lamp holders, connecting wire and wiring diagram. Price **£5 + 40p.** Post 60p + 6p.

Neon Novelties. One of the most versatile of electronic devices is the neon. you can make it do all sorts of things to regulate voltage, imitate "Ernie" by lighting numbers at random. We have miniature neons at **20p** each also just come in neon valves 4 pin type, 10 for **£1 + 8p.** Post 50p + 4p.

Emergency Lighting. We are coming up to the darkest and coldest days so most of us will have memories of power cuts during the previous similar periods. If you are thinking of installing temporary emergency lighting at all you might be interested to know that we have just received some Philips invertors for working 12" fluorescent tubes from 12v car batteries. We are able to offer these invertors at half the proper price, namely **£1·50p + 12p.** Post 40p + 3p.

Miniature Tubes also available 12" **75p + 6p.**, no extra post if ordered with invertors, bi pin holders for these miniature tubes **10p + 1p** each.

Central Heating; Regulating, Mixing, Pumping System. In additional to circulating the water through the system, this can be used to regulate the supply to upstairs and downstairs or to domestic water or central heating as in addition to normal pumping (which is itself adjustable 4 ways) the output of the pump passes first through a valve system, this valve system is motorized (or can be hand operated) and can be made to share the output evenly between two sets of pipes or can be made to give an increased amount to one at the expense of the other. In the Spring for instance, you may not want much heat going through to your radiators but you still want maximum for baths etc. During the daytime you do not want to heat the bedrooms so you can send all the hot water through the downstairs rooms etc. The pump is for normal mains operation and comes complete with 4 pipe unions. Summary of the special features of this system is as follows:—inductive pump drive (without shaft). Self cleaning pump construction, continuous water lubricated rotor, pump output adjustable in 4 stages. Switch to gravity circulation possible. Accurate automatic temperature regulation ± 1°C. We understand that the regular price of this pump is around £40. Our price is **£20 + £1·60p.** Post £3·24p.

Panel Meters mainly G.P.O.
(1) 3" × $2\frac{1}{2}$" flush mounting, 25UA f.s.d., scale calibrated 0-1000 meg ohms ideal if you are thinking of making a portable insulation tester. Price **£3·24p.** Post 40p + 4p.
(2) Edgemounting, size 3" × $1\frac{1}{4}$" scaled meg ohms, specification same as above.
(3) 3" × $2\frac{1}{2}$" centre zero 25-0-25 uA special purpose scale, price **£2·50p + 20p.** Post 40p + 4p.
(4) 3" circular scaled dB-0-minus 15 plus with current transformer. 0db 1 mW 600 ohms. Price **£4** each + **32p.** Post 40p + 4p.

PRINTED CIRCUIT KIT £4·25*
Make your own printed circuits. Contains etching dish, 100 sq ins of pc board, 1lb ferric chloride, dalo pen, drill bit, laminate cutter.

JC12 AMPLIFIER
6W IC audio amp with free data and printed circuit £2·25*

DELUXE KIT FOR JC12
Contains extra parts except JC12 needed to complete the amp including balance, volume, bass and treble controls. Mono £2·30. Stereo £5·25.
JC12 POWER KIT
Supplies 25V 1 Amp £3 85.
JC12 PREAMP KITS
Type 1 for magnetic pickups, mics and tuners. Mono £1·50. Stereo £3·00. Type 2 for ceramic or crystal pickups. Mono 88p. Stereo £1·76.

SINCLAIR IC20
IC20 10W+10W stereo integrated circuit amplifier kit with free printed circuit + data £4·95.
PZ20 Power supply kit for above £3·95.
VP20 Volume, tone-control and preamp kit £8·55.

JC40 AMPLIFIER
New integrated circuit 20W amplifier kit complete with chip, printed circuit and data £4·45.

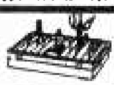
FERRANTI ZN414
IC radio chip £1·44. Extra parts and pcb for radio £3·85. Case £1. Send sae for free data.

