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You can build the Unit 3 Kit into one of two cabinet sizes. In the smaller cabinet the system will give a faithful and rich reproduction of all musical sounds from 65 - 17,000 Hz. The larger cabinet increases the range from 40 - 17,000 Hz.
Viking Amplifier

50 Watt Amplifier

An extremely reliable general purpose valve amplifier. Its rugged design, yet space age styling and design makes it by far the best value for money.

Technical Specifications

4 electronically mixed channels, with 2 inputs per channel, enables the use of 8 separate instruments at the same time. The volume controls for each channel are located directly above the corresponding input sockets.

Sensitivities and Input Impedances

Channel 1: 4mV at 1kHz. These two channels (4 inputs) are suitable for channel 2: 4mV at 1kHz. Microphone guitar.

Channel 3: 200mV at 1kHz. Suitable for most high output instruments.

Channel 4: 200mV at 1kHz. (Grammaphone, organ etc.).

Input sensitivity relative to input level.

Tone Controls are common to all inputs.

Bass Boost: +12dB at 60Hz. Treble Boost: +11dB at 15kHz. Treble Cut: -12dB at 15kHz. With bass and treble controls central, -3dB points are at 300Hz and 20kHz.

Power Output

For speech and music 50 watts rms. 100 watts peak. For sustained music 45 watts rms. 90 watts peak. For sine wave 38.5 watts rms. Nearly 80 watts peak.

Total distortion at rated output 3%.

Total distortion at 20kHz 0.15%.

Output to match into 8 or 15 ohms speaker system.

Negative Feedback at 1KHz. 3%.

Signal to Noise Ratio 60dB.

Main Vol's

Adjustable from 200-250V A.C. 60-60Hz. A protective fuse is located at the rear of the unit.

Valve Line Up

Double purpose ECC83 x 3, EL34 x 2 and GZ34.

Four Plus Four Stereo Amplifier

A superb high quality, yet inexpensive stereo amplifier. Due to the great demand we are now able to offer this precision made instrument at a fantastically low price. The high quality, reliability and styling have been maintained in spite of its low price.

Specifications

Elegant styled cabinet (sizes 16 wide 5 high 81 deep) in black rexin and woodgrained sides. Brushed aluminium front panel with contrasting black/silver knobs.

Controls


Inputs and Outputs

(Per channel)

Gram, aux, tape out and speaker out. A switched mains socket is also provided at the rear of the unit. Employed Mullard valves throughout. ECC83 and 2 x ECL86 with a metal bridge rectification.

Technical Specifications

Gain sensitivity 400mV at 1 kHz. Gain sensitivity 200mV at 1 kHz. (Sensitivities are given for rated output.) 4 watts r.m.s. 8 watts r.m.s. in monopolar mode. Output match into standard 8 ohms speaker system. Suitable 10/40 watts are available at 9/6 each, plus 5/- p. & p. Bass control at 100Hz lift +9dB cut -10dB. Treble control at 1kHz lift +9dB cut -10dB. Total harmonic distortion 0.005% at 100Hz and 2% for rated output at 1kHz. Negative feedback 12dB at 1kHz. Mains supply 220V-250V A.C. 50-60Hz.

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Manufactured by Lawrence Labs at a cost price of 195. In two units, Amplifier size 13 1/2 x 7 x 8 1/2. Heat sink size 11 1/2 x 9 x 7. Output into 10 ohm Speaker. Transistors: - eight OC45s. Two 2N2374, Sensitivity 12 DB at 80db. Input Impedance 60000 ohms. Power Response 1.5-22000 Hz. B.S. 4044, ideal for many purposes. Our price 39s. plus 3/6 P. & P.

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**SPECIFICATIONS**


Sensitivity: for rated output 1 mV into 3 & 8 ohms load. Frequency Response: minus 3dB points are 20 Hz and 40 KHz. Total Distortion: ±0.35% for rated output 15%, for 5 W output 20%.

Output Impedance: 3 ohms (15-15 ohms may be used).

Supply Voltage: 24 V D.C. at 800mA (6-24 V may be used) output at 14 V D.C. supply with 3 ohm speakers. 7 watts.

Size: 3 1/2 x 3 1/2 x 1 1/2". The fully comprehensive instruction manual does not only show the basics, such as circuit diagram and connections, but also gives the practical easy-to-understand detailed information about the complete standard equalisation networks are given for most types of conventional inputs. They include: Tape Head, Mic. P.U., X101. P.U., Tuner, X101, etc. 49/6 p.

**Control assembly:** (including resistors and capacitors): 1 volume: PRICE 5/-, 3 Treble: PRICE 5/-, 3. Comprehensive bass and treble: PRICE 10/-.

The above 3 items can be purchased for use with the X101.

**POWERS SUPPLIES FOR THE X101**

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**PR 101/M**

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Particularly suitable for use with the X101 if a ready-built, comprehensive, multiple input system is desired.

**CONTROLS**

Selector Switch, Tape Speed Equalisation Switch (3 and 4 p.s.), Volume, Treble, Bass, 3 position scratch filter and 3 position rumble filter.

**SPECIFICATION**

Sensitivities for 200 mV output at 1 KHz.

- Tape Head: 3 mV (at 21 p.s.)
- Mic. P.U.: 3 mV
- Treble: 80 mV
- Bass: 100 mV

M.K Right, Output 100 mV

Equalisation for each input is correct to within ± 0.2dB (R.I.A.A.) from 20 Hz to 20 KHz.

Tone Control Range: Bass ± 10dB at 60 Hz

Treble ± 14dB at 15 KHz

Total Distortion: (for 200 mV output) < 0.0 2%

Signal Noise: 3-30dB

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- Input: 6 pairs (Matched Pair).
- Crystal or Ceramic Crystal P.U. (3) Radio/Aux.
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TOPIC OF THE MONTH

What is "standard"?

We often hear that commercial radio sets use "standard circuits". Superficially this may be true, but a study of current models will uncover many variations in style and design. It is really quite remarkable that six makers can come up with six different approaches to the design of, say, a seven transistor portable. Except in fundamental aspects, there is no such thing as a standard circuit outside the pages of a textbook.

This will become abundantly clear when called upon to service some of the offerings from the Orient and elsewhere and there is no circuit diagram available. Often it is necessary (and is a useful exercise anyway) to trace out the circuit from the chassis. The basic stages should be easily located and from then on it is simply a matter of patience to fill in the gaps.

This is one activity in which the amateur scores over the professional. A technician trying to earn his bread and butter (and maybe a little jam) usually has little time to probe around a strange circuit while he could be engaged on more profitable work. The amateur, on the other hand, is not too concerned with the time factor and is relatively free to indulge his curiosity. And he can also learn a good deal into the bargain, for no amount of textbook swatting will compensate for practical work on actual receivers.

Yet, purely practical work will not advance a constructor's knowledge unless he takes the trouble to work out not only what a circuit is but what it does, and how. He should find out why a certain component is placed in a particular part of the circuit and why it has a certain value or rating. He should also be interested in knowing what might happen if the component breaks down in any way.

So, next time you find yourself with an unfamiliar set to look over, think of it not as a chore but as an opportunity to expand your knowledge and expertise. Such activity should be part of any enthusiast's education!

W. N. STEVENS—Editor.

NEWS AND COMMENT

Leader
News and Comment
Audio Fair 1968
On the Short Waves
by Christopher Danpure and David Gibson, G3JDG
Practically Wireless
by Henry
Letters to the Editor
Club Spot—Allerton and District Scout Radio Hobbies Club, G3TZR

CONSTRUCTIONAL

Portable Keyless Organ
by G. W. Hardy

The "Clubman", Part 7
by J. Thornton-Lawrence, GW3JGA

Simple Receivers for Beginners
by T. Simon

The Stephton
by H. T. Kitchen

V.F.O. for the Ten-Fifty Transmitter
by A. S. Carpenter, G3TYJ

OTHER FEATURES

Repairing Radio Sets, Part 4
by H. W. Hellyer

Five Steps to Hi-Fi, Part 3
by Iain Smith

AUGUST ISSUE WILL BE PUBLISHED ON JULY 5th
Yes, we know it's a photograph of a "tanner" but look at the little black thing next to the coin. This is a sub-subminiature micro switch and the makers, Honeywell, claim that this range is the smallest in the world. Certainly an indication of the way in which the discreet components are slowly shrinking to keep pace with the semiconductor miniaturisation programme. Statistics of our pin-up are:

Operating Force—5oz. max.; Release Force—1oz. min.;
Pretravel—0-020in. max.; Overtravel—0-004in. min.;
Differential travel—0-005in. max.; Weight—1/28th of an ounce. Temperature range—minus 95°F. to plus 375°F. (Phew!)

The electrical ratings given on the spec. sheet are very comprehensive. The d.c. ratings: 30 volts at —7A resistive; 4A inductive (sea level); 2.5A inductive (50,000ft); 24A max. surge. For a.c.: 115/250 volts at 7A resistive and inductive; 20A surge.

The switch itself is a single-pole double-throw snap-action type. Further information from Honeywell Controls Ltd., Great West Road, Brentford, Middlesex.

A new re-styled pack of their Match-Melting Multicore Tape Solder has been marketed by Multicore Solders Ltd. of Maylands Avenue, Hemel Hempstead, Herts. It is supplied in cut lengths sufficient for about 50 joints. This tape solder can be used without a soldering iron or extra flux, and can be applied with the aid of a match. The recommended retail price is 2s. 6d., matches extra—of course! Further details may be obtained from the manufacturers.

The gentlemen of Jodrell Bank, home of Britain's giant radio telescope, are unhappy. Signals are being received which just can't be explained and will not fit into any physical theory put forward so far. Until quite recently, the only spectral line known was that emanating from Hydrogen at around 21cms. Now, at frequencies in the 1,600Mc/s region from OH sources, come other spectral lines whose intensities don't coincide with what theory dictates.

The energy from these sources also appears to be polarised in various planes which again causes much frowning among radio astronomers. However, a recent set of measurements carried out in conjunction with American radio astronomers looks like proving fruitful. To date, the information from these experiments is still being carefully sifted and interpreted, but it could be that those giant concave steel eyes have already taken the first step to solve another of those mysteries of space. Some people have seriously suggested that the signals might be intelligible, but we are reserving judgement.

The Futura II is Ferguson's first transistorised mains operated table radio. It preserves the low, long look and is styled in rosewood. For the size-conscious reader, the manufacturers confess to the following dimensions: 22½ x 9 x 5½ in. including feet.

The controls all have spun aluminium caps with polished edges. The two large knobs are on/off and volume, and tuning, while the two smaller ones are bass and treble. Five push-buttons function for v.h.f., a.f.c., long, medium and short waves. Coverage on v.h.f.—87-5 to 108Mc/s, while long, medium and short waves are covered in three segments 1110-2020, 185-565 and 17-50 metres respectively.

Sockets are provided for a.m. and f.m. external aerials although the set boasts its own internal 8in. ferrite rod for a.m. An internal f.m. aerial using the mains lead is also fitted and may be disconnected when an external aerial is used. Output from the 5 x 3in. 15Ω speaker is 1-5 watts (speech and music rating). The Futura II requires 200-250V. a.c. 50c/s, 5 watts, has ten transistors and six diodes, and if you want one will cost you £41 10s. 0d.

Also from Ferguson is the Autotwin portable, suitable for home or car. A nine transistor circuit covers long and medium waves with 700mW output.
NEWS AND COMMENT...

THE ELECTROWRITER

This device enables one to send a drawing or sketch over the telephone or radio. One writes with a ball-point pen on regular paper as on a note pad, and as the pen is moved, the remote receiver(s) instantaneously and faithfully reproduces the copy as it is written. No extraneous power supplies are required since the instruments are fully transistorised and self-contained.

The electrowriter can be attached to a telephone system permitting alternate written messages and voice service. The device is an electro-mechanical pantograph giving the facility that one can write to other points by remote control. This is done by creating two frequencies transmitted down a pair of wires compositely, one of which is governed by horizontal movement and the other by vertical movement. This gives true analogue service unlike a teleprinter which relies on single pulses and is therefore a digital device.

The receiving unit has a mechanical response to a varying frequency on the line. The input is filtered in such a way that it splits the composite signal into two distinct frequencies each of which is then able to operate the vertical and horizontal pantograph motors, which in turn operates the pen. The action of the pen nib is achieved by frequency modulating one channel, which is then detected and converted to "pure" d.c. to operate a solenoid which, by mechanical linkages, causes the pen to touch the paper. This sequence of events is touched off at the transmitter by the operation of a gravity switch within the stylus and thereafter by a spring loaded plunger which operates the pen-down mechanism.

The receiving machine is inactive until a signal appears at its input, which operates a "squelch" relay which brings the whole device to life. Since both horizontal and vertical frequencies (1310-1490 and 2060-2340c/s) are within the voice bandwidth, whenever voice reception is possible this system will operate. You'll be able to send those circuits by telephone soon!

RADIO LEEDS

Construction is in progress on the transmitter building for BBC Radio Leeds which should be on the air this month. The building is in the grounds of Meanwood Park Hospital, about 3¼ miles north of the city.

The station will operate on v.h.f. 94-6Mc/s, horizontally polarised and will cover the whole of the city. The local programmes will be originated from the headquarters of BBC Radio Leeds at Merrion Centre. Reception is expected over an area bounded by Pudsey, Arthington, Scarcroft, Swillington and Lofthouse.

FLUID 101

"A transistor radio was completely immersed in water and obviously ceased to function. Afterwards it was sprayed with Fluid 101 and recommenced working within seconds".

"An electric light bulb was connected with bare wires, immersed in water after spraying the wires with Fluid 101 and lit quite normally".

This is what Special Products Distributors Limited claim for a can of Fluid 101, which costs 9s. 6d. for the 6oz. size. Almost worth getting a small can just to see—isn’t it?

METHOD 101

Have you ever wondered just how much testing goes on to ensure that your electronic components are reliable? Raytheon Company of Lexington, Massachusetts, really go the whole hog. If you were one of their new gold-plated precision spark gaps (for instance) you would have been subjected to the following shock test described as "method 205C": 15g's for 11ms: 18 impacts in three mutually perpendicular axes. Had enough? Well, there’s still the vibration test—10 to 300c/s along each axis for 30 minutes, ambient temperature check from minus 55°C to plus 85°C and just to finish you off—salt spray testing "... in accordance with method 101".

