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NEWS & COMMENT

180 LEADER ARTICLE—Something For Nothing
180 NEWS . . . NEWS . . . NEWS . .
190 PW READERS PCB SERVICE
199 TELEVISION—What's in the July issue?
200 LETTERS—comments from PW readers
202 HOTLINES—Recent Developments—Ginsberg
203 NEXT MONTH IN PRACTICAL WIRELESS
210 PRODUCTION LINES—Bill Tull
222 KINDLY NOTE—Tug-O-War April '77
225 ON THE AIR—Amateur Bands—Eric Dowdeswell G4AR
                      Broadcast Bands SW—Derek Bell
                      Broadcast Bands MW—Charles Molloy
                      VHF—Ron Ham

CONSTRUCTIONAL

182 20W IC AUDIO AMPLIFIER—F. G. Rayer G3OGR
186 MEASURING WITH OP-AMPS—A. Sharpe
188 S-DeCNOLGY No. 8—Ultra simple audio amplifier—
                        David Gibson
193 A 741 SIGNAL TRACER—W. Mooney G3VZU
204 24-HOUR DIGITAL CLOCK with precision time switch—
                        John Miller-Kirkpatrick
213 A RADIO 2 TUNER FOR YOUR HIFI—R. A. Penfold

OTHER FEATURES

198 THE PARIS SHOW—A report from David Gibson
216 IC OF THE MONTH No 63—RCA CA3140 Op-Amp—
                        Brian Dance
219 HIGH FIDELITY '77 REPORT—Richard Schofield
222 RNARS MORSE PROFICIENCY TRANSMISSIONS
222 CQ . . . CQ . . . CQ . . .

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SYSTEM 7000 COMPLETE DISCO MIXERS (With Autofada)

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175

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SEMI-CONDUCTORS—COMPONENTS

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Dept. P.W.J, P.O. Box 6, Ware, Herts
COMPONENTS SHOP: 18 BALDICK STREET, WARE, HERTS

Practical Wireless, July 1977
### Panel Meters

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### Price

- **P & P**
  - Postage and Packing add 25p unless otherwise shown.
  - Add extra for airmail. Minimum order £1.
A GREAT deal has been written in the last few years on major undertakings such as the building of the supersonic Concorde and the American space programme. While our spending on Concorde is trivial compared to the untold millions of dollars spent on space research nevertheless the lesson seems to be that we earthlings can achieve almost anything given nearly unlimited funds. But where do we draw the line? And who is going to draw it for us? Who is there big enough to say "No" to a particular project because it will mean an intolerable burden on the taxpayer? Only now is money in reasonable amounts being allocated to research on solar energy problems. It may not be too little but it may be too late!

If this matter had been tackled 20 years or so ago we might not be so beholden to overseas countries for our oil supplies. Next time you pop down the road in your car to see Auntie Flo just think about how that petrol you are using got into the tank. Someone drilled a hole in the earth, took out tons and tons of horrible, gooey, slimy sludge, put it into a boat and sent it to our shores where it was put through a complicated process of refining, adding this and that chemical, then put it back into the ground in a tank until you came along with your hard-earned lolly and bought a couple of gallons. But what did you do with it, when you had got it?? You burnt it! You sent out clouds of poisonous fumes into the air for the rest of us to breathe. Just to go to Auntie Flo's! You could have walked, anyway.

But seriously, it is all rather daft, isn't it, when there is that great ball of fire in the sky that pours more energy on to our Earth than we can ever hope to use, and all for free, relatively speaking. The Japanese, and possibly others, are already producing solar "cells" in strip form. Soon we will be able, with a bit of luck, to decide how many kilowatts of energy we need for our house and then pop out and buy the necessary length of strip from the local DIY shop! All those nasty bills that arrive each month from the electricity, coal and gas bods would disappear! Think of the money we'd save and all the nice new hi-fi gear you could buy, or that transceiver you've always wanted. All those nice people who prepared those nasty bills could do something really useful, for a change. Like building a barrage across the River Severn and taking advantage of the free energy to be got from the roaring tide.

But in the past, whatever the bonanza, be it oil or butter, the ordinary man-in-the-street never seemed to benefit from them in the form he can best appreciate—lower prices. As soon as something is given with one hand it is snatched away by another. Is it too much to hope that things might be different with solar energy when it becomes an everyday source of power?

Amateur experimenters could lead the way, as they have done in the past, by designing electronic projects using the sun as a primary source of power. Radio amateurs are already employing microwaves in the region of 10GHz (10,000MHz) for communication over quite respectable ranges, using only milliwatts of power, which could be derived from solar cells. Secondary batteries charged from the sun could provide a continuous source of power but at the moment our methods of converting solar energy are pretty crude.

No doubt space scientists have one or two useful practical ideas up their sleeves which could be adapted for use in our field of interest so we must keep our ears and eyes open. In due time it ought to be a matter of principle that we do not obtain any of our power requirements, for electronic equipment at least, from the public mains supply.

**Something for nothing**

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**Atten—TION!**

THE RNARS will be holding their annual mobile rally at HMS Mercury on Sunday, June 19th, 1977, from 1100 onwards. The site is situated on the South Downs between the villages of Clanfield and East Meon and signs are to be seen along the A3 south of Petersfield and on the A272 west of Petersfield.

In addition to trade stands for amateurs, there will be arena events from 1400 onwards, with displays by the Cowplain NTC Band, Petersfield Aero Club flying display (weather permitting), volunteer Boy Cadet Corps field gun display and a display by Kelly Squadron of HMS Mercury. A static show will be given of pre-1965 racing cars.

Refreshments will be available on site and a grand raffle will take place with the draw being made about 1530. Talk-in facilities on 2m via GB3SN, 4m and 80m (3660kHz). People are most welcome to picnic on the site, so why not make it a family day out, taking in the wonderful Hampshire scenery as well as the RNARS mobile rally.

Further details from M. Puttick G3LIK, 21 Sandyfield Crescent, Cowplain, Portsmouth, Hants PO6 8SQ.

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**Sounds tough**

A NEW syllabus has been prepared for the Radio Amateurs Examination, which sets out the new Home Office requirements. It also indicates the number of questions likely to be asked on each group of topics. The first examination of this new type will be in May/June 1979, while the last in the present series will be in December 1978.

The papers will take a multiple choice format and will comprise a 1-hour Licensing Conditions and Transmitter Interference paper (765-1-01), and a 1½-hour Operating Practice, Procedures and Theory paper (765-1-02). Both papers will be taken on the same day with a short break in be-
tween. Certificates will be issued to successful candidates of both papers, although if only one paper were failed, the candidate would be required to retake only this one at a later date, to qualify for a full certificate.

Copies of the new syllabus, together with specimen questions, will be available from the Sales Section from July 1977, price 40p.

City and Guilds of London Institute, 76 Portland Place, London WIN 4AA.

Free advice

OVER the past few months a new type of shop has sprung up in the High Streets which offer equipment and advice to the general public, that previously had only been available to professional customers.

The shops—Electronic and Time Centres, are run by a group of professional Electronics Engineers and offer electronic digital clocks, treasure tracers, TV games, electronic car ignition systems, as well as a large range of Swiss and American LED and LCD quartz watches, DIY kits and spare parts. All products are guaranteed, as is the promise that if any orders are received by post before 2 pm, dispatch will take place that same day. There are two shops open at present, one in Daventry High Street and the other in Uxbridge High Street. Further shops are now being planned for Deal, High Wycombe and Northampton.


Show time

THE Birmingham International Ideal Homes Show is due to open at the National Exhibition Centre on Thursday, August 4th, and run through until Saturday, August 20th (excluding Sundays). There will be hundreds of stands where some of the leading British manufacturers and retailers and many from overseas, will be displaying some of the latest goods for the home. Apart from these stands there will be a full programme of holiday features, fashion parades, cookery demonstrations, musical events, games and competitions.

The show will be open from 10 am to 10 pm. Any enquiries concerning the show should be addressed to ITF and BPM Exhibitions Ltd, Radcliffe House, Blenheim Court, Solihull, West Midlands. Tel: 021-705 6707.

Jubilee callsigns

THE use of a special prefix GE for UK amateurs has been approved and will be effective from 4 June to 12 June inclusive ONLY. The facility is available to Class 'A' and 'B' licensees. For example, G4AR can use GE4AR, G8XYZ becomes G8XZY, GW4ZZZ uses GE4ZZ. Although this means that the individual countries of the UK lose their identities for a brief period, to the chagrin of the prefix hunters, I suppose one could always add /GW etc!

Castle rally

THE 8th Elvaston Castle Mobile Radio Rally is scheduled to be held in the grounds of the castle on Sunday, the 12th June. The castle is located on the B5010, about 5 miles south-east of Derby.

Opening at 11 a.m., there will be a talk-in by GB8GC/P on 2m, G3EEO on 160m and GSZB1/P will be on the air as an exhibition station from the site. To please the rest of the family, the organisers have arranged for a bring-and-buy stall, prize draw, refreshments, sideshows and children's entertainments. An added attraction will be the presence of the EMI Tape hot air balloon. Entrance is free, although there is a car parking fee of 25p.