BATTERY ELIMINATOR BARGAINS
MILLENIA KITS*
5 Transistor highly stabilized power units. Switched 1 to 30V in 0·1V steps. Send sae for free leaflet. 1 Amp kit £12·45. 2 Amp kit £14·95. Case £2·95 extra.
RADIO MODELS
50mA with press-stud battery connectors. 9V £3·75. 6V £3·75. 9V+9V £5·45. 6V+6V £5·45. 4½V+4½V £5·75.
CASSETTE MAINS UNITS
7½V with 5 pin din plug. 150mA £3·95
3-WAY MODELS*
With switched output and 4-way multi-jack connector. Type 1: 3/4½/6V at 100mA £3·20. Type 2: 6/7½/9V at 150mA £3·30.
FULLY STABILIZED MODEL £5·45*
Switched output of 3/6/7½/9V stabilized at 400mA.
CAR CONVERTORS £5·10*
Input 12V DC. Output 6/7½/9V DC 1 Amp stabilized.

BATTERY ELIMINATOR KITS
Send sae for free leaflet on range.
100mA radio types with press-stud battery terminals. 4½V £2·10. 6V £2·10. 9V £2·10. 4½V+4½V £2·80. 6V+6V £2·80. 9V+9V £2·80.
100mA cassette type 7½V with 5 pin din plug £2·10.
Transistor stabilized 8-way type for low hum. 3/4½/6/7½/9/12/15/18V. 100mA £3·50. 1Amp £6·50. Heavy duty 13-way types 4½/6/7/8½/11/13/14/17/21/25/28/34/42V. 1 Amp model £4·95. 2 Amp model £7 95.
Car convertor kit Input 12V DC. Output 6/7½/9V DC 1A transistor stabilized £1·95.

MAINS TRANSFORMERS
6-0-6V 100mA £1. 9-0-9V 75mA £1. 18V 1A £1·95. 0/12/15/20/24/30V 1A £4·30. 12/0/12V 50mA £1. 0/12/15/20/24/30V 2A £5·95. 20V 2½A £2·95. 6-0-6V 1½A £2·85. 9-0-9V 1A £2·55. 12-0-12V 1A £2·95. 15-0-15V 1A £3·20. 30-0-30V 1A £4·10.

S-DECS AND T-DECS*
S-DeC £2·24. T-DeC £4·05.
u-DeCA £4·45. u-DeCB £7·85.
IC carriers with sockets:
16 dil £2·05. 1OT05 £1·95.



SINCLAIR CALCULATORS & WATCHES–
Cambridge Universal £6·60. Cambridge Scientific £8·95. Oxford Sci £13·30. Programmable Scientific with free mains unit £19·95. Mains adaptors for other models (state type) £3·20. Assembled Grey Watch with free stainless steel bracelet £16·45. White watch £13·95.

SINCLAIR PROJECT 80 AUDIO MODULES
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PIV	·8A (TO92)	1A (TO5)	3A (C106)	4A (TO220)	6A (TO220)	8A (TO220)	10A (TO220)	15A (TO84)
50	0·20*	0·25	0·35	0·32	0·41	0·42	0·47	0·96
100	0·25*	0·25	0·40	0·37	0·47	0·48	0·54	1·02
200	0·27*	0·35	0·45	0·40	0·58	0·60	0·68	1·14
400	0·30*	0·40	0·50	0·45	0·87	0·88	0·98	1·40
600	—	0·65	0·70	—	1·09	1·19	1·26	1·80

TRIACS (PLASTIC TO-220 PKGE ISOLATED TAB)

	4A (a)	4A (b)	6·5A (a)	6·5A (b)	8·5A (a)	8·5A (b)	10A (a)	10A (b)	15A (a)	15A (b)
100V	0·60	0·60	0·70	0·70	0·78	0·78	0·83	0·83	1·01	1·01
200V	0·64	0·64	0·75	0·75	0·87	0·87	0·87	0·87	1·17	1·17
400V	0·77	0·78	0·80	0·83	0·97	1·01	1·13	1·19	1·70	1·74
600V	0·96	0·99	0·87	1·01	1·21	1·26	1·42	1·50	2·11	2·17

N.B. Triacs without internal trigger diac are priced under column (a). Triacs with internal trigger diac are priced under column (b). When ordering please indicate clearly the type required.