The photograph shows three who made it—well done chaps! (Bet you readers are glad you’re on the other end of the soldering iron).

BROADCASTING CONVENTION

The International Broadcasting Convention is to be held in London from 9 to 13 September, 1968, at the Grosvenor House Hotel, Park Lane. The Television Conference, already announced by the learned societies for 1968, is incorporated within this Convention at which a wide cross-section of the latest broadcasting equipment will be shown. Further information from E.E.A., Berkeley Square House, Berkeley Square, W.1. The Convention Secretariat address is to be: The International Broadcasting Convention, Savoy Place, Victoria Embankment, London, W.C.2.
TRANSISTORS are used throughout this instrument, which is complete with power amplifier and loudspeaker. Despite its simplicity and low cost, the tone obtained is of great appeal, and compares with the solo voice of an expensive commercial electronic organ. Keys are not always easy to obtain, and then will need altering and adapting to the new instrument. The method used by the author in this instrument, is a series of small metal plates, arranged in the usual layout of standard keys, so that it is easy to recognise and select any required note.

Two wands terminating with a contact stud are needed, one for each hand. When the contact makes with any plate, the note generator starts oscillating at the previously tuned pitch of that note. Having two wands makes for smooth or legato playing. The switch on wand No. 2 disconnects the preamplifier, but a sound is still produced provided contact is still made with that plate, but slowly decays while capacitor C13 Fig. 2 discharges. For normal playing the switch is kept closed with the forefinger. The metal plates are kept very close to each other, so that the wand contact can freely glide from one to another.

Solo Organ Prototype

The system of tuning used in the new instrument was experimentally tried out in the author’s prototype of the organ described in an article which appeared in the February, March and April 1965 issues of P.W. Readers who have built this instrument will be interested to know that the new tuning method has proved very satisfactory while in constant use for a period of over 12 months. Constructors will only need to remove the tags that contain the tuning resistors, and substitute the tuning device to be explained later in this article. The vibrato used in this new instrument is a true vibrato, which means that the frequency of the sound is modulated, and is obtained from a one transistor phase shift oscillator. Another toggle switch was fitted alongside the original vibrato switch, and room found inside the case to accommodate a PP3 9 volt battery. The battery positive is taken to the common positive, negative through the new on/off switch, and then to the oscillator panel. Output from the capacitor C5 (Fig. 1) is taken direct to base of Tr3 Fig. 1 (Feb 1965 issue).

The Note Generator

A multivibrator circuit (Fig. 1) has been used again, as it is very accommodating and easy to set up. What other oscillator will give over three octaves of musical notes while only changing one resistance! With the components’ values given a range of three octaves will be comfortably covered, that is from C one octave above middle C and down three octaves to C in the bass, a most useful range. A limiting resistance, R7 should be altered if necessary so that top C will be in tune when the moving arm of the tuning control VR3 is at half travel. Do not use lower value than 10kΩ or Tr3 will pass excessive current, 15kΩ should be about right, a lower value will raise the pitch, and a higher one lower the pitch. Provision has been made in the layout of panel Fig. 2 for R7 to be experimentally tried out before finally soldering to the two tags provided.

Unless the constructor has another keyed instrument to give the pitch C (C above middle C on the piano), a tuning fork or pitch pipe becomes necessary. One can be purchased from any good music store and must be marked “C international or Standard Pitch”. The vibrations are 523-25c/s.

Vibrato

In Fig. 1 will be seen the circuit for the phase shift oscillator. It is important to use a high gain transistor, in order to maintain oscillation. The OC72 used was to hand and works very well. An OC45 and white spot germanium transistor have been satisfactory. VR1 alters frequency slightly, and should it not cover the requisite range of 5 to 7c/s, R3, 6.8kΩ, can be varied slightly in value. In the layout two tags have been left for an experimental try-out. VR2 slightly alters depth of modulation, and should be placed about half-way when setting up. Both controls should be midget or skeleton preset types.
The preamp Fig. 2 is a common emitter amplifier. The purpose of the 25Ω resistance R11, in series with the expression control VR4, is to prevent the sound being completely turned off, leaving it possible to play very softly. The sustain switch, S3, enables the sound to slowly decay, the duration being fixed by the capacity of C13. The 50µF specified is quite satisfactory, and gives some useful effects. R17 is to absorb make and break clicks.

The output stage has been designed around an AD140 transistor (cost about 10s.) instead of using the more conventional Class B push-pull amplifier, which has many more components and more complicated wiring. The main advantage of the latter is of course in the battery current economy. However, this is more of a consideration when used in a radio set, which might be on for long periods, in our case, the instrument would normally be used for shorter periods, and it is up to the player to make a habit of switching off at every opportunity after and between the intervals of playing. There is no warming up period to wait for when switching on again. The consumption is 40mA, and a 4½ volt flat torch battery will give good long service with care.

In the rather unusual output stage, the bias for the AD140 is derived from the driver emitter direct connection. The driver being a p-n-p transistor ensures correct polarity. Negative feedback is taken via R19 to the base of Tr5. This simple amplifier gives good quality musical output.

The contact plate board is made from a piece of exterior quality hardboard, which is oil hardened during
manufacture and much harder than ordinary hardboard, but very little dearer. A suitable off-cut may be obtained from a shopfitter or builder. The size is \(18 \times 5\text{in.}\) and is fitted with metal plates which form the “keys”. At the rear of the board is a \(\frac{3}{8}\text{in.}\) wide strip of the same hardboard, divided into 36 equal spaces. Each one, after treatment, will provide a variable resistance to tune each note, the soldering tags on the resistance strip are connected and wired through a small hole in the hardboard to the tag fixed by a screw to its respective plate. On the extreme right is a simple made up on/off switch, the arm of which, when moved to the left, makes contact with the countersunk head of a screw connected underneath with the top C screw. In the on position, top C will sound continuously, while the preset tuning control is adjusted into tune with a tuning fork or other reference.

**Panel Wiring**

Knowledgeable constructors will have their own ideas about wiring, but the method used by the author has proved straightforward, alterations are easily made, and components can be salvaged with useful lengths of lead-out wires intact. Assemble all the components and straighten out the wires, which are then cleaned bright. With a small tapering pair of pliers, place against the body of the component, so that a \(\frac{1}{8}\text{in.}\) of wire is in the grip of the pliers, now with the component values shown uppermost, the wires are bent down at right angles. Cut a piece of cardboard same size as the panel and mark position of tags. With a pair of dividers measure off the distance apart of the right angle bends, and using the lay-out drawing as a guide, impress on the cardboard where the component will be fixed. When finished the cardboard can be laid upon the panel and the impressions marked through with a sharp awl, these holes are then drilled with a \(\frac{1}{4}\text{in.}\) drill.

After this, the wires are pushed through the holes and bent over towards each other, with the component held tightly on the panel. Wires are snipped off leaving a \(\frac{1}{8}\text{in.}\) stub, under which connecting wire is placed, and stub pressed down hard to grip ready for soldering. In some cases leads will be long enough to orientate and place under the wire of the component to which it is to be connected. Soldering should be used as necessary, and transistors wired in last with their full length of lead-out wires. A \(\frac{1}{4}\text{-in.}\) length of tight fitting sleeving should be put on transistor base leads and pushed up as far as possible. This will assist in identification and prevent possible shorting of leads. The tip of each transistor wire is cleaned and held while being held in a pair of pliers.

The AD140 transistor is bolted down flat on to the panel, after making holes to take the stout base and emitter pins. The metal body is the collector, and when wiring up, terminate the lead to the collector with a soldering tag to fit on the bolt and tighten up with a nut. Observe the usual precautions when soldering transistor leads, and those of small electrolytic capacitors. Preparatory cleaning and tinning is a great help to good soldering. To assist in the external wiring to panels, it is recommended that they be marked with a sharp-pointed awl the legends as marked on Figs. 3 and 4. Correct battery markings are important.

---

**Components list**

<table>
<thead>
<tr>
<th>Resistors:</th>
<th>Capacitors:</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1 6.8kΩ</td>
<td>C1 1µF electrolytic</td>
</tr>
<tr>
<td>R2 6.8kΩ</td>
<td>C2 1µF electrolytic</td>
</tr>
<tr>
<td>R3 6.8kΩ</td>
<td>C3 1µF electrolytic</td>
</tr>
<tr>
<td>R4 470kΩ</td>
<td>C4 1µF electrolytic</td>
</tr>
<tr>
<td>R5 3.9kΩ</td>
<td>C5 0.1µF paper</td>
</tr>
<tr>
<td>R6 2.2kΩ</td>
<td>C6 25µF electrolytic</td>
</tr>
<tr>
<td>R7 27kΩ</td>
<td>C7 0.05µF paper</td>
</tr>
<tr>
<td>R8 2.2kΩ</td>
<td>C8 0.01µF paper</td>
</tr>
<tr>
<td>VR1 5kΩ</td>
<td>C9 0.01µF paper</td>
</tr>
<tr>
<td>VR2 1kΩ</td>
<td>C10 0.25µF paper</td>
</tr>
<tr>
<td>VR3 5kΩ</td>
<td>C11 10µF electrolytic</td>
</tr>
<tr>
<td>VR4 5kΩ</td>
<td>C12 50µF electrolytic</td>
</tr>
<tr>
<td>VR5 25Ω</td>
<td>C13 50µF electrolytic</td>
</tr>
<tr>
<td>VR6 4.7kΩ</td>
<td>C14 0.1µF paper</td>
</tr>
<tr>
<td>VR7 100µF electrolytic</td>
<td>C15 100µF electrolytic</td>
</tr>
</tbody>
</table>

Electrolytics all 15 or 25V wkg.

<table>
<thead>
<tr>
<th>Transistors:</th>
<th>Miscellaneous:</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 OC72</td>
<td>One double pole on/off switch; two toggle on/off switches; four 4¾ Volt flat flash lamp batteries; hardboard (interior) 1ft. 6in. (\times) 6in.; phosphor bronze draught excluder strip; 6ft. length stainless steel (\frac{3}{8}\text{in.}) wide (polished on one side); thirty-seven double ended tags; forty single ended tags; six (\frac{3}{8}\text{in.}) wood screws for top fixing; forty (\frac{3}{4}\text{in.}) 6BA round head bolts and nuts; thirty-seven (\frac{3}{8}\text{in.}) 6BA cheese head bolts and nuts; (\frac{3}{8}\text{in.}) and 1in. panel pins; Bostic No. 1 adhesive; L.S. covering material; carrying handle; plastic off-cut 1ft. 6in. (\times) 3in.; 6ft. 6in. (\times) 3in. square (ramin wood); 5ft. of (\frac{3}{8}\text{in.}) square (ramin wood); 4ft. of 3in. (\times) (\frac{3}{8}\text{in.}) wood; paxolin (\frac{3}{8}\text{in.}) thick for panels; sheet aluminium; 6in. of thin leather strap; thick felt 6in. (\times) (\frac{1}{2}\text{in.}); thin coloured felt 1ft. 6in. (\times) 6in.; solder; connecting wire.</td>
</tr>
<tr>
<td>T2 OC45</td>
<td>At this stage it may be as well to explain the type of soldering tags used by the author. Phosphor bronze draught excluder strip (Woolworths) is cut off into 6in. lengths—old scissors will do for this—then cut into strips (\frac{3}{4}\text{in.}) wide. Try out with a scrap piece of paxolin. Drill a (\frac{3}{4}\text{in.}) hole and thread one of the strips through until it jams tight. Bend each end down flat outwards. Place a small straight edge on</td>
</tr>
</tbody>
</table>
the strip over the hole 3⁄4in. from the bend, and with a sharp penknife score across the metal, still holding the straight edge firmly down, bend the strip up and down a few times until the metal breaks, leaving a 1⁄32in. tag. The same is done at the back of the panel. Tags will be mostly used on the edges of panels, in this case drill the hole so that there is a space 3⁄4in. left between the hole and the edge, bend outwards as before, this time using the panel as a straight edge, score and bend until the metal breaks clean in line with the panel edge. Deal with the other side as before. To use up strips which are slightly narrow, drill with a size smaller drill. With wider strip these are helped through the hole by using a wire file removed from its frame, broken pieces are ideal for this. File slightly each side where the strip will be inserted. These tags take solder delightfully easy, and with practice can be fixed quicker than ordinary tags. If desired the constructor can use the latter where indicated.

The contact plates are 3⁄4 × 1 1⁄2in. each and we require 37. First experiments were made with aluminium, but proved too soft. Bright polished copper was an improvement, but stainless steel was finally chosen, because it can be conveniently obtained in 6 foot lengths at the required 3⁄4in. width (cost about 12s.) one length being sufficient. We only need to take care in cutting off 1 1⁄2in. lengths, dead square. With a fine file clean off sawcuts, slightly radius the four corners, and slightly round the edges on the polished side. When finished, stack together and with the edges on the flat surface of a board see that they are reasonably square, none unduly proud. Remember that with 37 saw cuts something like 2 1⁄2in. will be wasted, however there should still be several inches left if needed. Contrary to expectations the metal is not unduly hard to work. With the polished sides down, the plates should be laid down on a flat surface and protected with some newspaper. On the back of each plate mark two pencil lines diagonally from opposite corners, at the intersection, make a punch mark for drilling the centre hole to take the 6BA screws. After drilling, to cleanly finish the holes on the polished side use a countersunk bit or larger

——continued on page 192

Fig. 3: Circuit board layout for the vibrato oscillator and note generator. All components are mounted on the reverse side, to the wiring.

Fig. 4: Circuit board details of the pre-amplifier and output stage.
It seems that each year the Fi goes higher and higher, unfortunately so does the price! A criticism of audio enthusiasts was given by one cynic who defined them as “People who listen to the equipment and not the music”. After a day at the Hotel Russell listening to a great number of both units and music the following items of interest were noted.

TUNERS AND AMPLIFIERS

Richard Allen displayed their Class A Stereophonic Amplifiers. These amplifiers use transistors in Class A and Richard Allen offer some pretty convincing literature that this is the way to real solid state hi-fi. Also on show, the C41 control unit. As shown in the photograph, this is quite a sophisticated unit.