Any further information from Ian Cage G4CTZ, Nunsfield House, Boulton Lane, Alvaston, Derby DE2 6FD.

R TVC have asked us to correct some pricing errors that occurred in their advertisement on page 5 of the May 1977 issue of PW. The correct prices are:

Sinclair IC20/PZ20 kit, £5.95.
Speakers, DuoIII, pair, £52.
Turntable, BSR MP60, £29.
Portable Disco Console, £64.

Practical Wireless, July 1977
This amplifier uses a single high power integrated circuit; the power supply is included for direct operation from the mains. Maximum output is up to 20W into a 4Ω speaker, or about 13.5W into an 8Ω speaker.

The use of an IC greatly simplifies construction of the amplifier section of the equipment, and comparatively few other components are necessary here. The IC features internal protection, so that no damage arises if the output (speaker) circuit is shorted. It also incorporates thermal protection. This is a valuable feature, since it avoids thermal runaway when dissipating excess power in relation to the heat sinking used. High temperatures cause the IC to shut down with normal working restored when the temperature has fallen.

**CIRCUIT**

Fig. 1 shows the complete circuit using the TDA2020. VR1 is the gain or volume control, and coupling is by C1 to the input pin 7. Negative feedback from the output pin 14 is by R3 to the inverting input 8, feedback also being set by R2 and C2. C3 is a frequency-compensation capacitor.

IC1 needs no speaker coupling capacitor but requires bipolar supply lines. The power supply makes provision for this.

The amplifier is assembled on its own printed circuit board which also carries the heat sink.

The mains transformer T1 has a 12-0-12V secondary; the centre tap provides the chassis line. Two of the rectifiers, with C8, give the positive supply for pin 1 of the IC. The remaining two rectifiers, with C9, produce the negative line supply for pins 3 and 5 of the IC. R6, C7 and R5 provide an auxiliary positive supply of about 12-14V for a pre-amplifier or suitable radio tuner although these may be left out if not required. C5 and C6 are HF by-pass capacitors fitted near to the IC.

The rectifiers, R5, R6, C7, C8 and C9 are assembled on a piece of tagboard adjacent to T1. R7 and the neon comprise an indicator. If a panel neon with resistor included is used, R7 will not be necessary.
Fig. 2 shows wiring of the tagboard. Colour coding of the leads will be helpful here. Violet was used for the 12V leads for T1, with yellow for the centre-tap, chassis, and 0V amplifier line. Red is used for 17V positive and black for 17V negative supply.

The capacitors may be of the type with two tags one end. Two brackets mount the board vertically. These were fixed by 6BA bolts through the tags which must also be in contact with the chassis and act as earth returns and anchor points for C7 and C8. The capacitors can be held by fastening string round them looping this through holes in the board, as well as by their connections. As an alternative the power supply card may be constructed from vero-board if tagboards aren’t to hand. Flexible leads run from the points shown to the amplifier board. These can be unsoldered at top tags 1 and 6 if it is wished to check current as mentioned.

The transformer fits to the left of the tagboard. Use a 3-core cord, and plug with 2A or other low rating fuse. The chassis should be earthed (Fig. 1). L and N mains conductors go to the transformer primary, with the switch in the L circuit.

**POWER OUTPUT**

There is latitude in both the speaker load and supply voltages when maximum power is not required. The circuit given in Fig. 1 was found to provide 17-0-17V, and with this up to 20W can be obtained with a 4Ω speaker. With 12-0-12V, output is 11.5W, rising to 15W with 14-0-14V, and 18.5W with 16-0-16V. For 8Ω speakers, ratings are 7W for 12-0-12V, 9.5W for 14-0-14V, 12W for 16-0-16V, and 13.5W for the 17-0-17V supply. The maximum supply is 20-0-20V, but this is not recommended as the IC may be damaged if higher voltages should arise, and power output is not a great deal more than with the 17-0-17V supply.

For high output while leaving some latitude for safety, the 12-0-12V rms secondary is probably best. A check across C8 and C9 should be made, and each reading should not be more than about 18V, with no signal. The tag-board is arranged so that a meter may, if wished, be placed in series with positive or negative supply lines, for an initial test; the current drawn will peak up to about 1A in each case.
**AMPLIFIER BOARD**

Fig. 3 shows the undersize of this, and the positions of components. The board is relatively simple, and was made from Print-A-Kit adhesive foil, but can be prepared in the usual way and etched. Alternatively, a board may be purchased from the PCB service—see p 190. It is important to note that C3 and the resistors lie under the sink, so that they may be near the IC, but that the other capacitors must be outside the area occupied by the sink.

Input is via a screened lead, which runs to C1 and the PCB 0V line, as shown in Fig. 3. Flexible leads are soldered on for the speaker connections. Also holes should be drilled so that the red, yellow and black power supply leads can be soldered to the appropriate foils as per Fig. 3.

The heat sink is 80 x 40 x 30 mm and its thermal rating is 2.75°C/W, for 20W operation. A smaller sink is available for 12W maximum. It has threaded holes to take two 6BA bolts. If other sinks are improvised, they should be of quite generous size. If the IC thermal cut-out operates, it indicates that the amplifier must be run at a lower power level, or the sink must be improved.

The IC has a mounting spacer which fits underneath it. Semiconductor mounting compound must be spread on top of the IC before fitting the sink. Be certain that the holding screws do not touch adjacent foils; insulating washers may be put under their heads if needed. The sink must not touch the...
Detailed wiring and assembly of the amplifier. Particular attention should be paid to the mains wiring; the live lags on S1 and the panel neon are depicted unhealthily near the 12V secondary of the mains transformer. The latter should be shown slightly further back from the front panel.

CASE or any other metal items. Two brackets hold the board vertically, and in this position the sink fins are also vertical.

**components list**

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<thead>
<tr>
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<td>1C: TDA2020</td>
<td>T1: 12-0-12V/2A mains transformer. Indicator neon, on-off switch, 3.5mm jack socket, knob tagboard. Speaker sockets, etc. Heatsink: 3.15 E18. Chromasonic Electronics.</td>
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<td>C9: 4700µF</td>
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Fig. 4: Detailed wiring and assembly of the amplifier. Particular attention should be paid to the mains wiring; the live lags on S1 and the panel neon are depicted unhealthily near the 12V secondary of the mains transformer. The latter should be shown slightly further back from the front panel.

ASSEMBLY

Fig. 4 shows how the transformer, tagboard and amplifier are fitted and interconnected. The yellow or 0V line is continued from the mains earth tag to transformer, capacitor assembly, and amplifier, so that reliance is not placed on chassis earth returns.

It is convenient to use a metal panel and bottom, but it is not essential to have metal sides, top or back. The least expensive assembly is to use a 25 x 10 cm (10 x 4") flanged "universal chassis" for the front, with a flat plate about 25 x 12.5 cm (10 x 5") for the bottom. The whole unit can then be completed as in Fig. 4. Subsequently, top, sides and back can be added. Appearances can be improved by making the sides of wood, large enough to give a front and bottom projection of about 1 cm (0.4"). A number of holes, or a slot or cut-out, must be arranged near the heat sink, to allow air circulation. The back should also be fitted with sockets for the speaker, and for the 12-14V positive supply outlet, including a chassis return.
A

N operational amplifier is so called because it can perform specific mathematical operations such as multiplication and division; the actual parameters of the operating mode are entirely dictated by the choice of external components in the feedback loop. In the following circuits the op. amp is shown in the multiplying mode. The differential op. amp usually makes a better DC amplifier than the equivalent single ended version. To explain the reasons for this, it requires some comprehension of DC amplifier theory.

**Single end**

Fig. 1 shows the basic single ended circuit. It exhibits two major deficiencies: the first is that the output voltage is offset to the input voltage by a fixed value equal to the normal collector base voltage; further the collector can swing only marginally below the base.

Second objection concerns the base emitter voltage which will be typically about 0.6V for a silicon transistor. The exact voltage depends on the junction temperature. Since the base emitter junction constitutes the input circuit any error in this department will be magnified by a factor proportional to the amplifier gain. In the circuit shown this relates to the ratio between Re and Rc. For instance if Rc=10kΩ and Re=1kΩ then the gain will be 10 providing one neglects the internal emitter resistance of the transistor. In practice, this invisible resistance would reduce the stage gain to slightly less than 10. By the same token, if the base emitter voltage changed by a hypothetical 3 units per °C then the output would change by slightly under 30 units.

**Long tailed pair**

Adding a further transistor produces the well known “long tailed pair” circuit shown in Fig. 2. In this case, Re no longer controls the amplifier gain; it simply serves to provide both transistors with current which will usually be split equally between the two. The real Re is the other transistor; the emitter output impedance of each transistor presents the emitter load to the other since both emitters are connected together. If the Re shown in Fig. 2 were replaced by a constant current source, then the amplifier would only respond to a differing voltage between Tr1 and Tr2 bases. A voltage common to both has no effect on either output since the supply current remains equally split between the two. However if one input is held at earth potential and the other is varied, then the supply current will vary unequally between the pair although the total value will remain the same. This will result in differing voltage drops across the collector resistors.