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7408	0·18
7409	0·18
7410	0·16
7412	0·25
7413	0·25
7414	0·72
7416	0·43
7417	0·43
7420	0·16
7422	0·38
7423	0·40
7425	0·30
7427	0·48
7428	0·53
7430	0·16
7432	0·37
7433	0·49
7437	0·35
7438	0·35
7440	0·16
7441	0·78
7442	0·65
7445	1·50
7446	2·56
7447	0·81
7448	0·81
7450	0·85
7451	0·16
7453	0·18
7454	0·18
7460	0·18
7470	0·32
7472	0·26
7473	0·30
7474	0·32
7475	0·47
7476	0·36
7480	0·55
7481	1·26
7482	0·75
7483	1·12
7484	0·85
7485	1·25
7486	0·32
7489	2·92
7490	0·45
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AC141	0·18	BD233	0·48*	OC44	0·12
AC141K	0·28	BD237	0·55*	OC45	0·10
AC142	0·18	BD238	0·60*	OC70	0·10
AC142K	0·28	BD184	1·20	OC71	0·10
AC176	0·16	BDY20	0·80	OC72	0·22
AC176K	0·25	BDY38	0·60	OC84	0·14
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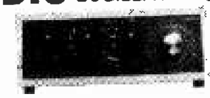

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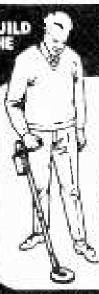