Braun have preserved their see-through covers, their new Audio 250 stereo control unit being no exception. It is equipped with a PS410 turntable, tuner which incorporates a stereo decoder, and an amplifier section. The improved pick-up arm is fitted with a vernier scale for correct stylus pressure adjustment and is equipped with a M75-6 cartridge. The player has a fine speed control and a semi-automatic cueing device. There is also a tuner section for the reception of f.m., f.m. stereo, s.w., m.w., and l.w. broadcasts. Power output is given as 2 × 15 watts continuous rating with a frequency response of 30-30kc/s ± 0.5dB. Distortion below 0.5% at 2 × 12 watts is claimed. If you want one it’ll cost you £284 17s. 4d.

Leak, a big name in hi-fi, showed “big brother” to their Stereo 30. The new Stereo 70 is all solid state and makers give the output as 35 watts per channel (both channels sine wave driven), total harmonic distortion 0.1% for all power levels up to 25 watts r.m.s., response flat ± 1dB 30-20kc/s.

Philips offered an attractive system cost about £67 and consisting of a GA228 record player, a GH925 stereo amplifier providing six watts per channel, plus two GL359 speaker enclosures ideal for shelf mounting as they stand less than a foot high.

Quad too are boasting all transistor circuitry. Their Quad 33 control unit and 303 power amplifier were on show, the latter rated at 45 watts. Also on show, the Quad FM Stereo Tuner covering 87.5-108Mcs.

J. Richardson Electronics Ltd. appeared for the first time at the Fair with their MA133 and MA200 giving 35 watts and 100 watts respectively for 0.25% distortion at 1kc/s in each case. These are valve amplifiers as is the SA170 stereo amplifier which has the same quoted figures per channel as the other two. Frequency response ± 0.5dB 20-20kc/s.

Sansui showed four new units at the Fair. One, their 3000A stereo tuner/amplifier, might accurately be described as the most beautifully styled audio bomb I have ever seen. Don’t be taken in by the total harmonic distortion factor of less than 0.8% nor the ± 1.5dB response from 10-50kc/s. Neither should the 53 transistors and 46 diodes fool you. If you get one you will have a complete hi-fi set-up which will give a total of 130 watts. If this is too much, then try the AU777 giving only 70 watts total with a total harmonic distortion factor of 0.1% and ± 1dB from 20-100kc/s. Prices 167gns. and 105gns. respectively.

TAPE RECORDERS AND DECKS

Last year in our Audio Fair report, we mentioned that possibly the most noticeable trend was towards the use of cassette loading machines. This year however there were not many of these units around and the accent seemed to be on the big, high-quality machines (“high quality” varies from maker to maker quite noticeably this year). It is also interesting to note that the British manufacturers were outnumbered by overseas competitors in the tape recorder market, with Akai, Ampex, Oki, Sennheiser, Tandberg, featuring strongly.

Akai exhibited their four-track stereo tape deck model 3000D which utilises silicon transistor preamps, three head system and grained wood finish. The price is £105 11s. 4d. Also on the stand were tape deck model X-150D—a cross-field stereo silicon transistor preamp type with four-track stereo/mono recording and playback at £130 2s. 4d., and the M9 stereo tape recorder—a replacement for the company’s M8 at the price of £195 3s. 5d.

Model 753 stereo four-track tape deck was shown on the Ampex stand as the firm’s lowest priced recorder at 91gns. and Brenell introduced their Mark 510 series 3 deck accommodating tape reels up to 10jin. diameter. Bosch (Uher) were showing their Royal De-luxe stereo tape recorder with two- and four-track facilities and 2 × 10W power output.

It was pleasant to see that Ferrograph have introduced a completely new generation of tape decks—the Series 7—which, the makers say, is a completely new design and incorporates features that a market survey showed users desired. This new unit is an all-silicon solid state model with field effect transistors used in the input stages. It can be vertically or horizontally mounted (this could be another trend) and unit construction provides for the mounting of three individual units—the amplifier complex, power supply unit and the actual deck itself. These are mounted on a separate frame which is easily removable from the cabinet. Three motors are used—no belt or pulleys to go wrong—there are three tape speeds, variable speed spooling,
THE Clubman

J. THORNTON-LAWRENCE GW3JGA

continued from the June issue

THE Clubman Mk VI is a Car Radio version of the Mk IV, but the a.f. power output stage is housed in a separate small box, which may either be attached to the back of the receiver or mounted separately.

The Clubman Mk VI is connected to its output stage box by a multiway cable. This cable terminates, at the receiver, in a B9A plug which connects with a corresponding B9A valveholder socket (SK1) on the receiver back panel. See Fig. 39. The box may be disconnected at any time by removing the plug. A link plug may then be inserted into the socket to restore the receiver to normal operation from its internal 9 volt battery. The “box” requires a 12 volt d.c. supply from the car battery (which must have positive earth) and provides approximately 2 watts a.f. output to a 3 ohm loudspeaker.

Circuit Description

The circuit diagram is shown in Fig. 38. The 12 volt negative supply enters the box via the fuse, F1, and the terminal block. This supply then passes to the receiver through SK1 pin 2 and then to the on-off switch S1. This slide switch is a double pole type, of which one pole is already being used for the 9 volt internal battery supply. For the sake of clarity, this pole will be referred to as S1a. See Fig. 40. The remaining unused pole S1b is now used for the 12 volt supply, the input being connected from SK1 pin 2 to S1b tag 1. The 12 volt supply is returned to the box from S1b tag 2 to SK1 pin 3. The 12 volt negative supply provides current for the output stage transistors Tr10 and Tr11, and for the receiver.

A 9 volt supply is required for the receiver circuits.
and this is provided by the voltage dropping resistor R32 and the zener diode D4. The zener diode regulates the 9 volt supply so that correct operation of the receiver is achieved over the normal variation of input voltages expected from a car battery system. The regulated 9 volt negative supply is taken to the receiver via SK1 pin 4 to the on-off switch S1a tag 2. The connection from the negative terminal of the 9 volt internal battery is now taken to SK1 pin 5. When the box is disconnected, a link plug, having pins 4 and 5 joined, may be inserted, thus restoring the 9 volt negative supply from the internal battery B1 to the receiver 9 volt negative line.

The output stage in the box consists of transistors Tr10 and Tr11 connected as a Darlington pair and operating in class A. The input to Tr10 is taken from the headphone closed-circuit jack socket J1, via SK1 pin 7. With the headphone jack plug removed a.f. signals from Tr3 collector are passed to Tr10 base via C10. Tr10 operates as an emitter follower, in that amplified a.f current signals are fed directly to Tr11 base. The combined collector currents of Tr10 and Tr11 pass through the output transformer T2. Amplified a.f. signal currents are passed through T2 to the external loudspeaker.

D.C. biasing of the Tr10 and Tr11 is provided by the potential divider R33 and R34, the emitter stabilising resistor, for the pair, is R36. Two forms of negative feedback are incorporated in the output stage to improve the quality of reproduction. Negative series feedback is provided by the voltage divider R74 and R75, the feedback resistor, for the pair, is R76.

Fig. 40 (above left): Rear of front panel, showing connections to S1a, b and J1.

Fig. 39 (below): Rear panel showing position of SK1 and power output stage.

Fig. 41: Metalwork comprising chassis and cover for the power output stage. Material 18 s.w.g. aluminium.
current feedback is provided by omitting the usual by-pass capacitor across R36, in this way the output signal current develops a signal voltage across R36 and this voltage is in phase and in series with the input signal. Negative shunt voltage feedback is provided by connecting R33 to the collectors of Tr10 and Tr11. The a.f. voltage across the primary of T2 produces an a.f. current through R33 and this is out of phase and in shunt with the input signal. If the receiver is disconnected from the box and the link plug inserted, a link from pin 7 to pin 6 reconnects the a.f. signal from J1 to the base of Tr9 and restores the normal operation of the internal loudspeaker output stage. Internal connections to SK1 are shown in Fig. 42.

**Construction**

The complete a.f. power output stage and zener diode regulator are housed in an aluminium box, the construction of this is shown in Fig. 41. The box is made from 18 s.w.g. sheet aluminium. Providing usual care is taken with the bending no difficulties should be encountered. The chassis part of the box should be made first and the cover made afterwards so that a good fit can be obtained. If the chassis is printed ‘in the flat’, before bending, it is recommended that the cover fixing screw holes “d” should be left undrilled. When the complete box is assembled, the actual position of these holes can be marked through the holes in the cover and then drilled. The cover is held on with two 4BA self-threading screws fitted in these holes. The output transistor Tr11 (OC35) is mounted in the position shown using a mica washer and insulated fixing bushes. An excellent illustration of the method of mounting is shown on page 25 of the May 1968 issue of Practical Wireless. Before fixing the transistor great care should be taken to ensure that no swarf or burrs are present on the chassis as this may puncture the mica washer when the whole assembly is tightened up. The driver transistor Tr10 is mounted as shown in Fig. 43. The multiway cable is made up by twisting together the requisite number of different coloured stranded insulated wires. Screening of the cable was not found to be necessary.

**Installation**

The completed box may be mounted on the rear panel of the receiver using two self-threading screws, as shown in Fig. 39. Alternatively the box may be fixed to the car in some more convenient place. The interior of the engine compartment should be avoided because of the possible high temperature. The standard type of car radio aerial will provide reasonable results for general listening. The inner of the coaxial cable should be connected to the aerial terminal and the outer to the earth terminal. For the very best possible performance over a narrow band it is desirable to use a loaded whip aerial resonant at the desired frequency.
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PW.7.
WITH the summer schedules now in the second month of operation and sunspots at their height of the 11-year cycle everyone is happy. In last month's issue I devoted the column to propagation and clearing up transmission queries. This month I will reverse that and only give the propagation predictions in details for N.E. Asia, S.E. Asia, Australia via Asia and S. America North of Amazon, so here we go.

**Africa:** Mornings and afternoons, 25 and 21Mc/s; evenings, 21, 17 and 11Mc/s; night hours, 15, 11, 9, 7 and 6Mc/s.

**N.E. Asia:** 0400-1600, 17 and 15Mc/s; 1600-2200, 17, 15 and 11Mc/s; 2200-2400, 15 and 11Mc/s; 2400-0400, 15Mc/s only.

**S.E. Asia:** 0800-1200, 21 and 17Mc/s; 1200-1400, 21, 17 and 15Mc/s; 1400-1600, 21, 17, 15 and 11Mc/s; 1600-1800, 21, 17, 15, 11 and 9Mc/s; 1800-2000, 21, 17, 15, 11, 9, 7 and 6 Mc/s; 2000-2200, 17, 15, 11 and 9Mc/s; 2200-0200, 17, 15 and 11Mc/s; 0200-0600, 17 and 15Mc/s; 0600-0800, 21 and 17Mc/s.

**Australia via Asia:** 1000-1200, 21Mc/s only; 1200-1300, 17Mc/s only; 1300-1600, 15Mc/s; 1600-1800, 11Mc/s; 1800-2100, 11, 9 and 7Mc/s; 2100-2200, 15, 11 and 9Mc/s; 2200-2400, 17, 15 and 11Mc/s; 2400-0200, 17 and 15 Mc/s; 0200-1000. This circuit is closed for Broadcast Bands.

**S. America (North of Amazon):** 1200-2000, 21Mc/s; 2000-2200, 21, 17 and 15Mc/s; 2200-2400, 21, 17, 15 and 11Mc/s; 2400-0200, 17, 15, 11 and 9 Mc/s; 0200-0400, 17, 15 and 11Mc/s; 0400-1000, 17 and 15Mc/s; 1000-1200, 17Mc/s only.

**EUROPE**

**Holland:** *R. Nederland* will operate the following schedule for its weekday English programmes, 0730-0820 on 11,730, 9,715, 9,525 and 6,020; 0730-0750 on 21,570, 21,480 and 6,020; 0800-0820 on 21,570, 21,480 and 6,020; 0900-1000 on 21,480, 17,810 and 6,020; 1000-1030 on 15,425 and 11,730; 1100-1120 on 21,540 and 11,740; 1130-1200 on 21,410, 21,570 and 6,020; 1200-1300 on 21,480, 17,810 and 6,020; 1300-1400 on 21,480, 17,810 and 6,020; 1400-1500 on 21,570 and 11,730 only; 1500-1600 on 15,425 and 11,730; 1600-1700 on 21,540 and 11,740; 1700-1730 on 21,410, 21,570 and 6,020; 1800-1900 on 21,540, 17,810 and 6,020; 1900-2000 on 21,540, 15,320 and 6,020. Dutch by radio lessons in English on Sundays only 0530-0550 on 11,730, 9,715, 9,525 and 6,020; 0730-0750 on 21,570, 21,480 and 6,020; 0800-0820 on 21,570, 21,480 and 6,020; 0900-1000 on 21,480, 17,810 and 6,020; 1000-1030 on 15,425 and 11,730; 1100-1120 on 21,540 and 11,740; 1130-1200 on 21,410, 21,570 and 6,020; 1200-1300 on 21,480, 17,810 and 6,020; 1300-1400 on 21,480, 17,810 and 6,020; 1400-1500 on 21,570 and 11,730 only; 1500-1600 on 15,425 and 11,730; 1600-1700 on 21,540 and 11,740; 1700-1730 on 21,410, 21,570 and 6,020; 1800-1900 on 21,540, 17,810 and 6,020; 1900-2000 on 21,540, 15,320 and 6,020. Dutch by radio lessons in English on Sundays only 0530-0550 on 11,730, 9,715, 9,525 and 6,020; 0730-0750 on 21,570, 21,480 and 6,020; 0800-0820 on 21,570, 21,480 and 6,020; 0900-1000 on 21,480, 17,810 and 6,020; 1000-1030 on 15,425 and 11,730; 1100-1120 on 21,540 and 11,740; 1130-1200 on 21,410, 21,570 and 6,020; 1200-1300 on 21,480, 17,810 and 6,020; 1300-1400 on 21,480, 17,810 and 6,020; 1400-1500 on 21,570 and 11,730 only; 1500-1600 on 15,425 and 11,730; 1600-1700 on 21,540 and 11,740; 1700-1730 on 21,410, 21,570 and 6,020; 1800-1900 on 21,540, 17,810 and 6,020; 1900-2000 on 21,540, 15,320 and 6,020. Dutch by radio lessons in English on Sundays only 0530-0550 on

**AFRICA**

**Congo Democratic Republic:** *R. Congo, Kinshasa* has been heard by M. Reed in Bournemouth, Hants on 15,245 starting at 2230 until after 0400.