For instance, suppose that an input signal caused a current of 10mA to flow in the base circuit of Tr1 but not Tr2. Assume that both transistors have a gain of 100. Then the emitter current of Tr1 will be 1mA higher than Tr2. Since both transistors are supplied by a source of constant current, then Tr2 will have to pass 1mA less if Tr1 is passing 1mA more. The current difference will be reflected in the voltage drops across the collector resistances: if Rcl=Rc2=10kΩ then the drop will be an extra 10V across Rcl and 10V less across Rc2, a difference of 20V total between the two collectors.

Provided that both transistors of the pair are maintained at identical temperatures then temperature error signals will be common mode (applied equally to each base) and thus not appear in the output. Integrated circuits enable easy fabrication of thermally and electrically matched long tail transistors. However the simple circuit of Fig. 2 requires a few more components to back off the standing output voltage and enable output swings below the input voltage.

*Practical Wireless, July 1977*
The true op. amp.

Fig. 3 shows how the addition of a further transistor may be used to back off the output voltage while retaining all the benefits of a differential input. Note that, although only one collector load resistor has been used, the current is still equally split between the input pair in the quiescent state. The value of R1 is chosen so that the current flowing in the collector circuit of Tr1 produces a voltage drop across R1 proportionate to the base emitter voltage of Tr3, i.e. about 0.6V. This means that Tr3 just conducts producing an output voltage across R2. As with the last example, the amplifier will only produce an output signal in response to a differential input signal between Tr1 and Tr2. Further the output can swing from supply rail to supply rail without any fixed reference to the common mode (common to each) input voltage on Tr1 and 2.

Whereas the gain of the single sided circuit shown in Fig. 1 could be adjusted by varying the ratio of collector to emitter resistance, that cannot be done with the circuit shown in Fig. 3. The latter, having a fixed gain of over 10,000 (80dB), relies totally on the way it is connected to external components to control this parameter—a true operational amplifier.

Operational modes

The classic circuit configurations to obtain controlled gain are shown in Fig. 4. The circuit block of Fig. 3 has been replaced by the well known op. amp symbol. In the non-inverting mode (drawing A) the output is in phase with the input. If R1 and R2 were equal, the amplifier would exhibit a voltage gain of 2. For unity gain in the non-inverting mode, the inverting terminal of the op. amp must be connected directly to the output terminal; this arrangement is known as a voltage follower since the output signal precisely follows the input signal. However the output is at a very low impedance, a factor which usually provides the motive for implementing such a circuit.

Fig. 4(B) shows the inverting mode connection. The input impedance will approximate to the value of R2. The input and output waveforms will be out of phase by 180°. In this connection, the op. amp inverting terminal acts rather like a mechanical fulcrum of a see-saw—when one end goes up, the other comes down. Further, the gain of the circuit can be likened to the mechanical advantage obtained with a lever system; in this case, the value of the circuit resistors are analogous to the lever lengths. Because of the gain in the op. amp, very little signal is present at the inverting terminal—the output always tries to counteract the effect of the signal—hence this is known as a virtual earth point.

Fig. 4(C) is a combination of A and B circuits. This arrangement gives a true differential input, i.e. rejecting voltages which are common to both inputs, by maintaining the relationship R2/R1=R4/R3. This ensures that a common mode signal will raise both the inverting and non-inverting inputs to the same level. This circuit is used extensively in electromedicine where very small skin differential potentials need to be measured in the presence of high level mains hum and other interference.

An op. amp millivoltmeter

Fig. 5 shows a typical DC application of the well known op. amp 741 integrated circuit: a high impedance DC voltmeter. The op. amp works in the voltage follower mode in such a way as to render the resistance of the meter movement totally non-critical.

Resistors R4 to R9 provide the switchable top section of a resistive divider; R2 forms the bottom half having one end connected to earth and the other connected to the top half. The junction voltage is applied via R3 to the non-inverting terminal of the IC. Resistor R5 and diodes D1 to D4 simply serve to protect the input of the IC and the meter movement; they do not contribute in any part to the normal operation of the circuit.

Practical Wireless, July 1977
THIS month's S-DeCnology project is an audio amplifier which should prove useful as an add-on unit to last month's two-transistor radio receiver. The amplifier performs efficiently from only 3V, the voltage used with the receiver.

Fig. 1 shows the complete circuit. It uses the absolute minimum number of components; excluding the microphone and loudspeaker only three transistors, one resistor and one capacitor are used. The circuit comprises three transistors wired as a Darlington triple, a configuration which exhibits a very high gain. The actual gain is a product of the gains of the individual transistors. The base of Tr1 is biased by a 2MΩ resistor R1 which also provides DC stabilisation. Input is via capacitor C1.

The circuit works very well with a crystal microphone plugged into S-Dec holes 41 and 66. The loudspeaker used in the prototype was a 75Ω 63mm component—a larger size speaker would give more volume. Note that the loudspeaker must be 75 to 80Ω: lower values (such as 3, 8 or 16Ω) should not be used.

**Construction**

Building the amplifier on S-Dec should present no problems—the prototype was "rebuilt" in less than 90s once circuit and values had been settled! When inserting the transistors, note that the leads are not in the sequence: emitter, base, collector (except for Tr3). This is made clear in the S-Dec layout diagram of Fig. 2.

---

**Fig. 1:** Circuit diagram. Cx provides bypass for RF when used with last month's radio receiver. See section 'Radio amplifier'.

**Fig. 2:** Component layout. Note that Tr1 and 2 leadouts are plugged into the S-Dec out of order.
you will need . . . .

| Tr1 BC109 | R1 2.2MΩ |
| Tr2 BC109 | C1 0.1μF |
| Tr3 BFY 51 | LS1 75 or 80Ω loudspeaker |
| One S-Dec, 3V battery, crystal microphone. Cx small value capacitor (see text). |

**Supply voltage**

Using a 3V battery, the amplifier draws some 16mA of current. At 4.5V, this rises to 26mA; at 6V the current drawn is around 50mA. The amplifier was left running on test where it was found that Tr3 became barely warm. If, however, the voltage was raised to 9V (current then about 86mA), Tr3 got warm quite quickly.

When used in conjunction with the radio receiver described last month, there will be ample volume at 3V. For greater sensitivity, a higher voltage may be used. In view of the experiments described above, it is suggested that 6V be considered the maximum unless intermittent operation is envisaged.

**Radio amplifier**

Connecting the amplifier to the S-Dec receiver presents no problems. Simply plug in a 4-7kΩ resistor in place of the earpiece on the receiver, and then connect the amplifier to the receiver as shown in Fig. 3. The circuit diagram of Fig. 1 shows a “phantom” capacitor Cx across the input (S-Dec holes 42 and 67). This prevents RF from the receiver blocking the sensitive AF amplifier. It need be used only in this application. Its value should be between 350 and 500pF (390pF used in prototype).

**Other applications**

The unit can also be used as a simple record player amplifier providing the pick-up is a crystal type. A screened lead is a must here. In some applications such as this one a volume control might prove useful. For this, connect the slider of a 1MΩ potentiometer to hole 41. Connect the earth end of the pot to hole 66. The signal source is connected across the volume control.

As it stands, the unit might be used as an audio signal tracer. A 3V supply should be ample for this application. It might be prudent to connect a 0.1μF capacitor in series with the earth lead.

The S-Decology project for next month is another circuit which will work well from only 5V (it even functions on 1.5V). It has various applications but sufficient to say it could be used to play blind-mans bluff.


Since the output impedance of the resistive divider is 10kΩ, any voltage measuring circuit connected to it must present an impedance many times higher than this. The voltage follower configuration of the IC typically offers an input impedance rather greater than 2MΩ and thus will not affect the voltage reading. The meter movement is connected between the output of the IC and the inverting input. A further resistor, R1, connects between the inverting terminal and earth.

The circuit shown does this by sending a current through the meter movement of exactly the right amplitude to equalise the voltage between inputs, even though this means passing extra current to counteract the effect of R1.

Since the input current to the amplifier is so small that it can be ignored, the sum total of the meter current is that which is required to reproduce the resistive divider output voltage across R1; in other words the voltage across R1 exactly mirrors that across R2. This makes it very easy to work out the FSD voltage for the meter circuit. When R1=1kΩ then the voltage required to pass 100μA is 100mV. If the value of R1 were 500Ω then the circuit FSD would be 100mV for a 200μA meter movement or 50mV for a 100μA meter.