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AC125*	22	BC157	10	BF180*	33	MPSU06	52	TIS44	27	2N3053*	16
AC126*	18	BC158	12	BF181*	33	MPSU52	60	TIS46	40	2N3054*	49
AC127*	18	BC159	13	BF182*	33	MPSU55	52	TIS50	47	2N3055*	49
AC128*	18	BC160*	32	BF183*	33	MPSU56	74	TIS74	47	2N3525*	76
AC141*	22	BC167	12	BF184*	28	MPU131*	39	TIS91	24	2N3614*	169
AC141*	K38	BC168	12	BF185*	30	OC25*	59	ZTX107	12	2N3615*	135
AC142*	20	BC169C	14	BF194	10	OC26*	95	ZTX108	12	2N3663	32
AC142K*	38	BC170	11	BF195	10	OC28*	58	ZTX109	15	2N3702	11
AC176*	18	BC171	11	BF196	14	OC29*	58	ZTX300	14	2N3703	12
AC187*	18	BC172	11	BF197	15	OC35*	54	ZTX301	14	2N3704	11
AC188*	19	BC177*	18	BF198	15	OC36*	58	ZTX302	19	2N3705	12
ACY17	35	BC178*	16	BF200	37	OC41*	18	ZTX303	22	2N3706	19
ACY18	28	BC179*	18	BF224A	15	OC42*	18	ZTX304	24	2N3707	11
ACY19	25	BC182	10	BF244	34	OC44*	25	ZTX311	15	2N3708	9
ACY20	24	BC182L	12	BF256*	34	OC45*	18	ZTX314	24	2N3709	9
ACY21	29	BC183	10	BF257*	34	OC46*	35	ZTX341	20	2N3710	12
ACY22	16	BC183L	11	BF258*	38	OC70*	35	ZTX500	17	2N3711	12
ACY28	21	BC184	11	BF259*	48	OC71*	23	ZTX501	15	2N3771*	164
ACY39	78	BC184L	12	BF594	30	OC72*	27	ZTX502	19	2N3772*	175
ACY40	24	BC188	22	BF595	28	OC77*	56	ZTX503	19	2N3773*	275
ACY44	39	BC187*	28	BFR39	25	OC79*	58	ZTX504	47	2N3819	22
AD149*	46	BC212	12	BFR40	25	OC81*	24	ZTX531	28	2N3820	42
AD161*	36	BC212L	13	BFR79	25	OC81D*	28	ZTX550	18	2N3823*	49
AD162*	36	BC213	11	BFR80	25	OC82*	25	2N526*	40	2N3824*	89
AF114*	20	BC213L	13	BFX18*	54	OC82D*	35	2N696*	15	2N3866*	90
AF115*	20	BC214	14	BFX29*	28	OC83*	28	2N697*	21	2N3903	15
AF116*	20	BC214L	16	BFX38*	38	OC84*	44	2N698*	30	2N3904	15
AF117*	23	BC307B	15	BFX53*	40	OC84N*	44	2N699*	45	2N3905	17
AF118*	47	BC328	18	BFX55*	40	OC123*	115	2N706*	15	2N3906	17
AF121*	33	BC441*	30	BFX84*	38	OC139*	140	2N706A*	18	2N4037*	39
AF124*	30	BC461*	40	BFX81*	141	OC140*	125	2N707*	50	2N4058	15
AF125*	30	BC462*	30	BFX84*	24	OC141*	157	2N708*	15	2N4061	13
AF126*	30	BC547	15	BFX85*	28	OC170*	30	2N914*	18	2N4289	24
AF127*	30	BC548	15	BFX86*	28	OC171*	32	2N916*	27	2N4859	35
AF139*	33	BC549C	15	BFX87*	23	OC201*	125	2N918*	34	2N4871	34
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AF179*	70	BCY30*	56	BFY50*	17	OC203	150	2N930*	18	2N5136	12
AF180*	70	BCY32*	65	BFY51*	17	OC204*	150	2N961*	61	2N5138	12
AF181*	46	BCY34*	80	BFY52*	17	TIP29	43	2N1131*	19	2N5179	60
AF185*	60	BCY39*	88p	BFY65*	25	TIP29A	45	2N1132*	23	2N5180	60
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BC107*	9	BCY71*	20	BSY95A	18	TIP30C	74	2N1306*	37	2N5459	36
BC107B*	10	BCY72*	15	BU105*	195	TIP31*	52	2N1307*	37	2N5485	42
BC108*	9	BD115*	52	E5567	48	TIP31A*	54	2N1308*	48	2N6027	35
BC108B*	12	BD121*	98	MD8001*	158	TIP31B*	58	2N1671*	150	40311*	38
BC108C*	12	BD123*	95	MJ400*	90	TIP31C*	68	2N1671B	190	40313*	98
BC109*	9	BD124*	85	MJ491*	180	TIP32*	60	2N1893*	27	40316*	60
BC109B*	12	BD131*	36	MJ2955*	125	TIP32A*	63	2N2160*	80	40317*	38
BC109C*	12	BD132*	38	MJE340*	45	TIP32B*	80	2N2217*	40	40326*	40
BC113	15	BD133*	60	MJE370*	68	TIP32C*	93	2N2218A*	25	40327	48
BC114	16	BD135	45	MJE371*	80	TIP33*	95	2N2219A*	24	40347*	65
BC115	18	BD136	40	MJE520*	65	TIP33A*	95	2N2220A*	26	40348*	73
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BC117	20	BD138	47	MJE2955*	98	TIP33C*	120	2N2222*	21	40361*	43
BC118	15	BD139	54	MJE3055*	62	TIP34*	110	2N2303*	250	40362*	43
BC119	25	BD140	57	MPF102	36	TIP34A*	115	2N2369*	14	40411*	220
BC135	13	BD142	53	MPF103	36	TIP34B*	140	2N2483*	30	40412*	42
BC136	15	BD145*	80	MPF104	36	TIP35*	219	2N2484*	30	40476	170
BC137	15	BDY17*	195	MPF105	36	TIP35A	225	2N2614	54	40494	89
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7408	22	7485	125	74164	121
7409	22	7486	36	74165	120
7410	15	7489	390	74166	161
7411	25	7490	43	74167	362
7412	25	7491	80	74172	890
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7414	74	7493	40	74174	173
7415	35	7494	85	74175	90
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7423	30	74104	48	74182	85
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7433	48	74118	115	74193	120
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7441	74	74123	73	74197	118
7442	74	74125	69	74198	248
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7444	122	74128	81		
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7446	116	74141	72		
7447	82	74142	315		
7448	80	74143	314		
7450	17	74144	314		
7451	17	74145	90		
7453	17	74147	275		
7454	17	74148	160		
7460	17	74150	128		
7470	32	74151	79		
7472	28	74153	82		
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4010AE	56	4025AE	17
4011AE	16	4026AE	175
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4013AE	55	4028AE	85
4015AE	99	4029AE	109
4016AE	55	4030AE	52
4017AE	95	4033AE	130
4018AE	92	4034AE	184
		4040AE	99
		4042AE	65
		4043AE	97
		4044AE	95
		4045AE	140
		4046AE	127
		4047AE	88
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		4050AE	55
		4054AE	120
		4055AE	134
		4056AE	134
		4060AE	112
		4067AE	350
		4068AE	22
		4069AE	18
		4070AE	55
		4071AE	20
		4072AE	20
		4076AE	155
		4077AE	60
		4078AE	22
		4081AE	22
		4082AE	20
		4510AE	140
		4511AE	165
		4516AE	140
		4518AE	140
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A.C. Current	1·5mA-6A	0·6mA-1·5A	0·5mA-2·5A
D.C. Volts	75mV-900V	75mV-600V	75mV-1000V
A.C. Volts	300mV-900V	15V-600V	1V-1000V
Resistance	0·02-3kΩ	1K-1M	300Ω-500kΩ
Capacity	—	0·5μF	0·5μF
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Price complete with pressed steel carrying case and test leads.	£14·50	£17·50	£14·95