**South Africa:** The All Night International Service of Radio South Africa is now on 3,250 and 2,376.

**ASIA**

**Afghanistan:** *R. Kabul* now transmits from 1730-1830 in German and English on 15,265 and 11,770 to Europe.

**Cambodia:** *R. Phnom Penh* has been heard with European Service on 17,710 from 0530-0800 but with extreme interference from Moscow also operating on 17,710, also beams to Europe from 1730-1800 on 15,255 but this is chopped out by *R. Nigeria*, Lagos, also on 15,255.

**Ceylon:** *R. Ceylon* has a daily overseas transmission to Europe from 0700-0800 on 17,815 in English, it has also been heard irregularly on 21,525.

**India:** All India Radio transmits to the UK and W. Europe from 1745-1945 on 11,620 and 7,215; 1945-2030 on 11,620, 9,912 and 7,215; 2030-2230 on 9,912 and 7,215.

**Indonesia:** *The Voice of Indonesia* has been heard with its programme in English beamed to Europe from 1900-2000 on the new frequency of 15,110.
QUITE a good month on the six amateur bands, but 10 metres has been a little disappointing. One would have thought that openings and propagation would have been more consistent, bearing in mind the help this latter band is (or should) be getting from the sun.

The Pacific and S. America have been in frequent evidence on 20 metres and Oceana has featured prominently on 40 metres at times. The £f segments (160/80/40) have been rather more noisy than usual, while top band in particular has been an awful din, particularly after dark.

S. Herod reckons "peak" DX times are early mornings (0700-0830) and late night (2000-2400). Two reliable scribes query 4K2A—sounds like a new prefix for Dogger Bank! R. King relates that 5LZ was used by Liberian stations for two days, and Sweden is now issuing SK call signs. P. Johnson queries JX1RL and so do I. He says 7P8 is Lesotho and that Mexico (XE) is now 4A. I'm sure some countries' prefixes are taken from disused bus number plates.

160/80/40

J. Edwards (London, S.E.20), SX24, 137ft. end fed, discovered the following happily "at it" on 160—G3SVK/P, G1SDX, GM3OUU, GM3OXQ, GM3TLS/P, GW3TSH, OK1AJU, OL1AAM, OL6A1U OL7AB, PAOHAO. On 80 metres—ET3USA VE1EIE, W1FJ2/P/KP4, W2PUB, ZC4MO, 3A2MJ, 4UI1TU. Forty metres—CM2DC, CN8CS, EA4JW, K3JH, PY2EGA, UA6KOE, VO1AK, WA1HJW, W2JA, 4X4QX.

J. East (Worcester), RI475 (I remember dropping one of those on my foot!), 67ft. end fed, snaffles on forty armed only with his trusty b.f.o. Captures included—K3YJW, K3ZNV, K4RSH/MM, K5YSO, PJ5SM, PY7AUT, UA5KD, W4KET, W8KMQ, WA6POD, YN2JF, YV1BI, ZP3AB, 4AICCG, 4UI1TU.

S. Herod (Suffolk), RI09A, 40ft. end fed, also braved 40 metres and hooked—CN8AW, CN8CS, EA8BQ, EA8EX, FP8CY, PY7ARP, UA9KDL, UV9CQ, VK3ZL, ZC4RB, ZP3AB. All these on s.s.b.

P. Hampton (Worcester) says he's heard G3A00 in QSO with VK's most mornings at 0700. His log for 7Mc/s fair sends a tingle up—CN8AW, K3ZNV, PZ1CF, VK2DO, VK2AHz, VK3BM, VK3PB/M, VK3XM, VK7SM, YN2JF, ZL4BO, ZS1JA. I'll have to oil the alarm clock.

20/15

D. Henbry (Sussex), HA500, 7ft. vertical rod at 30ft. confesses to building the "Clubman" MkII. Also contained in his statement was a 14Mc/s s.s.b. log from which the following are offered in evidence—F9G7T/FS7, FY7YL, FO8BV, HC2RZ, HK0BKW, H53DR, JW7YF, KH6EY, KS6CL, KW6EJ, TA2BK, UA0NL, U18LC, VO9JW, VO9V, VS9MB, XE1OE, XP1AA, YAI1YDAN, YNJ1LF, ZD3D, 4A1WS, 5U7AN, 5W1AR, 7Z3AB, 9K2BV, 9L2SL.

H. Dearing (Goffs Oak), Super-Pro, 140ft. end fed, is s.s. s.s.b. (staunchly supporting single sideband) as the following log for 20 s.s.b. proves—CN8AW, CR6IS, ET3USA, H13EJ, HK5YS, JA6AUS, KH0B2M, KJ6BZ, KL7EBK, OD5BV, PY1MK, PR41PN, TG8IA, TQ9EP, TF2WKP, VK1CN, VK2ON, VK3WW, VK3A0N, VK4DO, VK5WD, VK6FB, VK7ED, VK7RX, VK9GN, VP1BT, VP2GQB, VR6TC, WX8AX, YV5AG, ZL4BX, ZL41G, 4AI1AE, 4AILL, 4X4FQ, 4Z7HF, 5H3JJ, 7X0AHH, and the best DX this month—G3JDG/M. (Aw shucks!)

R. Spencer (Scarborough), SX111, PR30X, 20 metre dipole, shuffled the 20 metre pack and dealt himself the following—AP2AD, CE0AE, DU1FH, FO8BS, FR7Zg (Reunion Is.), HS1AF, JA3KHV, JW2BH (Bear Is.), JX6AL, K8NHWP/XV5, KG6AAY, KH6IJJ, KL7MF, KR6KG, KR6MH, MP4BEU, TA2BK, VK3BM, VR6IF, VU2CT, W32O, XE2CO, WX6BQ, YA5RG, YV4UA, ZL4BX, ZA2CP, 457PB, 7Z3AB, 9O5QD, 9M2NK, 9N1MM—full house Sir!

P. Batt (Lancs.), PCR3, 65ft. end fed only 6ft. high, heard these on 15 metres CT1AC, CT1ID, CX2CS CX4A, CX6BA, CX6EA, EA7MH, PJ3OH, PY2CDY, WA4PBY, WA8GBE, W5KC, all on a.m. too.

D. M. Clark (Bucks.), P.W. Progressive s.s.b. heterodyne, penned these on 15 metres s.s.b.—DU1IK, EA8EX, EA9AQ, H1KED, H53DR, KG6EF, KH6BB, KX6FB, JA1AE, JA2HTV, JA3KBP, JA6DHE, JA7UJ, JA8DSC, VK2FA, VK4TY, VK5GM, VK7GK, VK9LR, VS9MB, WX8BX, ZL1TU, ZL2H, ZL3IO, 4A1CB, 4S7PB, 5W1AS, 9M2PO, 9U5SK, 9X5MH.

10

Quite a bit of r.f. about in spite of the sun not being quite as spotty as it should.

P. Starling (Essex), HR05T, 40ft. end fed, bagged these on 28Mc/s between 1400 and 1800—EL2X, ET3FMA, HK4AET, LU9DTA, OD5BA, PY1BLZ, PY6PF, PY7VNY, SV0WL, UA6JWN, W4QJW, W9EXE, ZC4MO, ZC4RB, ZE1BP, ZE6BTN, 5N2ABG, 5Z4BS, 9J2DT.

P. Johnson (Northampton), RX60, 100ft. end fed, also went QRX on 28 for—CN8MI, CP3RCS, CR4BL, CR6CS, CR6KV, CV7CZ, CT2AA, CT3AS, EA8CVP, ET3REL, HK4AB, HP9AAH, LUS5DNT, PJ2CQ, PY2BG, SV1AE, UA9BFK, U18DFP, W6UFG, W7WLL, W91O/V, XE1CY, YV3NS, YV5ANE, ZS1BE, ZS2FA, ZS4CJ, ZS6DT, 4X4JH, 5Z4BS, 9H1AV, 9J2AB.

R. Dinning (Ayrshire), HA350 plus PR30X, 252ft. end fed, queries L0AR1 (no, it's not the Isle of Wight). He also heard—CR6KI, KG4CRC, LU1DAB, PZ1BF, UF6CR, VQ9JW, SV1AN, SV0WM, ZC4AK, ZD7KH, ZS5RS, 5Z4KT, 9JJ2DT, 9K2BV, 9L2SL, 9X5AA and W1-0.

CONTESTS

Eyes down for a full house—8th-9th June, UBA c.w. contest (80-10 metres); 8th-9th, National Field Day; 23rd, 70 c.m. contest (portables); 24th, 2 metre s.s.b. contest; 6th-7th July, 160 metre contest.
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TWO TRANSISTOR

NUMBER TWO . . . in our beginner’s series gives details for building a dual function two transistor receiver. It uses the minimum number of components—note that there are no resistors or coupling capacitors.

LAST month, in part one of this short series, a receiver was described which used only one transistor plus two diodes in a reflex circuit. The second receiver, shown here, uses two transistors in a complimentary direct-coupled circuit. Although this sounds rather a mouthful it boils down to super-simple circuitry and practically no components. There are no resistors and no fixed capacitors and, unlike last month’s circuit, no separate diodes for detection either.

Dual-function

One great advantage of this little receiver is that when the battery switch is off, the receiver will function as a crystal set. In areas of good signal strength, say for a local station, the switch can be left in the off position thus saving the battery.

Switching the battery into circuit boosts the signal very considerably. At the writer’s home, a small transistor output transformer, connected in place of the headphones, allowed a small speaker to give very good results from the local station at Brookmans Park on medium waves.

Selectivity

Although the set has only one tuned circuit, separation of stations was easily possible and no overlap was detected. This is probably due to the very high “Q” of the coil which aids the selectivity of the receiver. Normally, with 150ft. of wire for an aerial, both BBC1 and BBC4 tend to tune in together on a crystal receiver with a home wound coil. This is at the writer’s home in St. Albans. In other locations things might be better or worse, however, with such a large aerial, it speaks well for the selectivity.
of the receiver at being able to separate the stations so easily and successfully.

Referring to the circuit shown in Fig. 1. The aerial is connected to the coupling winding on the coil L1. The signal is thus inductively coupled to the main tuned winding, and from here is fed to the base of the first transistor Tr1 via a low impedance tap on the coil. Transistor Tr1 is directly coupled to the second transistor, Tr2, in whose collector lead the headphones are connected. With the battery switched off, Tr1 functions as a diode feeding the signal to the base of Tr2. This second transistor might be considered as acting as a collector load for Tr1.

Polarity

Note that Tr1 is a p-n-p type whereas Tr2 is an n-p-n type. This is important for the circuit to function. The battery is connected in such a way as to supply power in the correct polarity to both transistors. The emitter of Tr2 goes to the positive side of the battery which is normal for a p-n-p transistor. While the emitter of Tr1 connects, via the on/off switch, to the negative terminal of the battery. With the battery switched off, the diode action of the junctions of the transistors allows the circuit to function as a simple crystal receiver. With the battery switched on, the circuit will amplify the signal quite considerably. In this respect it is possible that too much amplification will be present for the strength of signal entering the set. This will be characterised by distortion due to clipping of the signal waveform. The solution is to use a smaller and/or perhaps a less efficient aerial. Or, if one signal is very loud while a more distant one much lower in strength, then the receiver could be used as a crystal set for the very strong signal, thus conserving the battery and avoiding the clipping referred to.

Results with the prototype were excellent using a pair of high resistance headphones (2000Ω), a good earth, and 150ft. of aerial wire. Very good results were also obtained from 40ft. of aerial wire with the same earth.

Construction

Construction is very simple but it is important to make sure of the connections to the transistors bearing in mind that one is p-n-p and the other n-p-n. The transistor used for Tr1 might be considered a strange choice since these are usually thought of as useful for audio applications and not r.f. However, the maker's specifications give the F of the BC108 as 150 Mc/s typical, and thus it would appear well suited to medium wave circuitry.

For those who would like to experiment, it is possible to turn the circuit round and use the OC171 in the Tr1 position, and the BC108 in the audio stage. This circuity is shown in Fig. 2, again the only points to note are the correct connection of the transistors with regard to polarity.

Chassis

The chassis is bent from a small scrap of aluminium and drilled as shown in Fig. 4. The front panel was made from a piece of thin Perspex which was to hand. Cut and drill as shown in Fig. 4. Note: Perspex cracks very easily so be very careful when drilling and filing.

The piece of Veroboard is used mainly as something to solder to. It is held to the chassis by the various bolts and also the coil. The tuning capacitor was glued to the Veroboard with Evostick applied along its bottom edge only. The coil mounts in the hole drilled and is held in position by its own threaded plastic nut supplied. The on/off switch needs two 8BA nuts and bolts which may be purchased from most good ironmongers in a small plastic pack containing half a dozen. These bolts may need to be cut down if they are too long.

The battery is a special Mallory type which is rated at ±6 volts. It is clipped into position with a
small piece of springy brass, perhaps taken from an old cycle lamp battery? This is bent to shape and bolted to the chassis. Note that there is a hole cut out in the chassis so that this bolt does not short the battery to the aluminium.

**Wiring**

When all components are mounted wiring up can commence, but do not bolt the front panel on yet. It is all too easy to touch it with a hot soldering iron with gruesome results. Wiring should be carried out to conform with Fig. 1 and Fig. 3. Use a pair of pliers as a heat shunt when soldering in the transistors. Leave clipping in the battery until the very last. Immediately prior to this, check again the connections to the transistors, remember that connecting the battery in the wrong way will almost certainly destroy these devices. Check if you have used the alternative circuit shown in Fig. 2, if so have you orientated the battery correctly?

**Testing**

Connect the headphones to the collector of Tr2 and earth, clip on aerial and earth leads but do not switch on the battery. Tune VC1 from max to min and see if you can hear any stations. If you have ever built a crystal set and got it working in your area, then it is almost certain that this receiver will pick up the station(s). If you can receive more than one station, tune in to the weakest one and switch in the battery. The signal should be boosted quite appreciably. Having got the receiver working satisfactorily, you might like to try experimenting with the aerial. Try the bedsprings—mine work quite well with the battery switched in and no earth at all!

There is no point in increasing the battery voltage since this will not increase the signal level to any significant degree. You might consider building a small case for the receiver for which almost any material would be suitable—plastic, wood etc.

The coil shown in the photographs has its own "built-in" trimmer. This is not really required in this circuit and thus it should be ignored. It does not require any adjustment at all.