![Fig. 3: Radio interface. In this drawing Tr1 and 2 refer to the transistors in last month's radio receiver.](image)

[![Fig. 5: Circuit diagram for a 100kΩ/10V millivoltmeter. The diodes included in the circuit are purely intended for meter movement protection; they serve no normal operational function. Within very wide limits, the resistance of meter movement M1 has no bearing on the accuracy of the instrument. The actual sensitivity is controlled by R1; this component may be made variable for calibration purposes.](image)
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<th>Project</th>
<th>Ref</th>
<th>Price P/P</th>
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<td>1.08+12</td>
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<td>Dig. Freq. Meter (set of 5)</td>
<td>A015 and 4x A004</td>
<td>3.17+15</td>
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<td>A002</td>
<td>3.08+18</td>
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<td>Disco Preamplifier</td>
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<td>0.65+12</td>
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<tr>
<td>Aug 76</td>
<td>Cassette Player Power Supply</td>
<td>A001</td>
<td>0.65+12</td>
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<td>Sep 76</td>
<td>Capacitance Meter</td>
<td>A009</td>
<td>2.59+14</td>
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<td>Digital Car Clock (set)</td>
<td>A001/2/3</td>
<td>2.58+12</td>
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<td>7.90+20</td>
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<td>1.18+12</td>
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<td>FM Stereo Touch Tuner</td>
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<td>7.50+20</td>
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<td>0.65+12</td>
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<td>2.38+12</td>
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**APPLICATIONS:** Hi-fi—Mixers—Disco—Guitar and Organ—Public address

**SPECIFICATIONS:**

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**FEATURES:** Complete Kit—Low Distortion—Short, Open and Thermal Protection—Easy to build.

**APPLICATIONS:** Updating audio equipment—Guitar practice amplifier—Teet amplifier—audio oscillator.

**SPECIFICATIONS:**

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**FEATURES:** Low Distortion—Integral Heatsink—Only five connections—7 amp output transistors—No external components.

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

**SPECIFICATIONS:**

- **INPUT SENSITIVITY:** 500mV.
- **OUTPUT POWER 25W R.M.S. into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0.04% at 5W at 1kHz.
- **SIGNAL/NOISE RATIO:** 75dB FREQUENCY RESPONSE 10Hz-4kHz-3dB.
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**60 Watts into 8Ω**

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**FEATURES:** Very low distortion—Integral heatsink—Load line protection—Thermal protection—Five connections—No external components.

**APPLICATIONS:** Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ

**SPECIFICATIONS:**

- **INPUT SENSITIVITY:** 500mV.
- **OUTPUT POWER 60W R.M.S. into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0.04% at 60W at 1kHz.
- **SIGNAL/NOISE RATIO:** 90dB FREQUENCY RESPONSE 10Hz-4kHz—3dB SUPPLY VOLTAGE ±3V

**Size:** 114 x 90 x 26mm

**Price:** £15.84 + £3.27 VAT P&P free.

**HY200**

**120 Watts into 8Ω**

The HY200 now improved to give an output of 120 Watts has been designed to stand the most rugged conditions such as disco or group while still retaining true Hi-Fi performance.

**FEATURES:** Thermal shutdown—Very low distortion—Load line protection—Integral heatsink—No external components.

**APPLICATIONS:** Hi-Fi—Disco—Monitor—Power slave—Industrial—Public Address

**SPECIFICATIONS:**

- **INPUT SENSITIVITY:** 500mV.
- **OUTPUT POWER 120W R.M.S. into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0.05% at 120W at 1kHz.
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**FEATURES:** Thermal shutdown—Very low distortion—Load line protection—No external components.

**APPLICATIONS:** Public address—Disco—Power slave—Industrial

**SPECIFICATIONS:**

- **OUTPUT POWER 240W R.M.S. into 4Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0.1% at 240W at 1kHz.
- **SIGNAL/NOISE RATIO:** 94dB FREQUENCY RESPONSE 10Hz-4kHz—3dB SUPPLY VOLTAGE ±6V

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191
W HEN greeted with silence from the output of a radio receiver or audio amplifier the problem of finding whether the signal is getting to the input or not and if so where it is lost can be difficult without some form of signal tracing device. Whilst a millivoltmeter is useful it only gives a voltage reading which could be noise or a highly distorted signal. Even with an oscilloscope one does not actually hear the signal. Using the tracer described here, the signal can be monitored with the aid of a small earpiece and a rough estimate made of its amplitude. The quality of the tracer amplifier is quite good, allowing noise and most common forms of distortion to be traced to a particular stage.

Design considerations

Although signal tracer designs abound there is always room for improvements or different design approaches. Many tracers are bench standing units in large cabinets housing a loudspeaker and mechanically offer a challenge to the beginner or those to whom time is at a premium. The device described here is in the form of a hand-held probe and the usual loudspeaker is therefore eliminated. No attempt has been made at miniaturisation, the size being kept reasonable to simplify construction.

The loss of the loudspeaker results in a number of advantages. The audio feedback occurring with some circuits is unlikely without the loudspeaker and the need for a fair amount of driving power is removed. The quality of the usual tracer amplifier/speaker combination is not very good mainly as a result of the speaker and its mounting. The audio heard through the earpiece is therefore at least as good as that which would be heard through a speaker-type tracer and the use of a pair of stethoscope earphones would improve matters. The lower power requirements makes probe-like construction possible and a long life can be expected from a small internal 9V PP3 battery.

The tracer should not load the circuit under examination and to this end an input impedance of 2MΩ has been the aim. To cope with the wide range of signal levels likely to be encountered in practice a range of well over 60dB can be accommodated, from several volts downwards. Signals of 100μV were easily readable on the prototype and signals of only a few μV could be detected under quiet conditions. The 200kHz BBC transmission could be heard quite well using a tuned winding/ferrite rod and a simple diode detector. The requirements of high sensitivity and wide input range have therefore been met. Further requirements are that the device should be inexpensive and of reliable design, with little setting-up required. The circuit uses the cheap 741 operational amplifier IC along with a single

2N3819 FET input stage. On completion no adjustment is required other than the optional step of roughly calibrating the input attenuator.

Protection against accidental connection to a large input signal whilst the gain is set to maximum is provided by the use of a high impedance earpiece and by the limited output voltage swing of about ±5V. With a normal earpiece impedance of 50Ω the power input is about 10mW. The FET is protected by the usual back-to-back diodes across the input.

The circuit

The circuit is shown in Fig. 1, high frequency roll off and most of the gain is provided by the 741 op. amp, the output being sufficient to drive the earpiece directly. An FET input stage provides the required high input impedance and operates at a small gain of about 5dB. This input stage was necessary since an overall gain of 50dB was the aim and using the 741 alone the maximum input impedance achievable is too low unless abnormally high value feedback resistors are used. Also, at the required gain of 50dB, the bandwidth is too narrow due to the internal compensation. The prototype had a measured gain of 50dB at 1kHz. The gain is determined by the feedback and input components, C3, R5, R6 and R1 feeding the inverting input, and giving an upper frequency limit of about 10kHz in this circuit. A single supply rail is used and the non-inverting input is connected

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to a potential divider such that the output pin is at 5-6V. This is the middle of the range over which the output can swing. Here the voltage at the non-inverting input determines the virtual earth point into which the input and feedback operate. The output is taken through a 10µF capacitor C4. The capacitor should be a high-impedance type, that used in the prototype had a measured impedance of about 500Ω at 1kHz. The output voltage at pin 6 is a little over 2V RMS at the commencement of clipping.

The FET input stage uses the readily available 2N3819 and operates at a drain current of 3mA and a gate bias of −5V. The component values represent a compromise between available gain and reasonable drain current at this rather low supply voltage of 9V. The AC voltage at the drain of the FET will be about 20mV maximum so with this method of biasing most 2N3819 samples will fall in operating range. The input impedance of the amplifier is approximately the value of the input potentiometer VR1 2MΩ. The frequency response of the unit was 50Hz to 8kHz at the −6dB points and this was considered adequate. Since the gain control is situated at the input, the amplifier is operating at constant gain and the noise generated within the amplifier is therefore present at all settings. The signal-to-noise ratio is however about 50dB and therefore this is not of any importance.

### Components List

**Resistors**

- R1 1-5kΩ
- R2 1kΩ
- R3 3kΩ
- VR1 2MΩ log, potentiometer

**Capacitors**

- C1 0.1µF 250VW polyester
- C2 10µF 10V
- C3 0 1/µF polyester

**Semiconductors**

- Tr1 2N3819
- IC1 741 8-pin DIL
- D1-D2 1N914

**Miscellaneous**

- J1, 3.5mm jack socket. S1, double pole, miniature slide switch. Coaxial socket. SK1-2, wander plug sockets. Aluminium box 135 × 70 × 40mm (5 3/4 × 2 3/4 × 1 3/8 in) approx. Veroboard 44 × 22mm.

**Construction**

The unit is built in a small case made of light aluminium as shown in Fig. 2. A 10mm flange is bent in all around and to this is attached the "U" shaped cover using self-tapping screws. The mounting holes A, B, C and D are for the probe input socket, potentiometer and the two output wander plug sockets. The input socket is a normal protruding type coax socket. Mounting holes E and F are for the output jack socket and the slider on/off switch. Dimensions of these holes should suit the particular components used. The circuit board is held in position by a long 6BA bolt.

![Fig. 2: Dimensions of the case as used by the author. These can be changed to suit the sizes of components actually used.](image)

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Most of the amplifier components are mounted on a piece of 0.1m Veroboard measuring 45mm by 22mm (17 holes by 8 holes), as in Fig. 3. Deviation from the layout given should not prove hazardous provided the output and input wiring is kept apart. The input capacitor C1, protection diodes D1 and 2 and the decoupling capacitor C5 are wired in point to point. If the jack is of the shorting type it should be wired so that the output is not shorted when the jack is removed as this would also short the wander plug sockets. The wiring to the output sockets should be made with a screened lead. The battery is held in position by a piece of foam rubber glued to the cover. When setting up without the cover the battery can be held to the main chassis by double-sided Sellotape, Fig. 4.