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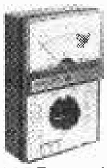

D.C. Current:	0·06-0·6-60-600mA-3A
A.C. Current	0·3-3-30-300mA-3A
D.C. Voltage:	0·6-1·2-3-12-30-60-120-600-1200V
A.C. Voltage:	3-6-15-60-150-300-600-900V
Resistance:	500Ω-5-50-500kΩ
Accuracy:	D.C. 2·5%; A.C. 4% (of F.S.D.)

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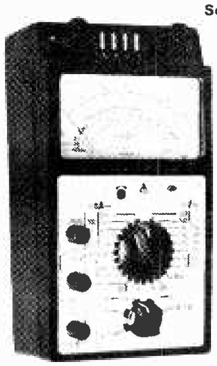

Sensitivity:
16700Ω/V D.C.,
330Ω/V A.C.
Ranges:
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A.C. current 0·3–3–30–300mA
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A.C. Voltage: 1·5–7·5–30–150–300–750V
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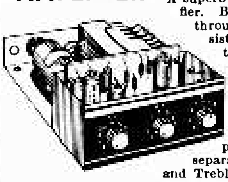
SUPERSOUND 13 HI-FI MONO AMPLIFIER



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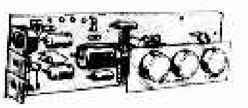


A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din sockets & 5 pin din tape rec./play socket are mounted on the printed circuit panel size approx. 9½" × 2½" × 1" max. depth. Supplied brand new & tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically) at only **£9·00** plus 50p P & P. Mains transformer with an output of 17v a/c at 500m/a can be supplied at **£1·50** + 40p P & P if required. Full connection details supplied.