**NUMBER THREE… next month—a simple three transistor superhet receiver with a reflexed i.f. stage, and its own miniature 1.in. speaker.**
THE majority of purely "electronic" timers are dependent for their operation upon the length of time it takes a capacitor to charge up to, or discharge from, a given voltage. The charging and discharging processes are usually accomplished by means of a resistor, though a thermionic diode or valve is sometimes used. In the charging process, the valve or resistor is in series with the capacitor; in the discharging process, in parallel.

Variation of the timing period is achieved by varying either R or C, sometimes both. Since C is usually one to several thousands of μF, R is usually the variable element. The product of C × R is the time constant, and is in seconds when C=μF and R=MΩ. This time constant can be maintained if either C or R is altered, by altering the other quantity by the same factor.

In the practical circuit of Fig. 1, C and R are represented by C1, and R1 to R12. The timing period is therefore variable in 12 steps, the shorter times being associated with the lower value resistors. Practical experience dictated the upper and lower limits, as well as the progression, which is roughly logarithmic. In practice, the theoretical time constants are somewhat modified by the characteristics of two of the associated components. These are the timing capacitor itself and the first transistor Tr1.

An ideal capacitor would, when charged up to any given voltage, and in the absence of an external discharging device, hold that charge indefinitely. Very few capacitors do. The reason is due to the inherent leakage resistance within the capacitor itself, which causes it to discharge over a period of time. This leakage resistance, which can be safely disregarded in many applications, can have serious consequences when capacitors are used in timing circuits. Not only does it limit theoretical calculations of time constant, particularly when long periods are involved, but, in my own experience, causes the time constant to change in a random manner when the leakage resistance is of the same order of magnitude as the discharging device's resistance.

The input resistance of a transistor is hfe × R_e where hfe is the gain and R_e the emitter resistor. In parallel with this resistance is the leakage resistance of the diode formed by the transistor's base emitter contact. The former can be increased by increasing R_e, and by using a transistor having a high value of hfe. The latter, by using a silicon transistor which has an inherently lower leakage, between base and emitter, than a germanium transistor. The timing period can also be affected by any variation in the voltage to which the capacitor is charged. Yet further variations can be caused by components altering in value.

Circuitry

In the circuit of Fig. 1, constancy of the timing cycle is secured by using a good quality capacitor for C1 and by choosing the constants so that the leakage resistance is appreciably greater than the discharging resistance; by stabilising the supply which is, of course, the voltage to which C1 is charged; by using only good quality components used well within their ratings.

The operation of the circuit is quite simple. The mains voltage is reduced by T1 to 9-0-9V, is rectified by D3 D4 and smoothed by C2. Stabilisation of the voltage at 9V is effected by D2, a 9-1V ±5% zener diode. R17 drops the surplus voltage, with Tr2 cut off, at the zener's working current load of approximately 20mA. In the prototype a value of 47Ω proved to be just right. As Tr2 draws a current of 16mA when conducting, the line voltage remains virtually unaltered at 9V, the zener and Tr1 accounting for the current difference.

Capacitor C1 is connected to the central or

---

**Fig. 1: Circuitry for the electronic darkroom stopwatch.**
The changeover section of the relay contacts designated \( R_{LA} \).

In the normally off position when Tr2 is non-conducting, this capacitor is connected to the supply line via the anti-surge resistor R13, and when the supply is on, it is charged up to the supply voltage.

When the relay is conducting, the changeover contact moves and connects C1 to the base of Tr1 via R14, and via S1 to one of the discharging resistors R1 to R12. Since Tr1 is an emitter follower, a proportion of the voltage to which CI has been charged, typically 95%, appears across VR1. A further proportion of this voltage, depending on the setting of VR1, is therefore passed on to the base of Tr2 via R16, and causes it to conduct, pulling the relay on. The result is that C1 is held connected to the base of Tr1 until it is virtually discharged. When this happens, the voltage across VR1, and hence the base of Tr2, is too low to cause it to pass sufficient current to hold the relay on. As soon as the relay drops out, C1 is reconnected to the supply line, is recharged, and is ready for the next duty cycle. There is no delay and the next cycle can be initiated as soon as the user wishes.

Initiation of the timing period is effected by S1. This is a miniature spring loaded “press to make” switch, in series with \( R_{LA} \) contacts and R15. This causes the base voltage of Tr2 to rise, so causing an increase in collector current and the pulling in of the relay. Immediately this happens, CI is brought into circuit by \( R_{LA} \) and the timing period begins.

So much is obvious. Less obvious is the need for the \( R_{LA} \) contacts. Different ways of initiating the timing period were tried and the method finally used was found to be the most reliable provided \( R_{LA} \) contacts were included. Omitting these contacts led to some variation in the timing period, depending on the length of time S1 was held down. By including \( R_{LA} \) contacts, yet another source of possible inaccuracy was removed, because as soon as the relay closes, \( R_{LA} \) contacts open, and continuing pressure on S1 cannot affect the timing period.

### Capacitors

- **C1**: 2500\( \mu \)F 30V
- **C2**: 250\( \mu \)F 15V

### Resistors

- R1: 1k\( \Omega \) 5%
- R2: 1.5k\( \Omega \) 5%
- R3: 2k\( \Omega \) 5%
- R4: 3k\( \Omega \) 5%
- R5: 5k\( \Omega \) 5%
- R6: 7.5k\( \Omega \) 5%
- R7: 10k\( \Omega \) 1% (see text)
- R8: 15k\( \Omega \) 5%
- R9: 20k\( \Omega \) 5%

### Semiconductors

- Tr1: 2N2926 green spot
- Tr2: ASY28
- D1: OA10

### Switches

- S1: 1 pole 12 way
- S2: press to make
- S3: single pole on/off
- S4: single pole two way
- S5: single pole two way
- S6: double pole on/off

### Transformers

- 9–0–9V 80mA Osmor

### Relay

- 500\( \Omega \) coil

- \( R_{LA} 1 \) light duty changeover
- \( R_{LA} 2 \) light duty normally closed
- \( R_{LA} 3 \) heavy duty normally open

### Plugs and sockets

- 3 pin, Bulgin, miniature
The transistors chosen have excellent characteristics as well as being expensive. Tr2 could be replaced by an n-p-n germanium transistor of adequate rating. It is, however, advisable to retain Tr1 as specified, which is a green spot 2N2926 having a hfe of 470.

The relay could possibly prove difficult to obtain locally in some areas, though it should be obtainable from nationally advertised sources. Provided the requisite contacts are there, coil resistances between 500 and 1,000Ω should prove adequate. By adjusting R17 or even disposing of it altogether, and by changing D2 for a higher rated component, lower coil resistances could be used, without exceeding the maximum wattage rating of Tr2. This is because when Tr2 is non-conducting its collector is at supply potential. The products of Ic × Vs, where Ic is collector current and Vs supply voltage, is well below the maximum permitted dissipation. Similarly, when Tr2 is conducting, it is virtually bottomed, and again Ic × Vc or collector to emitter voltage, is well within the maximum permitted dissipation. There is therefore room for experiment with varying coil resistances, provided Ic is always monitored and the maximum ratings are not exceeded.

Some saving in expense can be effected by omitting the zener diode. In an area of stable mains voltages, the effect upon timing periods will be minimal. Varying mains voltages, as in my own area, could cause some variation in the timing periods. Although these variations can be masked by the tolerance of the printing papers, experienced “enlargers!” (or perhaps more correctly, enlarging operators) will know that optimum print quality can only be obtained when all variables are reduced to their precise, correct, proportions. Thus the slight additional expense of the zener diode is considered justified.

**Resistors**

Resistor R17 should be chosen, assuming the recommended relay is used, to allow approximately 20mA to flow through the zener with Tr2 non-conducting. This is sufficient to adequately stabilise the line voltage with Tr2 passing some 16mA when “on”, whilst allowing a few mA spare in case the mains voltage should rise. The timing resistors must be hi-stabs of 5% or better accuracy. The progression chosen is logarithmic with alternative times being halved or doubled. If the enlarging lens has the more modern click stops where the light output is exactly 1, 1, 1, etc., of wide open, these
times will prove most useful. Initial exposure, whether by meter or test strips, can be determined with the lens wide open. The lens is stopped down as required and the timer adjusted to suit.

Diode D1 across the relay must not be omitted. When the transistor "switches off", very high induced back e.m.f. voltages are present across the relay coil and transistor. This back e.m.f. is in the form of a pulse of opposite polarity to the supply voltage and could damage the transistor. The diode across the coil short-circuits this pulse and therefore protects the transistor.

The timing circuit, with the exception of the relay and ancillary switches, is built on a piece of p.c. board measuring $5 \times 4 \frac{1}{2} \times \frac{1}{2}$ in. The layout is shown in Figs. 2 and 3. The use of heat shunts for soldering the semiconductors and range resistors is recommended.

### Calibration

For ease of testing and calibration, the timer should be assembled out of its case, coupled to the relay and S2 by means of flexible leads. After switching on the mains, the voltages should be checked, and should agree with those given. The zener diode and Tr2 emitter currents can be checked, bearing in mind that as one increases, the other decreases, and vice versa. The currents given are min. and max. The values allotted the timing resistors include one or two values that may prove hard to obtain in some areas. In this case, they may be made up of a series/parallel combination. The $5k\Omega$ resistor could thus be obtained from two $10k\Omega$'s in parallel, and so on.

The use of a stop watch is of the greatest assistance during calibration. Failing this, the seconds hand of a clock or wrist watch may be used. The procedure is quite simple. A suitable time, for example the ten second position of S1, is selected with the wiper of VR1 at the Tr1 emitter and of its travel. S2 is depressed, whereupon the relay should pull in smartly. If it does not, but its armature is seen to move, R15 can be reduced in value until it does pull in smartly. If it does not move, connect a voltmeter (0–10V) across VR1 and close the armature by hand. As soon as C1 is brought into circuit, approx. 8.5V should appear across VR1, and via R16 to the base of Tr2. The voltage across VR1 will begin to fall, and it may be necessary to release the relay and depress it again. The collector voltage of Tr2, whilst Tr2 is cut off, will be virtually supply voltage. As soon as C1 is brought into circuit, and assuming the earlier stages check out satisfactorily, the collector voltage should fall to about 1V above earth potential. If the relay does not now move, the fault is almost certainly mechanical, or, perhaps, the coil resistance is incorrect.

If the $\frac{RLA}{2}$ contacts are present in the relay actually used, R15 can be reduced drastically or even dispensed with. If the $\frac{RLA}{2}$ contacts are absent, R15 must be kept as high in value as practicable with reliable operation. It must not be removed from circuit under these circumstances as it is quite possible to burn out Tr2 by holding S2 closed for an excessively long time. A "vacuum state" analog; connecting the grid of a value to h.t.!

Assuming all is well, the time obtained in the ten second position should be noted. It will almost certainly be in excess of ten seconds, in which case VR1 is reduced and another check is made. After several attempts it should be possible to obtain a time of ten seconds precisely. As this is the "calibrating" range, and as $10k\Omega$
is a preferred value anyway, a 1% resistor is recommended for this position. This is to ensure that the other ranges have a "standard time" to be checked against.

The other ranges are similarly checked, except that VR1 is not touched. Assuming a good capacitor for C1, and accurate range resistors, the times obtained should be in substantial agreement with the nominal times marked on the dial. Times shorter than those marked on the dial will require additional series resistors; longer times, additional parallel resistors.

Constructors who feel that fixed, stepped times are unsuitable for their particular use, could replace S1, R1–R12 with a variable resistor having a value commensurate with the longest time required. The disadvantage of a continuously variable timer is in accurately calibrating very short times, plus the difficulty of reproducing these short times accurately once changed to a longer time.

The disadvantage of a fixed, stepped timer, is the time required to accurately select the timing resistors. The long and short term accuracies can be very high, whilst there is no resetting error.

Oscilloscopes working satisfactorily, the timer can be mounted in the cabinet. The p.c. board in the prototype was mounted at three points; by means of 6BA bolts having 3in. spacers between the p.c. board and the panel, the bolts also serving to hold the Perspex facing the panel. The legends are drawn with Indian ink upon thin white card which is clamped between the Perspex and the front panel.

The ancillary switching is shown in Fig. 4. The contacts control the current flow to the enlarger lamp, and are normally open. The focus switch S5 performs two functions. In position 2 it is in parallel with contacts and allows the enlarger to be focused, or to be used for timing periods longer than that allowed by S1/R12. In this position it switches off the safelight which is normally not required during focusing, particularly when large enlargements are being made, or when the negative used is very dense. If required, however, the safelight can be switched on by S3.

In position 1, S5 brings one of two safelights used, one for reflected, one for direct lighting, into operation, the safelight used being selected by S4. S6 switches the mains supply to the timer and is the mains switch. The ancillary switching adds greatly to the flexibility of the timer which has proved, over a period of time, to be consistently reliable.

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KEYLESS ORGAN

—continued from page 173

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PRACTICAL TELEVISION

PULSE AND PATTERN GENERATOR

A semiconductor 625-line pulse and video pattern generator built on perforated board and giving in addition to mains-locked sync pulses horizontal and vertical bar and checker-board patterns.

COLOUR RECEIVER A.G.C.

Current colour receivers all use the sync tip system, described in this article, in which the sync tips are the reference level for a.g.c. action. In addition on 405 lines many receivers use a ringing circuit, also described, to give gated a.g.c. action.

X-RAY RADIATION

The first part of a short series on electromagnetic radiation with special reference to television problems.

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July issue on sale June 14

★ DRILL SPEED CONTROLLER
★ MULTI-CHANNEL RADIO-CONTROLLED BOAT
★ WAA-WAA: EFFECTS UNIT FOR ELECTRONIC GUITARS

PRACTICAL ELECTRONICS
BANNING the critics from the première of his epic, The Charge of the Light Brigade, film director Tony Richardson called them '... a group of acidulated intellectual eunuchs, hugging their prejudices like feather boas.' He commented that one of the many indulgences the critics permitted themselves was to talk "honestly" about their own prejudices, imagining that this would make them even more lovable.

Well now, this critic makes no claim to cuddly lovability, and would probably look even less prepossessing in a feather boa, but he must admit to a few prejudices.

So he must join with the Editor in deprecating the unsatisfactory episode of Ted Short’s throw away line in the Commons about the Beginners’ Licence.

Henry has no particular claim to a vested interest in B licences or any form of radionic L-plate.

Nevertheless, this matter is important to anyone who dabbles in wireless, whether or not he has ever bashed a key in anger.

Should we throw open the airways to all, or restrict the bands to those with sufficient sense of responsibility to take what is, after all, quite a simple test? That seems to be the crux of the argument.