The use of a coax input socket allows a permanent connection to be made to the equipment under test with a short length of screened lead and two miniature crocodile clips. A suitable probe may be plugged into this socket for normal tracing operations. The construction of such a probe is shown in Fig. 5. This probe is made from a good quality aluminium coax plug. Without the small tinplate screen the mains hum pickup will be considerable due to the high impedance. The insulating sleeve is cut from a potentiometer shaft, perhaps VR1 if it is bought new. A 1/8 inch hole is drilled down the centre of the sleeve so that the brass contact makes a tight fit. The contact used in the original was cut from a brass welding rod, filed to a point at one end and the other end filed to a smaller diameter so as to fit down the centre of the coax plug to which it was soldered.

**Setting up**

Before switching on for the first time a meter should be connected in series with the battery supply to check the current which should be 5 to 6mA. If everything is functioning correctly a slight hiss will be heard in the earpiece and possibly some mains hum. If possible a check on the gain should be made when an input of 3mV should give an output of 1V RMS at about 1kHz with the gain turned up fully. The input attenuator can be calibrated in several ways. A voltmeter can be connected to the output and a signal generator to the input through a suitable attenuator. The gain control then being marked in millivolts input for 1V out. The prototype was calibrated in a similar way to this except that the scale was marked 0, -20, -30, -40dB etc. for an output continued on page 199
THE Exposition Park at the Porte de Versailles in Paris covers an area of 65,346m². It is the home of a major annual electronics exhibition and this year some 1,200 exhibitors displayed a diverse range of electronic goods. With 30 different countries displaying their wares, the exhibition can fairly claim to be international!

Exhibits varied from old friends seen last year, to the novel and curious. For example, one stand boasted an ionograph which might be loosely described as an electronic device which measures cleanliness! In certain areas of electronics it is necessary to know that the PCB is clean since it picks up all kinds of solvents and greases on its route through the production lines. The ionograph flushes the PCB in a fluid which then passes through a chamber, and the ionisable particles of dirt in the fluid are measured and displayed on a dial. This gives a measure of the dirtiness/cleanliness of the particle content in the fluid and hence the cleanliness of the PCB. Just the thing in this modern age for checking on the state of little boys’ necks (could probably be calibrated in tidemarks).

The cordless soldering iron has been on the market for some time, but one company has gone a stage further. They are offering a miniature drill which plugs onto the contacts of the heating element and runs from the internal rechargeable batteries in the body. The drill measures only 7.8cm x 3.2cm and weighs 65g. Definitely a hot little number! If you have $400 under the mattress you could consider buying an MCP-1, a radio receiver with no tuning knob. Inside, the MCP-1 has just about everything: a microcomputer, phase-lock loop, digital frequency synthesiser, just to name a few. They combine to give a small calculator-type keyboard and a digital readout window. Touch a button and the receiver will start to scan. When it comes to the first occupied frequency it will stop. If you want that station, touch another key and the exact frequency is entered into memory. Then carry on scanning. To recall any station, merely touch in the frequency. Just a thought—the memory has sufficient capability to store 12,000 separate stations! An unusual feature is that no crystal is used; the receiver relies on phase-locked loop and digital frequency synthesiser techniques.

Some items were so new that they were only talked about in low voices. One novel IC was described as a driving circuit for analogue displays. This turned out to be a chip which has outputs suitable for driving LEDs. The novelty is the number and arrangement of these outputs. There are 10 outputs and 5 “lines” selection. Thus, if one imagines 30 LEDs arranged in three rows of ten, it is possible to address or illuminate any one (or more) LED in the matrix. Possible applications suggested were digital voltmeter where lit diodes would indicate voltage and eliminate the need for a meter. The device operates from 9V and it is possible to cater for two alarm points i.e. when (say) the voltage went above or below certain preset limits in the digital voltmeter application described above. It would seem to offer some interesting possibilities in the area of electronic games although this is not its prime function. Development samples only are available at present.

Most people have seen or heard of a teleprinter. This is a keyboard like a typewriter but which can send signals over the telephone lines which are subsequently printed out by another teleprinter at the receiving end. Trouble is that the keyboard is rather large and so invariably fixed in some office. That
was until this year’s Paris show. A company called Technology Resources exhibited a pocket TTY. This
measures only 25 x 75 x 155mm and comprises a complete pocket teletypewriter terminal. It allows
both transmission and reception of signals and has a 36-button keyboard. Each button has two sets of
characters and a small switch at the top dictates which is sent, depending upon whether this switch
is set to the left or right. The standard ASCII code is used and the speed is 110 bauds. The terminal
requires two power supplies: +5V at 500mA, and
-12V at 100mA.

One unexpected stand was that of REF, Reseau
Emetteurs Francais, the French RSGB. The Society
had a station on the air using a 144MHz transceiver
under the callsign F8REF. The rig was a Kenwood
2-metre all-mode transceiver with 10W of SSB. FM
and CW, and 3W of AM. He society offered for
sale a “Hams Interpreter” which gave equivalent
phrases in most languages. While your scribe
searched diligently, there was no polite phrase which
could be used for those Iron Curtain T3 notes which
still haunt 144MHz!

For readers who find the soldering iron has a
nasty habit of burning through its own lead: good
news. A Scandinavian firm which specialises in
wires and cables has one which can withstand enormous
temperature differentials. Available in a
variety of sizes it will work over the temperature
range minus 100°C up to plus 300°C.

And so the show drew to a close for another year
with snippets still ringing in the visitors ears: GIM
has sold eight million games chips which “play”
tennis, squash, football, a sort of “four-rule” games
chip. AEG Telefunken showing a 5cm rectangular
flat CRT with heating power only 33mW and an
accelerating voltage of 1-5kV described as suitable
for pocket TV sets. With an average of over 10,000
visitors a day, the show will rest now until April
1978, when we’ll find another 1,200 exhibitors
showing new devices even more wondrous than this
year.

A 741 SIGNAL TRACER—continued from page 197
of 0dB or 0.774V. A less accurate method is to use
a low frequency input of say 200Hz and note the
input level required to cause clipping as heard in
the earpiece, at various gain control settings. How-
ever it should be noted that this is not intended as
a measuring instrument and that any calibration
can only be approximate, as the gain is to some extent
dependent on the supply voltage and the frequency
since the response is not perfectly flat.

An RF probe, as such, was not constructed for the
prototype, a diode detector as in Fig. 6 being set up
when required, keeping all “hot” leads as short as
possible. The prototype worked well on supply
voltage as low as 7V although the gain decreased.
Dear Sir,

Letters

New style R.A.E.

Candidates for the R.A.E. will probably be aware that it is intended to change the format of the examination.*

My students have taken part in a City & Guilds Protest, and if their reactions are typical there seems to be no relaxation of the standard. The multiple choice method enables the entire syllabus to be covered, probably with 150 questions. There is a sophisticated method of eliminating the chance of success by guesswork. My basic method is to subtract the wrong ones from the right ones.

Past experience in other C. & G. examinations having a syllabus including some Regulations, some recognition and interpretation with elementary calculations, has demonstrated to my satisfaction that the competent candidates succeed.

I have been able to monitor the performance of these students in the College and at work and I maintain that the gradings achieved reflect as accurate an assessment as any other method which does not require a display of practical, manual ability.—Name and address supplied.

* See News Item on page 180.

Out of this world!

I write in answer to the letter by Mr. G. L. Manning, G8JBH, titled “High Power Interference” published in the May issue of Practical Wireless.

The transmission that is referred to is undoubtedly that of the AMSAT-OSCAR 6 command station, located at the University of Surrey, the purpose of which is to control the satellite’s periods of utilisation, hence the battery state and continued function, as a part of a world-wide command group in phase with similar stations in Hungary, New Zealand, Australia, Canada and the USA. The British section of the command network has been active for over two years and the project is now developed to a fully automatic az-el real-time computer controlled status, that has performed its part in keeping the satellite “alive” for the one thousand plus Oscar communicators around the world.

Thus, in real terms, one cannot claim that “minority groups are being given absolute priority over other groups” especially when one considers that we are dealing with some 30kHz of a band 2MHz wide. The actual bandwidth is considerably less than the 100kHz stated, although I would agree that the nature of the transmission would make it appear to be of a much wider bandwidth in many types of receivers close to the source.

The reason that the transmission is greater in its spread is in part so that any interfering signals do not accidentally command, and because it has to overcome the Doppler shift during an orbit. The selection of the particular part of the band used is because it is one of the two “all modes” sections, and also to cause the minimum possible inconvenience to other band-users, it being on a little-used section of the two metre spectrum, to which many alternatives exist. It also needs to be a frequency that is internationally available on a mutual basis for such sophisticated functions.

Our regret is that apparently this section of the band is employed in the more densely amateur populated areas, and that it would obviously be better to have the station situated at a more remote and less inhabited area, but, the considerable technical resources and cost of the installation limited its placement to the only position where the competence and allocation was available.