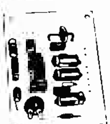
VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. **Our price £1·50 yd. length.** P. & P. 50p per yd. (min. 1 yd.). S.A.E. for samples

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240v. Secondary combinations 0-5-10-15-20-25-30-35-40-60v. half wave at 1 amp. or 10-0-10, 20-0-20, 30-0-30v. at 2 amps full wave. Size 3in. long × 3½in. wide × 3in. deep. Price **£2·90** P. & P. 90p.

MAINS TRANSFORMER. For power supplies.
Pri. 200/240v. Sec. 9-0-9 at 500 mA. **£1·50.** P. & P. 60p.
Pri. 200/240v. Sec. 12-0-12 at 1 amp. **£1·65** P. & P. 60p.
Pri. 200/240v. Sec. 10-0-10 at 2 amp. **£2·35.** P. & P. 90p.
Pri. 200/240V Sec. 23V at 1·5amp, 6V at ·6 amp, 8V at 50mA. **£2·00** + 65p P. & P.

ALL-PURPOSE POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp on load.
Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3½" × 2¼". Ready built and tested Price **£8·75** P. & P. 85p.

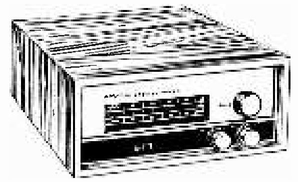
STEREO-DECODER



SIZE 2" × 3" × ½" ready built. Pre-aligned and tested. Sens. 20-560 mV for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. **£5·62** plus 20p. P. & P. Stereo beacon light if required **40p** extra.

QUALITY RECORD PLAYER AMPLIFIER MK. II A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide × 3in. deep × 6in. high. Ready built and tested. PRICE **£7·00**, P. & P. 90p.
ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE **£8·00**, P. & P. £1.

MAINS OPERATED SOLID STATE AM/FM STEREO TUNER

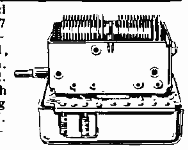


200/240V Mains operated Solid State F/M A/M Stereo Tuner. Covering M.W. A.M. 540-1605KHz VHF/FM 88-108MHz.
Built-in Ferrite rod aerial for M.W. Full AFC and AGC on AM and FM. Stereo Beacon Lamp Indicator. Built in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600m/v RMS into 20K. Simulated Teak finish cabinet. Will match almost any amplifier Size 8½"w x 4"h x 9½"d approx.

LIMITED NUMBER ONLY at **£28·00** + £1·30 P. & P.

SPECIAL OFFERS

Mullard LP1159 R.F.-I.F. Double Tuned Amplifier Module for nominal 470 KHz. Size approx. 2¼" × 1¼" × ½" 7·6 Volt + earth. Brand new pre-aligned. Full specification and connection details supplied. **£2·25.** P. & P. 12p



Pye VHF/FM Tuner Head covering 88-108 M/Hz. 10·7 M/Hz I.F. output. 7·8 Volt + earth. Supplied pre-aligned, with full circuit diagram. Connection details supplied. Beautifully made with precision-geared FM gang and 323Pf + 323Pf A.M. Tuning gang only **£3·15** + P. & P. 35p.

PRECISION MADE
Push Button Switch bank. 8 Buttons giving 16 S/P C/O interlocked switches plus 1 Cancel Button Plus 3 d/p c/o. Overall size 5" × 2¼" × 1". Supplied complete with chrome finished switch buttons. **2 for £1·50** + 20p P & P.

HI-FI LOUDSPEAKER SYSTEM MK II

Beautifully made, simulated teak finish enclosure with attractive slatted front. Size 16½" high × 10½" wide × 9" deep (approx.). Fitted with E.M.I. Ceramic Magnet 13" × 8" bass unit, H.F. tweeter unit and crossover. **AVAILABLE IN NOMINAL** 4 Ohm, 8 Ohm or 16 Ohm impedance (state which). Handling power 10 watts R.M.S.
OUR PRICE £12·80 each. Carr. £1·90 ea.
Cabinet Available Separately £7·60, Carr. £1·40 each.
Also available in 8 ohms with EMI 13" × 8" bass speaker with parasitic tweeter £11·10, Carr. £1·90 ea.