This projected Beginners’ Licence could be like the American “Novice Licence”.

We shudder to think what that could mean. As recently as April 1st, we saw the ban on sales of imported Citizen’s Band Equipment come into force. This 27Mc/s stuff is still widely advertised, and, we suspect, available under the counter. All manner of unlikely applicants will now be lined up to chip loopholes in any fence the PMG may choose to erect to safeguard the Beginners’ Licence. But as to what our loyal band of hams will say to a possible restriction of their air-space—that would hardly be covered by the Q-code.

There are plenty of existing restrictions. The A licence permits telegraphy and telephony on all h.f., v.h.f. and microwave bands. The City and Guilds of London Institute set a Radio Amateurs’ Exam, that should not daunt the determined. And surely, 12 words a minute with the morse key is not asking too much, even of an under-fourteen contender. Which, I understand, the new licence may admit?

We must wait and see whether the proposed Beginners’ Licence will be used as an incentive to those wishing to progress toward a full ticket—or some bending of the rules to placate a vested interest.

One of my short-wave enthusiastic colleagues grunted: “For Licence read License.” And if we extend our vision a bit he is not far wrong. Think of the overcrowded m.f. and l.f. bands which makes all but the most local of programmes an aural obstacle course.

The Copenhagen Plan authorised 600 stations on Medium and 18 stations on Low Frequen-

cies. But not all countries were parties to the Plan, and there is no international air-space police force. The price of freedom has been a 226 per cent increase of m.f. stations (power going up 230 per cent), 1360 stations on m.f. against the original 600 and 28 on l.f. against the original 18—that’s a heck of an argument against overcrowding. No wonder the pirates were banned. Pity those eight blighters that do nothing but jam could not be boarded also!

What is the answer? Despite the BBC’s plugging of v.h.f., there is a real need for both m.f. and l.f. communications. The partial solution of day and night band-sharing that the USA has toyed with does not go far enough. S.S.B. seems to be the best solution—but that has its snags.

Recently, Georges Hansen, technical director of the EBU and H. Eden of the Institut fuer Rundfunktechnik, have suggested non-compatible single sideband transmissions as being the only way of sharing the bands without adjacent channel interference. The implications, much as we heard ad nauseam when the colour TV controversy was raging are that we should need new sets, and because of the need for synchronous detection, the cost of these would be higher.
YOU may perform miracles of electronic diagnosis; you may dig out of the spares box all the transistors and components you need; you may wield your soldering iron with consummate skill...but just wait until you hand the repaired receiver back to the lady of the house. If it has a tatty cabinet, all your good work was in vain.

Appearance matters. Repairs often entail small rejuvenating touches to woodwork and plastic, and unless you know what you are doing, the end result can be disaster.

Woodwork—even for transistor radios, for the modern trend to wood finishes, even if it fades out temporarily, is sure to come around again when our designers feel the seven-year itch. Different woods need different treatment. Veneers require great care, and some of the artificial wood laminates present yet more problems of their own.

Very often a damaged cabinet will not respond to any patching or camouflaging; it may be necessary to re-colour or re-cover it. The success of a recent gay-colour range of television receivers prompts one to suggest that this sort of treatment may occasionally be a good thing. First requirement is to remove all the appendages, knobs, escutcheons, etc., that can be removed, and carefully mask all those that cannot.

When masking, always use a simple form of tape or paper with an innocuous adhesive. Lettering on panels or glass dials is so easily damaged by being "lifted" when the adhesive surface is stripped—and this point must be considered before you begin. Remember that ordinary adhesive tape of the transparent variety can become very tacky with heat, and will tend to leave an edge mark when removed. Although the material is more expensive, the cellulose tape as supplied to radio dealers by Messrs. Radiospares is very suitable for odd jobs of this nature. It can be stretched slightly, thus giving a more intimate bond, and the adhesive is not destructive to cabinets and laminate finishes. Readers will undoubtedly be able to suggest alternatives.

If masking a straight edge, do not fiddle with the tape to get an accurate line, but overlap slightly, press and smooth the tape, then trim the surplus tape with a razor blade, or some form of patent cutter, angling this inwards so that the cutting motion also tends to take the edge of the tape under the panels, etc., presenting a cellulose surface to the stain or paint rather than the necessarily rougher edge of the tape. A neater completed job will result when the masking is removed.

Covering a curved surface can be rather more tricky. It is best to use a similar approach, i.e., to overlay in a series of straight pieces, then trim as before. A useful dodge when doing small touch-up jobs with cellulose paint or any high-gloss touching-up medium, is to mask by simply painting over the protected surface with grease or even water-colour poster paint. This need only be done at the edge where the two surfaces meet, to prevent the hard gloss paint or stain running beyond its required limit. Then, after the main body of the work has been finished, the grease can be cleaned off with a lint-free rag, or, except in the case of cellulose surfaces, a cloth damped slightly with methylated spirit.

The other problem is lettering. All too often this is stencilled on the main panel, and to colour round it is, except for a master forger, a much too formidable task. Why not consider renewing the legends completely? There are sets of symbols, words, individual letters and signs in a multitude of styles now available. Most of them go on the finished smooth surface as easily as the transfers we got smacked for sticking on our wrists when we were young. Some of those offered as a free gift in a recent issue of this journal can be used to improve upon a manufacturer's design with telling effect. At least, one has an original piece of apparatus to show for one's efforts.

Touching-up may not be good enough for you. Nothing is as good as a completed job in true wood, you may argue. This approach is especially valid when loudspeaker cabinets are being constructed. Timber is still one of our best materials, despite the proliferation of plastic substances. And there is something opulent about the look and feel of true wood surfaces that pleases the constructor. There are one or two points he must remember, however, if he is not an experienced handyman. This article cannot go too deeply into woodworking—even if its author was qualified to deal adequately with the subject!—so do-it-yourselfers, and regular subscribers to Practical Householder must forgive a few relevant points thrown off at random.

Before we attempt to do any colouring at all, there is the very necessary preparation to consider.
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Total building costs: **69/6**

**RADIO EXCHANGE CO.**

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Telephone: Bedford 52367

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This may sometimes seem tedious, but the finished result will greatly depend on the trouble we took at this stage. All holes must be stopped or filled and the filler rubbed down to level exactly with the main surface. Small grooves, scratches or protrusions become very noticeable when the job is polished, the more so if a high gloss finish is used. Even when merely patching-up damage, the primary rubbing-down is worthy of a great deal of care.

For basic wood and some plywood and laminates, a sanding block is useful. This is simply a rubber block with flat faces, on to which sandpaper can be fastened. Starting with coarse grade and gradually working towards the lower number, i.e. finer grades, the wood is rubbed down along the grain to give a surface smooth to the touch and even to the view, when inspected along its edge plane under a strong light. For a final rubbing down, a cork block in place of the more solid wood will allow the sandpaper sufficient "give" to achieve a satiny finish.

Small holes and cracks can be filled with a putty filler, plastic wood or one of the many water-mixes available. When using putty filling, remember that the oil in it will tend to seep into the wood. These, and some of the water-mix preparations, shrink as they dry. Therefore it is necessary to overfill, allowing the stopping to stand "proud" of the surface and dry, then sand away the surplus. Experience tells us just how much to allow extra, but for odd jobs, we must err on the liberal side.

Stained hardwoods can look very effective. Oil, wax or French polishing methods can be used, though the last mentioned needs a lot of patience and careful control of conditions. Dust is absolute anathema to cabinet polishing, so do not get on with other constructional work in the same room while waiting for the polish to dry. Oil staining can be fairly quick and easy, with the oil laid on thickly, then the surplus wiped off, and the process repeated until the required shade is obtained. End grains must be treated with more care, being more porous, and tending to soak up the oil, leaving a darker finish.

**WATER STAINING**

Water stains are not so easy. They need more applications, and one approaches the darkening process gently, even though the stain itself is fairly quick-drying and simple to use. An emergency water-stain that can be used to protect a natural wood and simply darken its colour, is obtained from dissolving crystals of potassium permanganate in water.

Staining is not the end of the job, and once must never be tempted to go too far along this line or the surface will be darkened beyond what one needs. After staining, the grain must be filled to get a smooth surface, this filling rubbed down, and final polishing can then take place. There are numerous patent fillers on the market, and these are generally applied with a pad of cloth across the grain of the wood, beginning with a small area and gradually extending the action. A drop of linseed oil can then be wiped over the surface when the filler is quite hard—usually an overnight process.

Deeper scratches may be filled as before, with polymer and plaster mixes, but it is always wise to incise the cut a little with a sharp knife or chisel to allow the filler a "key", and again remember to allow protrusion, then rub down. The shellac is then employed as a finish on top of the basic filler, and this will give a hard match for the original surface. Wide, shallow depressions can be filled with shellac and spirit mixture, with greater care being needed to obtain a level surface when rubbing down.

Plastic cabinets need quite different treatment. Minor scratches can be removed on most plastic by patiently rubbing them down with metal polish. For deeper scratches, a rubbing compound should be used to smooth off the surface to its new, lower level, before finishing with the milder abrasive. But it must be remembered that the colouring of a plastic material is part of the construction, not added to the surface. Although this may make the job easier, in that we have no problems of matching, it will always mean that the polished part will be lower than the original. Thus it may be required to extend the area of polishing to camouflage this depression.

Cracks and definite breaks offer more of a challenge. It is sometimes possible to fill these with chippings from a less obvious part of the cabinet than that to be treated, i.e., foot ridges and so on. The chippings can be softened with a slight application of trichlorethylene or a similar solvent, taking great care not to splash this around, and the resultant paste is moulded into the crack after keying ridges have been cut. The solvent evaporates and eventually the plastic hardens, leaving a rough surface that can be rubbed down.

It is even possible to repair clean splits by this method, moistening the edges of each side of the split with the solvent, pressing them together and clamping them until the plastic hardens—overnight is sufficient—and then rubbing down and polishing as before. If you want to make a clean joint and avoid the polishing, use a fine pointed paint brush, apply the solvent along the edge of the crack with a bias toward the unseen surface of the cabinet, and let it dry a little, as when using a contact adhesive, before pressing the two parts together. This last operation needs a steady hand. The solvent tends to spread, and one shaky attempt can ruin a smooth surface.

The joint can be reinforced on the inside with a rougher seam, made by application of solvent and a "kneading" action, taking care that any protrusions thus formed will not foul the innards of the receiver when it is reassembled. And always remember that the solvent softens the material, so that excessive pressure or clumsy handling will irrevocably deform the plastic shell. These repairs need great patience—but can be immensely rewarding, and an aid to economy. Occasionally a hot soldering iron may be used on inner surfaces to "weld" a seam in plastic.

![Fig. 21: One method of plastic cabinet joint not always obvious. To release the two portions, gentle pressure is needed along the seam at the side shown arrowed.](image-url)
FLOOD LIGHT CONTROL

Our dim and full switch is ideal for controlling photo flood lamps: it gives 70% to 100% brightness in two lamps full brilliance and jumps off. Similar control of other applic-
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7 transistors in a really neat radio in very pretty case, size 6 x 3 x 11 1/2 in.—complete with soft leather slipper bag. Spec.ification—Circuit : 7 transistor superheterodyne. Frequency range : 330 to 3000 Kc. Sensitivity : 5 microamps. Interception : 250 Kc at 50 Kc. Selectivity : 500. 1000. 5000. 10,000 c.p.s. Power output : 40W. Antenna : ferrite rod. Loop antenna : Ferrite rod. Magnet type : Rare earth. From the fact that these three sets suffered slight corrosion as the battery were left in them this sets when this corrosion is cleared away they should work perfectly—offered without guarantee that they are new 19/6 plus 2/ post and tax. less batteries.

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Each kit comprises seven items—Choke, 2 tube ends, starter, timer, transformer, tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Tufsol" tubular fish tanks and indoor plants. Chokes are super-
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Want to open your earphone door with a knob? Or close your controls with a whistle? To make anything your own for half price? Then you first need an audio switch. Then you need our kit. This is a complete kit, including all parts, parts list, instructions, etc.

WHERE POSTAGE is not definitely stated as an extra or not order 2/6 for each is free, Below £3 add 2/9, 2/9-Hemi add 7/6 post. Over 6/ post free. S.A.E. with enquiries please
Cleaning the plastic surface, both before the repair and afterwards, is best done with warm, soapy water. Beware of some detergents, which have a discouraging effect. Pure soap is recommended. Although some engineers favour the use of methylated spirit for practically every operation except cleaning their teeth, it is wise to avoid this or any other spirit when cabinets are lettered of over-painted in any way. No matter how carefully you try to clean around taboo sections, the capillary action of fluids may defeat you, and the ancillary paintwork smudge and smear. It may seem a little like cheating, but this writer has found the cleaning fluid supplied in the BIB kit for tape-head cleaning and the like to be ideal for intricate cleaning jobs on plastics, and quite harmless to paintwork, and cheap at 4s. 6d. a bottle. It can even be used to get the dirt from the milled edges of some of those ducky little knobs.

Flutings, louvers, milled knobs and such can be nasty-looking dirt-traps. This is where the orangestick and cotton-wool, or, again, one of BIB's cleaning sticks comes into its own. If the brushing action is done away from the closed end of flutes or louvers, the accumulated dirt can be wiped away with these quite easily.

ANTI-STATIC TREATMENT

However clean her ladyship thinks she may be, some dust will be present in the atmosphere. Plastic cabinets attract it. Dimple or crackle finishes look very dull and unattractive when dust has gathered in the hollows, even quite minute amounts. The cure, after cleaning and drying, is to wipe over with an anti-static cloth, such as supplied by most retailers of gramophone records. Following this treatment with an overall wipe with one of the disc cleaning preparation can leave a cabinet pristine and sparkling.

This is all very fine, I hear some unfortunate say, but before I can begin to repair my cabinet I have to remove the knobs, perhaps the dials, and often most of the working parts inside. How to start going about it?

Admittedly, the task is not always simple. Some knobs appear welded forever to their spindles, and are shaped so that a strong pull simply leaves one pinching air. With these, it can be helpful to apply the old button-stick method of slotting a piece of thin, stiff card, sliding under the knob, then using two screwdrivers to apply a regular lifting movement from beneath its outer flanges. An assistant to help by holding the receiver down while you do this would be an asset. The use of two screwdrivers is to prevent a sideways twist that can so easily fracture the spindle grip of a fragile knob. Even better is a homemade lifter, consisting of a slotted piece of thin brass, that applies the pressure around more of the base of the knob. An invaluable item of the author's toolkit, often used for knob-lifting, is a long-nosed pliers with angled points.