The periods of transmission are restricted solely to those times when Oscar 6 is in line-of-sight to the command, this being some two hours total time daily, varying from transmission times of a few minutes in the early morning and late evening hours, to a maximum of 25 minutes on over-head passes, at a rate frequency of 100 minutes. The actual times are dictated by the orbital constants, which are available from G2RS, BARTG Teletype bulletins, CEEFAX, ORACLE, TELE-TEXT, AMSAT and many other sources, thus permitting those interested to know the exact times when to expect the transmission. Although AMSAT have strong links with the RSGB, the Society cannot be held responsible for the difficulties encountered by stations also using this part of the two metre band.

The particular choice of frequency of any user of the band employing it for normal QSO’s is up to the user, having regard to the band-plan, and if an operator chooses to employ a section allocated for mixed modes, he still has the choice of 700kHz unaffected by the command signal, with the complete freedom to move, unrestricted by international requirement. AMSAT were not unaware of the problems being experienced by other users of the section converted, and had a valuable dialogue with G3HTP, representing the affected other users, at the last AMSAT-UK meeting at the University of Surrey, resulting in a good mutual understanding. As a result a letter explaining and outlining the problem was sent to every club Secretary of amateur radio groups within a 75 mile radius of the command station. The bandwidth was reduced, power also, to the very minimum capable of commanding the spacecraft, and azimuth control was added to reduce the groundwave signal level.

On a more optimistic note (from the point of view of those who wish to use this particular section, if not from AMSAT’s) the OSCAR-6 satellite has now lost four of its Ni-Cad cells, and despite careful nursing by the command network, is unlikely to be with us for much longer. OSCAR-7 is in the main self-controlled, and is not commanded by the British section of the international network. Further, future satellites should only need short bursts of a few seconds duration to “hold” the information fed, and this only a few times per week.

On a more personal note, I do not feel that the presence of a few amateurs holding QSO’s on a

Practical Wireless, July 1977
particular frequency is likely to justify the continued allocation of this greatly envied spectrum at WARC in 1979. On the other hand, the knowledge and know-how of satellite operation multi-access and the development of the means of satellite command auto-control systems is an activity that is likely to be of value to those who will decide as to whether the amateur service maintains its current band availability.—Pat Gowen G3IOR (Norwich). Chairman and Coordinator AMSAT-UK.

April fool

With reference to your informative article ‘Surefire’ in your April 1977 issue, I must congratulate you on a most marvellous and comely piece of prose. However, when I commenced the fabrication of said circuit, in situ, I was perturbed to discover the absence, to wit the total lack, of an APR 77 transistor in my collection. Fortunately, I perchanced to recall my ownership of a multiplicity of Unitrons —of which much has been penned in your illustrious magazine.

Whereupon, on inserting said Unitron, an imaginary current was perceived to flow. Could this be the first contact with an alien universe?—Yours laboriously, Prof. T. Pott. (Whataripoff Institute of Parapsychology, Moscow.)

A complaint

I am writing to you to complain about the lack of valve designs in your magazine. Many people have written asking for valve designs and I think you should have some. Surely, if you ignore what the readers are asking for, then people will stop buying your magazine!

After all a valve radio is simple to design; no complicated regulated power supplies are needed or heat-sinks. In my opinion, people don’t build radios any more. They just get a couple of integrated circuits, a ferrite rod, a printed circuit board and there you are, instant noise maker! In the old days, to build a radio was a major task. A chassis had to be punched, transformers had to be mounted. Valve holders, coils, large variable capacitors and tag strips all had to be thought about before the soldering iron was plugged in.

I am only fifteen and I recently built a four-valve TRF to my own design using Denco coils. This had a good tone and a high output. The selectivity and sensitivity were good even though no reaction was used, and it wasn’t a superhet. Valves are still in use in many TV and amplifier applications all over the country and I think you should include them in your magazine. Apart from this I find your magazine excellent!—Andrew Redding (Rotherham).

We would welcome such designs from readers. How about you, Andrew, submitting an article on your receiver?—Asst. Editor.

2kW from a PP3?

Having constructed my own style of Disco Unit, using some of the circuits in Practical Wireless, I found that I had omitted to build any form of pre-fade amp into the unit. I rushed out and purchased a small half-watt module and fitted this into the unit as a temporary fitting, powering it from a PP3 battery neatly clamped on the side of the cabinet.

A few weeks later I was booked for a party in our local public house and during the course of the evening a rather merry gent staggered up to me and asked to have a look at my ‘gear’. I told him that I had built the majority of it myself and he remarked that it looked and sounded very good. He noticed the PP3 battery strapped to the side and remarked, “and it all runs off that wee battery, magic stuff” and staggered away!

I must write to a certain battery company and ask if they have found anyone else using PP3s to power a 50 watt amp, two turntables and 1800 watts of flashing lights!—P. C. Glen (Glasgow).

Who’s he kidding?!

I am writing to you in connection with the article SUREFIRE published in the April issue of your magazine.

I would first like to agree with Mr. D. Jones theories and explanations. I would also like to point out that when VR1 is in fact acting as a Kenotron not only will all present positrons undergo adiabatic contraction, but it can also be proved that photon entering the magnetic field will actually gain energy, this energy is then converted into ultra violet light. It was also found in the atomic research laboratory that adiabatic contractions in positrons changes the charge of a given electron by exactly 1-3754966 x 10^-26C, this was measured with an atomic operational amplifier very similar to the good ‘ol 741. This amplifier can be made to detect charges as small as 10^-20e.

The circuit in the article also helped to prove beyond any question the Lorentz-Fitzgerald contraction and also helped with the measurement of the time dilatation between two given events in a frame of reference travelling at twice the speed of light.

May I take this opportunity to congratulate Mr. D. Jones on the achievement of achieving Nothing.—N. Nazoa (London).

Look behind you!

Some time ago I constructed a 6 transistor radio for the short-wave bands in a metal case with an open “rear”. A few days ago I noticed that regeneration had become somewhat “fierce” and decided to investigate as the radio is in a shack in the garden! I duly took the set out of its case and then noticed that a small spider had built a “web” around the regen-control (a variable capacitor of an open type) and as the weather was damp tiny globules of water had formed along the strands and in between the fixed and moving vanes of the capacitor and in addition there was also a web built around the volume control and I suspect shortening the life of the 9V battery, when the web became damp! So watch out boys if your equipment is in a damp or humid shack or “spidery” attic, batteries are expensive and also transistors could be damaged!—J. Owens (Dolgellan).
Microprocessors
—new uses
Great news for Teletext/Viewdata addicts. I hear that a British company is to turn to microprocessor technology to produce what amounts to a very low cost TTV (teletext/Viewdata) module. Price quoted in the US is 20 dollars—that’s around £11. The same company hopes to add another module later which will offer on-screen channel number, time, remote control, and digital tuning. This latter device will cost around 30 dollars.

Speaking of microprocessors, I hear that these components will play a major role in motor cars of the 1980s; and that’s less than 3 years away. Fuel injection by electronic means has already appeared on many vehicles, but the motor manufacturers are now working on fuel management. A sensor in the exhaust system feeds back information to the electronics which in turn can control all the major adjustments possible in the engine—like fuel injection, fuel/air mixture, throttle, engine speed, etc. The electronics is so designed as to ensure that the engine is always running at maximum efficiency. One can imagine the ultimate in auto electronics—just sit in the car and say to it, “Home, James”.

1½ inch switch
... almost
Let’s switch to a different subject-switches! Imagine a ten-way single pole switch. Quite a large affair; until Micro-Dip came along. This switch will operate over the temperature range —10° to +60°c and can switch 5V at 100mA. Its size is truly remarkable—just half a 14-pin DIL package. In inches, that’s only 0.38 × 0.4 × 0.24in. The contacts are gold plated and the switch is also available in codes, such as BCD and complemented BCD. It is rotated by the blade of a small (very small!) screwdriver.

I was interested to learn of some power MOS FET devices just on the market. These give a minimum gain of 10dB at 200MHz and have a power dissipation rating of 35W. These would seem ideal for QRP Ham rigs since not only are these devices "thermal runaway-proof", they are also immune to load-mismatch burnout too. Small quantities (in the US) are priced at around 20 dollars.

Magnetic display
Displays are always items of interest especially new ones. The latest to come to the ageing Ginsbergian eardrums (I haven’t actually seen these yet) consist of little balls floating in oil. One half of each ball is white, and the other half black. The balls can be rotated by means of an applied magnetic field. Thus a pattern can be shown by simply applying the necessary magnetic fields. Quite true—not a load of balderdash.

Another display uses a liquid crystal only 10mm by 10mm. Onto this tiny cell, some 40 rows, each with 50 characters can be packed. A laser beam is scanned across this “cell” and the image projected to 10in × 10in. The speed of the system is about 20 characters per second which is very fast.