LOUDSPEAKER BARGAINS
5in. 3 ohm **£1·45**, P. & P. 35p. 7 × 4in. 3 ohm **£1·69**, P. & P. 48p. 10 × 6in. 3 or 15 ohm **£2·50**, P. & P. 75p. E.M.I. 8 × 5in. 3 ohm with high flux magnet **£2·06**, P. & P. 50p. E.M.I. tweeter. Approx. 3½". Available 3 or 8 or 15 ohms, **£2·00** + 25p, P. & P.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11¾" × 14¾" × 1 1/16" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details.
Only **£8 40** each + p. & p. (one 75p, two 90p).
Now also available 8". – 8 ohm 10 watts, r.m.s. 20 watt peak 40 Hz-20,000 Hz. Overall depth 1". Ideal for Hi-Fi or for use in cars **£5·10** + p. & p. (one 35p, two 65p).

SPECIAL LINES

OFFERED SUBJECT TO STOCK AVAILABILITY

Limited number of British manufacturer's surplus professional 100 watt RMS slave amplifiers. Special features, 2 separate power modules, 1 for Bass response and 1 for mid.range/tweeter. 5 stage LED display for power o/p indication. A/C mains i/p switchable for 110 or 240v. Can easily be converted to Stereo. **AVAILABLE TO PERSONAL CALLERS ONLY, PLEASE PHONE TO CONFIRM AVAILABILITY.** Brand new & tested only **£33·75.**

25 watt RMS Solid state power amplifier module. Fre. Resp. 35 Hz.-20 KHz. Power requirements 40 volts @ 1·5 amps. Full c/d & connection details supplied. **£6·20** + 30p P/P.

New but very slightly marked 'GLENBURN' BSR automatic record changer decks fitted with cueing lever, lightweight arm and ceramic Hi-Fi stereo/compatible cartridge. Can be used for automatic or manual play. PRICE **£9·56** + £1·20 P. & P.

Limited number of the latest BSR C142 auto manual changer de-luxe. Lightweight tubular arm with adjustable counterweight cueing lever, bias compensator. PRICE **£13·00**—£1·00 P. & P.

HARVERSONIC SUPERSOUND 10 + 10 STEREO AMPLIFIER KIT

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12-30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12-15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp. Overall Size 12"w. × 8"d. × 2½"h.

Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

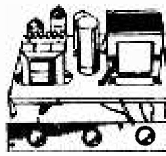
AMPLIFIER KIT	**£13·50**	P. & P. 65p
(Magnetic input components 33p extra)		
POWER PACK KIT	**£5·50**	P. & P. 85p
CABINET	**£5·50**	P. & P. 85p

SPECIAL OFFER—only £23·75 if all 3 items ordered at one time plus £1 p. & p.

Full after sales service

Also available ready built and tested **£31·25.** P. & P. **£1.**

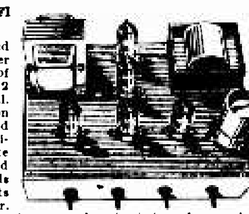
8-VALVE AUDIO AMPLIFIER HA34 MK II



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7¼"w. × 4"d. × 4½"h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£8·20.** P. & P. £1·00.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc **£7·60** P. & P. £1·00.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p + SAE (Free with parts)' All parts sold separately. ONLY **£12·00** P. & P. £1·35. Also available ready built and tested **£16·50** P. & P. £1·35.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER
For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300v. Frequency response 15Hz—25KHz. Gain 26dB. Solid encapsulation size 1½" × 1½" × ½". Brand new complete with instructions. Price **£1·80** P.& P. 15p.

Prices include VAT at Current Rate

Open 9.30–5.30 Monday to Friday. 9.30–5 Saturday Closed Wednesday.

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