Fixing screws in cabinets are often one-shot devices. Coarse-threaded types are employed and removal may ruin the plastic thread in the hole. One remedy is to insert a piece of pvc sleeving in the screw hole to make a kind of plug, before reassembly. It is a better system than building up the plastic with some form of putty, as it then becomes easier to dismantle next time.

Flot the best way to deal with portable radios.

Cabinets themselves may be sprung together in sections. Many plastics lend themselves to this, and where a joint is obvious and no removal method indicated, it is best to press gingerly at each side of the joint to discover which of the two is the underside section of the key (see diagram). Having found this, and applied even pressure, the cabinet will generally split along the seam with frightening ease. As with all other jobs on plastic cabinets, pursue this operation with the care you would take in handling women—be gentle, but firm!

Removal of the chassis may entail disconnection of aerial rods, speaker or earphone sockets and sundry hardware. Do not overlook the basic chore—make a small drawing of connections, colour-codes of wires, etc. Trusting to memory has led many a good man into error. Some of the mini-jack sockets are secured with knurled rings which defy attack from outside the cabinet. With these, it is best to wedge a fine-bladed screwdriver in the knurled edge, then gently turn the whole socket from within to free the thread. Only a portion of a turn is required, as a rule, and it is seldom necessary to disconnect completely. Always take care, when handling these sockets, not to twist the connecting blades relative to each other, as short-circuits are not only disconcerting but can, in some instances, damage output transistors. Many of the earphone sockets are "shorting" types, with the connecting blade pushed away from a contact blade by insertion of the plug. With these, the common fault is weakening of the spring connection, always accelerated by mishandling, so again—take care.

That, if anything, has been the theme of this section. Take care of your cabinets as well as the works inside, to make a worthwhile job of radio repairs.

TO BE CONTINUED
Hoof tugging

Your letter about leg pulling, by your letter you have not much experience on transistor as I have had OC45 specimen working at 30MC/s AND more as these transistor seem to improve with age and it is up to the circuit confusphan that controls the operating poin. So think before you criticising I would like to add the same about OC44 are the same mind you you have to have a transistor tester which put the transistor into oslerailion at they's FREQSIS your's sorry about bad spilling.—G. Williams (Walthamstow, E.17).

The above letter, printed as it was received, refers (we presume) to comments in The Amateur Bands, page 850, March issue. The author replies—"Cor" de G3JDG.

Ham-band converter

Regarding the 10-metre transistorised converter (Feb. 1968). The following modification has been carried out with success enabling both 10 and 15 metre bands to be covered.

A 100pF twin-gang variable capacitor is substituted for VC1a—b which, in the original circuit, was a 20—25pF maximum. With the 100pF gang, 10 metres will peak with this capacitor almost fully unmeshed, the tunable i.f. remaining as in the original article. Fifteen metres will peak with the new gang almost fully meshed and with the main receiver tuning over 4.5—4.95Mc/s.

—L. Case (Lancs).

Such a state

"Solid State", what does it mean? This term nowadays prevalent in our reading matter, be it editorial or advertising, it is beautifully engraved on to equipment obviously to proclaim something. Hi-Fi I can relate to high fidelity, but solid state—I am at a loss. Can anyone offer an acceptable explanation? — W. J. Tomlinson (London, E.17).

Soldering saga... cont.

I have no wish to develop J. Macfarlane's 110V 75W soldering iron into a saga. But—if the method of M. Francis (Cheltenham) is followed the 75W iron would be converted into a 150W iron. To achieve 75W with a series diode would require an additional series resistor of 68Ω or so. Even with this resistor, the BY100 diode is over-run.—H. Bisplan (Morecambe, Lancs).

Beginner's Licence

I wholeheartedly endorse your comments in last month's Leader (June issue, page 95) re the Beginner's Licence. However, I suggest that the rot has already set in, and was probably instigated by the amateurs themselves.

Why should Class B licensees be allowed on the two-metre band? If you subscribe to this idea, then why stop at two metres—why not let the Class B types down on to four metres? Many arguments could be put forward to support this. Then, once they are on four—why not ten metres? In allowing and indeed supporting this move, the radio amateur is surely guilty of sowing the seeds of an idea that there is need for greater laxity in the rules and regulations governing licences.

It is too early to comment on the proposed plan for a true Beginner's Licence since nobody (well, only the late PMG) has any real idea of just what is involved. But with the present amateur's eagerness to allow all and sundry on to the two-metre band, one shudders to think what the real beginners will be allowed to do when they get going.—E. Mason (Cheyne Walk, London).

Car radio interference


What you have suggested is sound advice but I think you have overlooked one important factor, namely, aerial adjustment. Most modern car radios have a trimming screw and the usual method of adjusting it is to—rotate the screw through the position for maximum volume and return again to the maximum position to ascertain that a peak has been found. Should you be unable to find a peak position, poor matching should be suspected and may be due to fitting of an inferior aerial. This will inevitably result in reduced efficiency, and in poor reception of the more distant popular stations. It will also make the set more prone to interference.

This advice is given with Motorola Radiomobile car radios and I can assure you that if these instructions are not carried out, interference is the result.—W. Doran (Bangor West, Co. Down, Northern Ireland).

Advertisers' Rating

In view of the number of letters concerning advertisers, could they be given "star" ratings like the AA do in assessing hotels?—J. Mirren (Bath, Somerset).

[You mean the advts should read like—OC71 3s.; AF115 6s. 6d.; bed and breakfast 15s. (17s. 6d. with integrated f.m. tuner); BC108 3s. etc.]—Ed.

The bob drain

Mr. McLaren, Letters May, writes of the fortunes being made from 1s. postal orders sent in reply to adverts.

We advertise on this basis because we find that 95% of requests for literature do not result in orders. If no charge was made the costs of printing, postage and advertising would have to be paid solely by those ordering goods, with a consequent increase in prices.

I can assure Mr. McLaren that 1s. is a small amount towards the handling costs of an inquiry, if all costs are considered.

This is in no way to condone deliberate fraud of this type, but before condemning try a little simple arithmetic, and also remember that mistakes can happen with regard to enclosures omitted.—R. G. Silson (near Station, Tring, Herts.)

Twenty-two sets

As you are aware there has been a release of Ministry 22 sets.

I have a manual on these sets showing heater values, circuits, resistor and capacitor values together with technical descriptions. No doubt some of your readers have bought these sets, so if there is any query they have, please contact me and I will try and answer their questions, or supply information.—P. James (27 Herbert Road, Sompting, Lancing, Sussex).
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We have a few of these V.H.F. 12 valve transceivers operating on 8 switched channels between 60Mc/ 80Mc complete with all 6 crystals, headphones, mike, mobile aerial and tipping aerial, all enclosed in plus silver taped for mounting the set on. Power input LT 6V D.C., TX output 2 watts. Internal speaker (all valves Bri). All air tested O.K. Supplied in good grade 2 condition at 40/- each, carr. 2/6. Also available in matched pairs 225/- per pair, carr. 30/-/tested.

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This is a modern self contained tunable V.H.F. low frequency modulated transceiver for R.T. communication up to 8-10 Mcs. Made for the Ministry of Supply at an extremely low price. Consists of a box containing British makers, using 15 midget R.B. 7 valves, receiver incorporating R.F. and A.F. amplifiers. Double range tuning with the dial calibrated in 4 channels, each 200 Mcs. A.F. 38 Mcs. 48 Mcs. A.F. Also has built in Crystal calibrator which gives pipe to coincide with markers on the tuning dial. Power required LT 43 volts, HT 150 volts, tapped at 200 Mcs. New or as new receiver. Every set supplied complete with valves and crystals. Few in storage, complete with adjustable whip aerial, and circuit. Price £4.10.0, carriage 10/.

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This is one of the latest releases by the govt. of an extremely recent R.T. set covering 2Mc/e in two switched bands, containing 11 valves (3 EL34a in TX output) which can be used for Morse G.V. or R.T. A set has setting trimmer, M.P.O., RF and AF controls, switched meter for checking all parts of set, max. 12 x 24 Mcs. Power required LT 12V D.C., HT 32V D.C. Supplied brand new and boxed with headphones and mike and two spare valves and circuit of set. Few only at £2.10.0, carr. 20/-.

FAMOUS ARMY SHORT-WAVE TRANSCEIVER MK III

This set is made up of 8 separate units: (1) a two valve amplifier using a 6V6 output valve, (2) valve only, not built in the very latest model) a V.H.F. transceiver covering 229-224 Mcs using 4 valves, (3) the mainshort waveform transmitter/receiver covering in two switched bands, below 2 Mc/s only. (4) 4 Mcs and 4 Mcs-8 Mcs (approx. 160-100 Mcs) using 8 valves. Per R.T., G.V. and M.C.W. The receiver is superhetodyne having 1 R.F.

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PART THREE . . . . AMPLIFIERS

In Part 1 of this series I mentioned that the amplifier was the strongest link in the reproducing chain. This is probably due to the fact that an extremely accurate assessment of the performance of an amplifier can be made, as the function of an amplifier is purely electrical. There are no mechanical considerations, such as with pick-ups or loudspeakers. Amplifiers are the power producing link in the chain and must be very efficient. They must also be distortion free in their signal handling capacity. With modern amplifier circuit design this sort of performance is not uncommon.

The Choice

Valve or transistor? This is the question that most aspiring high fidelity sound enthusiasts ask. The answer really depends on how much you are prepared to spend on this vital but superlative link. I firmly believe that unless you are professional, or prepared to pay the sort of price a professional expects to pay, you would be better off with a valve amplifier. Up to the present, transistor amplifiers have not turned out quite as we were led to believe. The term “transistor sound” implies an insult rather than merely a performance description. The main point is that there should be no such thing as “transistor” or any other sound, just the original sound actually as it occurred.

Design of valve amplifiers and understanding of valve parameters has reached such a stage that harmonic distortion can be brought down to the 0.1% region, which is negligible. It is true that this can also be achieved with transistor amplifiers. However, it is achieved with the application of greater amounts of negative feedback, meaning less output power for a circuit giving equivalent gain without feedback. One characteristic of transistor amplifiers, not prevalent in valve amplifiers of comparable cost, is “crossover distortion” due to the fact that transistor amplifiers usually have outputs in Class B operation. This distortion cannot be reduced with negative feedback.

To sum up this argument on valves or transistors I would say that transistor performance can equal valve performance in all aspects but the cost is far greater at present. No doubt this situation will rapidly change. Now let us examine amplifiers in general.

Good quality amplifiers suitable for high fidelity use will have a frequency response from 20c/s to 20,000c/s ±1dB. The ±1dB assures an even flat response. Response curves for sound performance are usually plotted as frequency, to a logarithmic scale, against decibels, which is the sound output. The reference of 0dB is usually taken as 1,000c/s and any variation from the straight line of this reference is quoted as plus or minus the number of decibels (dB) variation. Why is frequency plotted as a logarithmic scale? This is in order to compress the frequency range so that the whole spectrum can be fitted on to one graph. Besides having a wide frequency response amplifiers should have outputs with a low harmonic distortion output in the region of 0·1% to 0·5%. Square wave response is important and there should be little or no traces of overshoot, ringing or fall-off in the output. Figure 3 shows some examples of good and bad square wave response.

Valve amplifiers, because of the high impedance loading necessary for valves, have an output or matching transformer. The primary winding of this transformer is wound to the impedance value necessary for correct loading of the valve and the secondary winding is wound to the same impedance as that of the speaker coil. The turns ratio is determined by the relationship $Z_{primary} = n^2 Z_{second}$ where n is the number of turns of the primary winding.

Output Transformer

The output transformer is, perhaps, the most important single component in a valve amplifier. Unless carefully designed it can cause the response curve to drop in the upper frequencies. This is because $XL=2\pi fL$ where XL is the winding reactance, f is the frequency and L is the winding inductance. The bigger XL is, the bigger is the impedance and the bigger is the volts drop across the winding. The output transformer must also be conservatively rated so that it is “man enough for the job”. If the amplifier is rated at the maximum

---

**Fig. 3:** Some examples of square wave performance: (a) very good, (b) reasonably good, (c) fair, (d) poor.
output of 15 watts then the transformer should be rated, at least, to this value. If the transformer is under rated then saturation of the core will occur, causing “clipping” of the waveform and hence distortion. This is particularly so at the low frequency end of the range. Transistor amplifiers, due to the low impedance loading necessary, can be designed to function with a transformerless output stage, an obvious advantage.

Noise and Hum

A problem more prevalent with valve amplifiers is hum and noise. Transistor amplifiers tend to give some hiss and crackle, known as noise; but they give virtually no hum. Valve amplifiers usually hum because of the a.c. heater supply. You have probably seen in specifications that hum and noise is −60dB at full power. This means that with the amplifier delivering full power the hum and noise level is 60 decibels less in intensity. In other words, the signal is 1,000 times greater than the hum and noise. This is referred to as the signal-to-noise ratio and a good amplifier will be in the region of −60dB.

Earlier, negative feedback was mentioned as a cure for harmonic distortion. Quite simply, negative feedback means taking a portion of the output signal and feeding it back to one of the earlier stages in phase opposition to the main signal. This cancels, to some extent, harmonics. There is another way of reducing harmonics by connecting output valves or transistors in “push-pull” operation. Figure 4 shows two valves connected in this fashion. The previous stage is a phase splitter and inverter stage, and feeds each output valve with half of the output signal, one valve handling the positive half, the other handling the negative half. By feeding these two halves into a primary winding of a transformer, which is centre tapped, a continuous output signal can be obtained. The fact that the signal is split and “pushed and pulled” in this way tends to cancel all even harmonics, thereby greatly reducing harmonic distortion. Amplifiers with output stages not connected in push-pull are termed “single ended” and are not really of a high enough quality for us to consider here.

Sensitivity

Now let us switch our attention from the output to the input and the “sensitivity” of our amplifier. Briefly, sensitivity is the minimum signal required to develop full output power. Our signal source, therefore, must be able to develop this magnitude of signal if we are to obtain maximum power. This is particularly important with low-gain, low-power amplifiers where power reserve is small. If your signal is too small to drive your main power amplifier then you need what is known as a pre-amplifier. This is a small voltage amplifier, connected between the signal source and the main amplifier input, to “boost” the signal voltage to the required magnitude.