Hot car
One hears about absent-minded professors, but here’s a story about a retired, but very forward-thinking one. He lives in Los Angeles and drives a small Honda motor car. Power is derived from two 35 horsepower electric motors. These take their power from six 6V batteries. On the roof of the car is an array of photocells which keep the battery charged. Top speed is around 25 mph with about one hours’ driving time before the battery runs down and needs a recharge (free from the sun). The array of cells on the roof manages to produce around 3A/hour in sunlight and an eight-hour "exposure" gives enough battery power for at least one hours drive. But don’t start eyeing your mini roof yet; the total cost of the cells was over £1200—and the wise professor has kept the petrol engine part of the vehicle intact!

While the Citizens Band in the UK is still at the idea stage it is interesting to see the volume sales in America for CB radios—particularly from Japan. The 1976 trade figures (for the US) indicate that Japan exported 9,900,000 automobile transceivers alone! And they managed to capture 88% of the US market for this type of equipment. The actual value of these transceivers was put at well over 500 million dollars. There is currently a move afoot to restrict the imports of these equipments by putting up tariffs and setting quotas. I wonder if the UK will learn anything from all this?

Stamp collecting
... outdated?
How long before computer hobbyists emerge in Britain? Perhaps when the potential to the hobbyists/experimenters is fully understood. Take the things some people are already doing. One man generates music with his computer. He writes electronic songs by playing notes into the memory from a keyboard. These could be read out via a synthesiser to reproduce almost any instrument.

Another computer enthusiast has a wood-burning stove (which helps heat his house) coupled to the computer which has improved efficiency by some 10% on very cold days. In weather above freezing point, the efficiency has been increased by nearly 30%

Yet another enthusiast keeps all manner of information in his computer’s memory banks on things affecting his buying and selling business—could be an idea for those who play the stock market?

Ginsberg
Handy-Mini POWER SUPPLY

No experimenter can have too many power supply units around! This one will always prove valuable, providing from 0 to 12V at 500mA or 1A as required. It incorporates overload protection and a meter to monitor the output current.

Morse Tutor

Learn Morse the easy way with the PW Morse Tutor. Electronically generated Morse characters produce a perfectly keyed audio or visual signal. Code cards plug into a socket and out comes the code! Plus speed and tone controls. Invaluable for code instructions or just teach yourself.

ATOMIC Time Receiver

You won't believe it, but the period of the earth's rotation is just not constant enough these days for some purposes! Build this Atomic Time Receiver, driven from a signal from station MSF at Rugby, and compare instantly the earth's time and atomic time.
TIME-controlled switches have been with us for many years for switching electric lighting in streets, central heating in homes and offices and in their most complex form as sequence programmers for industrial machinery and such mundane things as washing machines. The original time-switches were run by clockwork with an eight-day movement which meant that, for instance, a council employee had to tour all the streets in the area once a week to rewind all the movements. This type of switch was soon replaced with an electric movement which, although more expensive initially, soon paid for itself in the saving in manpower and in its accuracy.

Most electric time-switches used today have a synchronous motor tied to the mains frequency thus giving very accurate long term stability and requiring little in the way of servicing except after power cuts! One of the major problems left with this type of unit is the fact that the setting or repeat accuracy of the switch itself relies on a cam attached to a drive shaft which rotates once every 24 hours and contacts with switches set on the circumference of the 'dial'. As the dial has a circumference of about 250 mm at most this means that in a 24-hour cycle each hour is represented by some 10mm of movement and thus each minute is represented by something like 0.15mm. On a high quality switch these tolerances could be met and probably bettered but on a mass-produced item the resulting accuracy means that the time switch can only be set to within about 5 minutes of the required time.

Fig. 1: Circuit diagram. The IC pinout is given on page 209.
In industrial machinery and even in some household appliances such as washing-machines and ovens the switching of the various internal motors and other functions is controlled by dedicated TTL circuits or even microprocessors. This, coupled with quartz crystal timing if required, gives rise to equipment which can be switched on or off at any time during a 24 hour cycle (or even longer) with an accuracy of better than 1/1000th of a second. Although this sort of equipment is probably within the design ability of a lot of readers the applications and high cost would limit the interest.

With the advent of electronic digital clocks the method of timekeeping in many households has now changed from the 'quarter to two' approach to the potentially more accurate '13:43'. Some of the alarm clock chips could be modified to operate as a time-switch with an accurate "turn-on" time but, with only one alarm comparator, the "turn-off" time could not be similarly set (unless two alarm clock chips were used in parallel with the associated problems of synchronising the two chips). The CT7001 clock chip includes an alarm and an elapsed time alarm, these two functions could be linked to give an accurate turn on time and an accurate elapsed time up to a maximum of about ten hours, however, the elapsed time counter has to be set each time it is required and would not repeat in the following 24 hour cycle.

General Instruments have released the AX-5-1230 digital clock chip with a switched alarm output which comes on at the time set in the "on-time" register, goes off at the time set in the "off-time" comparator and also operates as a 24 hour, four digit, clock.

**Circuit description**

The circuit diagram of the unit is given as Fig. 1. The transformer drops the mains voltage to about 24 volts which is rectified to DC by diodes D1 to D4 and smoothed by capacitor C1. The resulting voltage across C1 should be within the range 24V to 30V and capable of delivering 100mA. The positive side of C1 is referred to as Vss and all other voltages are referred to as negative with respect to Vss.

If it is assumed that the voltage on C1 is 27V then, under no load conditions, the potential divider chain R1, R2, R3 gives Vss-12V, Vss-18V and Vss-27V. When the load of the chip and the filament of the display are taken into consideration the resulting voltages are nearer Vss-15V, Vss-22V and Vss-27V.

The Vss-15V line is connected to the Vdd input of the chip and with a 50Hz signal being taken from the transformer, via limiting and shaping components C2 and R4, the chip will start to operate. An internal multiplexing oscillator starts to run and sequentially selects the data in the display registers for each digit in turn and presents that data on the segment outputs at the same time as turning on the appropriate digit drive. The data for the next digit is then selected and presented at the outputs and the next digit drive is turned on. The speed at which this happens when connected to the display is too

**Components list**

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<thead>
<tr>
<th>Resistors</th>
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<tbody>
<tr>
<td>R1</td>
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</tr>
<tr>
<td>R2</td>
<td>220Ω ±5% 1W.</td>
</tr>
<tr>
<td>R3</td>
<td>390Ω ±5% 1W.</td>
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<tr>
<td>R4</td>
<td>100kΩ ±5% 1W.</td>
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<table>
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<td>C1</td>
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<td>C2</td>
<td>3300pF disc ceramic.</td>
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<tr>
<td>IIC</td>
<td>AY-5-1230 -G.I. (Metac, Bi-Pak or Watford Electronics)</td>
</tr>
<tr>
<td>D1 and D2</td>
<td>1N4001</td>
</tr>
<tr>
<td>D3 and D4</td>
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<td>SPDT, centre-off</td>
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<tr>
<td>S2</td>
<td>SPST, sub-miniature</td>
</tr>
<tr>
<td>S3 and S4</td>
<td>miniature push button, one pair normally open contacts, non-latching action</td>
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<tr>
<td>S5 and S6</td>
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<table>
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<th>Display</th>
<th>Value</th>
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<td>Phosphor diode, 5-LT-01, Futaba, (Metac or Watford Electronics)</td>
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<table>
<thead>
<tr>
<th>Miscellaneous</th>
<th>Value</th>
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<tbody>
<tr>
<td>T1, mains transformer, 24V at 250mA secondary, (MT150) fixing centres 60mm. Case 205mm x 75mm x 140mm, (8&quot; x 3&quot; x 5½&quot;), Vero code 75/14112. Front plate, 198mm x 68mm x 2mm, perspex, red or clear. PCB from Readers PCB Service. Output socket to suit use.</td>
<td></td>
</tr>
</tbody>
</table>
fast for the eye to follow and a continuous four digit display is seen.

The AY-5-1250 has facilities for BCD, seven segment or blanked output. In this project the BCD and blanking (INH) inputs are connected to Vdd to give a seven segment output at pins a-g.

The chip is designed to allow it to interface directly with fluorescent (Phosphor-diode) displays. This type of display has a heater which acts as the cathode with the segments being the anodes. Between the two are grids connected to each digit drive.

**Display**

To light any one segment both the segment drive and the digit drive grid must be at least 15 volts positive to the centre voltage on the filament. In this circuit the centre voltage on the filament is Vss-24.5V and the segment and digit drives switch to Vss to turn on, thus the voltage differential is 24.5 volts. When in the off condition the chip outputs would normally switch to Vdd which is Vss-15V. This would result in a voltage differential on the display of about 9 volts and could result in the segment remaining lit. For this reason the chip outputs are internally connected via resistors to a common line referred to as VLL which is connected externally to the negative side of the heater. This ensures that the chip outputs switch off to Vss-27V giving a display differential of zero volts and thus extinguishing the off segments.

The display includes two indicators for AM and PM which cannot be used with this chip (it does not have AM/PM outputs since they are unnecessary on a 24 hour display). The chip does have two output indicators which show that either or both ON and OFF times have been set, and, to save costs, these are connected to the AM/PM indicators on the display.

An alternative is to use two LEDs, as shown in Fig. 2, with the current limiting resistors mounted on the PCB. On the prototype provision was made for these diodes on the back panel but it would probably be more convenient to mount them on the front.