At what power should your amplifier be rated? The answer really depends on the area to be covered by the sound. For outside use, 50 to 100 watts is reasonable, but the majority of domestic requirements will be satisfied by 10 watts, which will give adequate reserve.

Amplifiers can be examined in great technical detail but this is not meant to be a technical article, just an advisory one. Let us, therefore, summarise as follows:

1. On a cost/quality basis a valve amplifier is probably a better buy.
2. The frequency response should be 20c/s to 20,000c/s.
3. The harmonic distortion should be 0-1% to 0-5%.
4. Hum and noise should be in the region of −60dB.
5. Square wave response should be good.
6. The output transformer should be conservatively rated.
7. The output stage should preferably be in “push-pull” mode.
8. The input signal should match the sensitivity of the amplifier.

Fig. 4: A typical push-pull output stage of an audio amplifier.

Please Note

We are concerned to hear that there are still one or two people who are ill-treating their copies of Practical Wireless, allowing them to become torn and dirty. Of course, all our humanitarian readers will have treated their precious copies to a Binder, however, for the few who haven't, we offer a great chance to save their consciences. Send just 14s. 6d. —no, send 16s. and treat yourselves to an index as well. State which volume number you want on the binder, if you don't, we'll send you a blank one.

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THE club came into being three years ago, and was founded by Mr. I. G. Rees (G3VKZ). The club has a number of licensed members; Tony (G3WRY), Andy (G3PKW), Ken (G3WCS) and Ivor (G3VKZ). The club also boasts a group of keen s.w.l.'s who are always willing to help out at contests etc., by logging, while those who cannot read c.w. are quite content to make tea. The tea makers, however, plan to graduate to a callsign of their own, and the club offers every assistance. At every meeting a half-hour Morse class is taken by one of the licensed members, and every other week talks and demonstrations are given by G3VKZ on basic radio theory. Thus it is hoped that in time all the s.w.l's will hold tickets of their own. One member has already taken the R.A.E. and Peter, harmonic of G3WRY, will be doing so as soon as school exams permit.

Members come from all walks of life and most are still in the process of receiving education of one sort or another. The club can obtain from within virtually all its needs either free or at trade prices. It even has its own photographer who was duly converted and now hopes to get his ticket soon. Licensed members can be heard on the air fairly regularly and when more members are licensed regular skeds are planned.

Future plans for the club include entry into as many contests as possible, and a DX-pedition to a "rare" County operating on topband and 4 metres. All prospective members are very welcome and a fair proportion of members are not actually scouts, but are regarded as permanent visitors.

If you live in or near Liverpool, why not drop in and see the club for yourself? Meetings are held regularly on Thursdays at 8 p.m. clock time. Don't forget the address: Scout H.Q., Church Road, Woolton. See you this Thursday OM?
V.F.O. for the Ten-Fifty Transmitter

A

LTHOUGH the “Ten-Fifty” Transmitter described last month is a compact and effective rig, its usefulness is limited by crystal control. Even when several crystals, differing slightly frequencywise, are available, attempts at operating may prove frustrating on a crowded band, and one soon realises that if it were possible to QSY slightly a clear channel could be found.

Circuitry

The complete circuit diagram of the v.f.o. is given in Fig. 1. The familiar Clapp configuration as adopted for such an oscillator is reliable. Excellent stability results due to heavy capacitance “swamping” and to the fact that the input and output circuits are very effectively divorced from each other.

The fundamental operating frequency range chosen is 3500–3550kc/s and the L1/VC1 combination and associated items tune this range. Coarse band-setting is effected by capacitor C1 with trimmer TC1 providing a means of setting the LF band-edge as required to 3500kc/s. Since the effective valve oscillator anode is grid 2, the d.c. potential to this electrode is voltage stabilised at 150V which assists frequency stability.

The fundamental oscillator frequency plus harmonics appear at the valve anode proper where L2, tuned to approximately 7000kc/s is fitted. All four frequency bands, viz., 7, 14, 21 and 28Mc/s are workable from the basic v.f.o. frequency and “straight-through” operation is avoided. To counteract inevitable harmonic “tail-off” coil L3 is provided to stimulate output on “10”.

Power supplies, viz., 220V d.c. at 25mA and 6-3V a.c. at 0-6A are picked up from the main “Ten-Fifty” chassis at the octal socket provided, whilst the v.f.o. signal is fed via coaxial cable—and only 3in. is required—to socket Sk1 on the Tx; screened inter-connecting cables are essential.

Constructional

Dimensions of the metal-work required are given in Fig. 2, the simple chassis matching that of the main transmitter. In the interests of stability care has been taken in positioning components, and the layout adopted and recommended is shown in Fig. 3. Tuning is accomplished via a vernier reduction drive mechanism through an insulated coupler, capacitor VC1 being rigidly held by an inverted screening “L” section; the band-edge setting capacitor TC1 is also fitted to the front panel.

All the coils are easily wound by hand and details are given in Table 1. Use of an air-cored coil former is preferred for L1 whilst L2 must be provided with a screening can. Since it is essential for all wiring to be taut and rigid 22 s.w.g. copper wire is used throughout, adequately sleeved. A single tagstrip conveniently anchors power supply leads to the rear chassis apron.

![Circuit diagram of the v.f.o.](Fig. 1)
S.T.C. SILICON AVALANCHE 2nd Order quickly) full connection. Prealigned components.

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Proof of operation is readily found by inserting a test meter adjusted to read 0–50mA in circuit on the “hot” side of L2 when at switch-on a reading of approximately 15mA should be obtained; V2 should also be seen to glow. By disturbing the grid circuit of V1 in some way—short-circuiting L1 momentarily for example—should cause the meter pointer to swing smartly to a higher reading immediately falling back when the temporary short is removed. If, however, it is found that the meter indicates a steady current of say 35–40mA during the test it is clear that the circuit is not oscillating and before proceeding a circuit and component check must be made. When the circuit is functioning correctly the external meter may be transferred to V2 and when connected between pin 7 and chassis should show a reading of around 10mA when power is applied.

Checking

The station receiver is then switched on and tuned to 3500kc/s precisely with the aid of a frequency marker. With the v.f.o. dial set to “100” and the vanes of VC1 fully engaged, TC1 is carefully adjusted until the signal is detectable on the receiver; the v.f.o. signal should also appear at approximately 3550kc/s when VC1 is tuned to the other end of its travel. If excessive frequency coverage results, this may be reduced by inserting a fixed value capacitor in series with VC1 and if it is not possible to tune down to 3500kc/s, a small capacitor connected across C1 may do the trick. To adjust L2 the receiver is tuned to 7050kc/s and the v.f.o. signal sought. Using the receiver “S” meter as a guide, the coil of L2 may be adjusted for maximum deflection. Due to the interconnecting cable, coil L3 cannot be adjusted until both v.f.o. and transmitter are connected.

With both units connected the transmitter band-switch is set to “10”, the key inserted in its jack socket and the panel meter switch set to show grid current. The transmitter function switch is then moved to “Net” and the key depressed whereupon the drive control is set to show maximum meter deflection. Coil L3 and trimmer TC2 may then be carefully adjusted to increase the current indication and some 4mA of drive should be obtainable, although this is more than normally required. A similar amount of drive should also be present when the transmitter band-switch is set to the other bands covered.

<table>
<thead>
<tr>
<th>Coil</th>
<th>Turns</th>
<th>Wire</th>
<th>SWG</th>
<th>Former dia. (inches)</th>
<th>Core</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>26</td>
<td>enamel</td>
<td>22</td>
<td>1·0</td>
<td>Air</td>
<td>Close-wound. Former length = 1·25 in.</td>
</tr>
<tr>
<td>L2</td>
<td>22</td>
<td>d.s.c.</td>
<td>36</td>
<td>0·25</td>
<td>Iron</td>
<td>Close-wound. Screened Close-wound</td>
</tr>
<tr>
<td>L3</td>
<td>8</td>
<td>enamel</td>
<td>30</td>
<td>0·25</td>
<td>Iron</td>
<td>Close-wound.</td>
</tr>
</tbody>
</table>

With the v.f.o. complete, the idea of integrating the two units should be considered. In the interests of t.v.i. elimination a metal case is required; it is also essential to fit vertical screens between the v.f.o. and Tx units, extended to shield both above and below chassis items from each other.
Two sheets of 16 s.w.g. aluminium each 12 × 8in. will provide enough metal for the main case shell whilst a further section will serve as a base-plate. The base-plate—to which rubber feet are fitted—is easily secured to the chassis undersurface flanges provided using self-tapping screws. The case and panels are grey-lacquered with legends applied using transfers.

After checking the v.f.o. for drift its dial may be made more useful if a set of band calibration curves are drawn up on graph paper using as a reference a Crystal-marker/Receiver combination. It may also be additionally interesting to note that the “Ten-Fifty.” Transmitter may be made a 5-band affair to include “80”. This may be done by increasing the tank coil windings to 32, fitting an additional coil to the 6C6 and anode assembly and making S1 a two-pole, six-way rotary type switch with one of the “ways” blanked off. Adequate drive is obtainable although a poor or choppy note may result due to “straight through” working.

**Note. A licence is required to operate the 10-50 transmitter and v.f.o. Details are obtainable from Radio Service Branch, G.P.O. Headquarters Building, St. Martins le Grand, London, E.C.1.**

### AUDIO FAIR 1968 —continued from page 175

endless loop tape cassette facility etc. Models 713, 713H and 715 are mono types and models 702, 702H, 722, 722H, 704 and 724 are stereo models.

From Philips comes the model PRO 12 recorder designed for hi-fi enthusiasts who want something more than the ordinary domestic recorder, and professional people who want a recorder for studio applications. It is a two-speed machine (3⅔ and 7⅔ i.p.s.) which can be operated either vertically or horizontally and is suitable for twin-track mono or twin-track stereo recordings. Price is 180gns. Also from Philips comes the stereo player N2500. This unit has preamp output which can be fed through a hi-fi amplifier to provide full stereo reproduction. The price was not fixed at the time of going to press.

### PICK-UP CARTRIDGES, LOUDSPEAKERS AND TURNTABLES

There were many new products on show, especially in pick-up cartridges. Cosmocord displayed an improved version of their Acos Cosmocord; including the Acos stylus pack. Latest of the Decca Mark 4 pick-up cartridges was the FFSS 4RC which was being demonstrated, and priced at 16 gns. On display by Shure was the M75E-95G Gard-a-Matic Hi-track cartridge, which we understand has been designed specifically for use with the Garrard SL95 turntable. Various other new models on show by Shure Electronics, including the M31E and M32E, both with bi-radial elliptical stylus.

Kef Electronics’ new addition to their range of loudspeaker systems was the Concerto, a three speaker system in an enclosure measuring 28 × 17 × 12in. Maximum audio input 25 watts r.m.s. 50 watts music rating with a frequency response of 30-30,000c/s.

The Lowther range has been augmented by the PM6 MK1, which has an entirely new diaphragm assembly, giving an all-round improved performance.

EMI were offering matched loudspeaker sets, complete and ready for enclosures. They came in seven different sizes ranging from the “250”, with a 5in. “woofer” designed for a 0-4 cu.ft. enclosure, up to the “950”, with a 19 × 14in. “woofer” for a 4 cu.ft. enclosure. The photograph shows the “750” matched loudspeaker set, suitable for a 2 ½ cu.ft. enclosure, which comprises a bass, mid-range, and two high-frequency tweeters. The “750” has a frequency response of 20-20,000c/s.

Amongst the new range from Garrard were the SL75, SL65, AP75 and 3500. Models SL95 and SL75 are automatic transcription turntables, and SL65 a high quality automatic turntable. Model AP75 is a moderately-priced single record playing unit fitted with a four-pole induction motor. Model 3500 is a moderately-priced automatic turntable, featuring a low mass pick-up arm for use with high compliance pick-up cartridges.

As an extension to their range of automatic turntables BSR introduced the UA75. Additional refinements, exclusive to the UA75 over their earlier models, include a heavy cast non-magnetic machined turntable. A muting switch provides complete silence during the record changing cycle and a “pop” filter suppresses switch arcing when the unit shuts off. It also has manual facilities and alternative spindles are provided.

Lustraphone had several new microphones on show. In their Series Four, these included the 4-20 multi-impedance omni-directional moving coil; 4-30 multi-impedance hyper-cardioid moving coil; 4-50 professional multi-impedance dual ribbon studio quality with noise cancelling (for the first time).

Amongst the host of microphones on show AKG (Politechnica Ltd.) were showing the D200, a cheap version of their earlier model D202. Also appearing for the first time was the D224, a microphone for the professional user of the dynamic cardioid type. AKG also displayed the K20 and K60 moving coil headphones, suitable for stereo listening.
The series will be of exceptional value in training mechanics and technicians in Electricity, Radio, and Electronics.

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213
Widely acclaimed at the 1968 AUDIO FAIR

When the Sinclair Q.14 was demonstrated at this year’s Audio Fair, it delighted some of the world’s keenest and most critical listeners. It more than held its own against far more expensive loudspeakers and proved beyond all question that research and careful design could produce a quality loudspeaker for a remarkably low price. The Q.14 measures 9\(\frac{3}{4}\)in. square on its face and is finished in black matt with natural aluminium bar embellishment. Its unique shape allows it to be tried and used in a far wider choice of positions than conventionally shaped speakers. A pair in stereo give true “in-depth” performance with complete freedom from listening fatigue. If you missed the Audio Fair, why not hear this speaker in your own home. Should you not be pleased with it, your money including cost of return post to this office will be refunded in full.

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ACCLAIMED BY USERS TOO!

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<table>
<thead>
<tr>
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Volume 65, Issue 2, 22nd January 1961
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<th>Width</th>
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<td>7&quot;</td>
<td>4&quot;</td>
<td>5&quot;</td>
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Boxes of B.A. Nuts and Bolts, All Brand New and high grade machine cut items, available to all Services etc. etc. etc. Bolts include 2.4 BA. 6 BA. up to 2" long, various heads, mainly brass, approx. 3-400 items per box, our Special Price /6d, plus 2/- post and packing. WALTON'S WIRELESS STORES, 15 Pit Lane, Mountain, Queensbury, Bradford. Yorks.

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<tr>
<td>0-90</td>
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<tr>
<td>2mA</td>
<td>1&quot; round panel</td>
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