The switched output from the chip can be used to drive a relay of the type specified direct. Before using any other type of relay check that the operating current of the relay does not exceed 30mA at 15V. Other switching systems can be used as shown in Fig. 3.

**Construction**

Construction is reasonably straightforward but two points are worth extra attention.

First, use standard MOS handling procedures with the clock chip.

Second, beware of the mains on the board. The relay specified has its metal body connected to the centre contact of the change-over set. If the mains is being switched it will appear on the body of the

![Rear plate drilling details.](W488)
relay. For this reason the track linking it to the mains has been broken and a link inserted. Leave the link out until the preliminary testing has been completed.

Similarly the mains is carried by tracks on the board and it would be better if these tracks are painted with enamel paint or several coats of shellac.

The single PCB used is shown as Fig. 4 and the component locations as Fig. 5. Start the assembly with the transformer, resistors R1, R2 and R3, diodes D1, D2, D3, and D4 and capacitor C1. This will allow the power supply to be checked before the more expensive components are fitted. The voltage readings should be similar to the unloaded figures given earlier.

Assuming the power is correct the remaining components can be inserted (not the link to the relay) and the switches mounted on the rear panel. (see Fig. 6). The use of a socket for IC1 is strongly recommended. If separate LEDs are used on the front panel, leave the leads fairly long.

Do not assemble the board, front and rear panel into the box at this stage.

**Testing**

When switched on the display should light up and show 00:00 which is that shown after a power failure. This display will not change until the advance buttons are pressed even though the clock chip is functioning correctly. If the display is correct the remainder of this section can be ignored. If it is not correct then the following checks can be made.

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*The prototype was built using a single PCB for mounting all the major components. Since the board carries mains wiring, great care must be given when assembling this area. Remember to earth the frame of the mains transformer by using an external wiring strap.*

*Particular consideration should be given to the handling and soldering of the display strip. Prolonged and excessive heat will crack the metal/glass seal inducing terminal damage. Similarly when handling/soldering the IC, the usual anti-static precautions should be observed.*

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*Practical Wireless, July 1977*
Fig. 4 (above): PCB shown actual size—copper side.
Fig. 5 (below): PCB component side showing locations and leadouts.
1. Switch off. Remove the IC from its socket (put it in its conductive foam) and switch on again. Do not attempt to remove the IC with the power on. The result is almost certain destruction of the device.

2. Measure the voltage between pins 1 and 26 on the IC socket. It should be about 15V.

3. Measure the voltage across the filament of the display. It should be about 5V.

4. Check that pin 28 is connected to Vdd.

5. Check that pin 25 is not connected.

6. Check the individual segments of the display as follows, connect pin 18 (the minutes digit, Mx4) and pin 10 (segment G) to Vss. The segment should light. Repeat the other segments on the minute digit, one at a time (pins 11, 12, 13, 14, 15 and 16), then repeat for the 10 minute digit, the hours and 10 hour digits.

If these tests are satisfactory the only remaining area of malfunction is the integrated circuit. Before discarding the IC try it again but ensure that it is inserted correctly. If it still doesn’t work, replace it with another.

### Setting up

When a suitable display has been arrived at the following procedure should be carried out:

1. Set the switch for setting the ‘on’ time, ‘off’ time and ‘clock’ (S1) to its middle position.

2. Push the ‘hours’ set button (S3) and hold closed. The hours counter should advance and the colon should start flashing. Set the hours to read 23.

3. With switch S2 set the minutes to 50. (ie. time reads 23.50).

4. Put S1 to the ‘set time on’ position. The display should read 00:00. The ‘time on’ indicator (AM or LED) should also light.

5. Use S2 and S3 to set up 23.55.

6. Switch S1 to ‘time off’. The display should read 00:00 again and the ‘time off’ indicator should light (PM or LED).

7. Use S2 and S3 to set up 23.57.

8. Return S1 to ‘clock’. The display should have moved on to something like 23.53.

9. At 23.55 the relay should close. This can be checked by observation or with a meter on Ohms.

10. The relay should open at 23.57.

11. Put S5, the ‘repeat/once’ switch, to the ‘repeat’ position and advance the clock to 23.55. The relay sequence should repeat.

12. Put S5 to ‘once’ and again advance the clock to 23.55. The relay should repeat its sequence but the ‘set on’ and ‘set off’ indicators should go out.

13. Advance the clock to 23.55. This time the relay should close. Push the switch a second time and the relay should open again.

14. Set any time into the ‘on’ and ‘off’ memories and then push the cancel switch, S4. The ‘on’ and ‘off’ indicators should both go out.

Having completed the tests satisfactorily the remaining items can now be added including the link to connect the relay switch to the mains input and the connections to the output socket made before final casing up. If required a neon can be connected to the relay output and mounted on the front panel of the case to show that the output circuit is operational. The current which can be taken from the output socket depends on the type of relay used but in the prototype was about 2A maximum.

### Options

The basic operation of the clock is outlined in the setting up section but with the following notes:

1. If an ‘on’ time is set without an ‘off’ time the output will stay on for ten minutes then turn off.

2. S6 will change the state of the output each time it is pressed.

3. ‘Repeat’ will cause the output to switch every day, ‘once’ will reset the logic after the first operation.

4. Cancel will reset the switch logic to 00.00 when pressed.

Options which can be added easily are a tone alarm output at turn time and display dimming con-

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*Practical Wireless, July 1977*
**Light years ahead**

Initially supplies of Lightsticks will only be available from the sole UK distributor and usually in bulk only. However, by the late autumn of this year they should be in all the shops priced at £1.95 for a pack of three.

_Tye Security Ltd., Dolphin Road North, Sunbury-on-Thames, Middlesex._

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**Music maker**

Electronic pianos have come and gone with monotonous regularity since their birth some years ago. They have 'gone' primarily because they just don't have the sound, and more importantly, the 'feel' of a good quality conventional piano. For this reason the market has been eagerly awaiting the new chip which has been the centre of rumours for some time now, and proposes to put an end to the inherent faults found in earlier electronic pianos.

The manufacturer to be first with this new chip is General Instruments Microelectronics, Glenrothes, whose new device—the AY-1-1320 is claimed to 'simulate the sound and touch of hammer action instruments'.

Unlike electronic organs the electronic piano incorporates circuitry which senses the key velocity as the pianist strikes each note, adjusts the output volume accordingly and produces a note which decays in amplitude in a similar manner to a hammer action instrument. Adjustment can be made to simulate the Honky-tonk piano, Harpsicord and the Clavicord.

The AY-1-1320 incorporates 12 separate envelope generation circuits for octave tones and semitones. Thus a five octave instrument would require no more than five 40pin DIL devices of this kind.


_PRACTICAL WIRELESS, JULY 1977_
Get kitted out

Doram Electronics, the general public's branch of RS Components, have recently announced seven new constructional kits to complement their already growing selection in this particular field.

The kits include a quadraphonic resolver to give the effect of surround sound by connecting an existing stereo system to four speakers; a 25W per channel stereo amplifier, called "The Audiomaster", and a phase-locked-loop stereo decoder. The price for these kits, which incidentally are absolutely complete down to the last nut and bolt, are £9.95, £82.50 and £4.45 respectively plus VAT at 12½%.

Also in this new range are two test equipment kits comprising a 3½ digit multimeter (100µV to 1000V AC or DC, 100µA to 2A plus resistance) and a matching digital frequency counter which reads from 10Hz to 50MHz. Each kit is complete with case, PSU and full instructions. Both models are priced at £54.50 plus VAT at 8%.

The final two kits are of special interest to the DIY enthusiast, with an accurate ignition timing light utilising a Xenon flash and automatic polarity selection, and a transformer kit which has everything a constructor needs to wind his own 50VA transformer. Price for these two kits is £18.95 and £4.18 respectively. Both plus 8% VAT.

Doram Electronics Ltd., PO Box TR8, Wellington Road Industrial Estate, Wellington Bridge, Leeds LS12 2UF. Tel: 0532 452548.

Morning time

Come on, be honest, who doesn't have trouble in getting up in the mornings—specially winters mornings. The answer of course is a clock radio such as the new Philips AS460, with LED display, AM/FM radio and a list of added extras as long as your arm.

One of the novel extras included is an automatic function that allows the display to dim in a darkened room, another is a "Slumber facility", which allows the set to be operated for a period of up to 59 minutes before switching off automatically. With ordinary alarm clocks, once the alarm has been switched off, it stays off, but with the AS460 a touch sensor is used to switch the alarm off, but will automatically sound again in approximately nine minutes. This will happen up to five times, by which time Philips reckon that you'll get up just to get away from the alarm.

Aerials are built in for both AM and FM, there is a choice of either buzzer or radio to wake you up, and if there is a power failure the display flashes to indicate incorrect time.

Philips Electrical Ltd., Century House, Shaftsbury Ave., London, WC2H 8AS. Tel: 01-4377777.

Amateur chips

Two new low power IF/AF circuits designed for NBFM receiver applications, such as mobile and hand-held radios have now become available from Plessey Semiconductors.

Notated the SL 664 and SL 665, each circuit is a complete IF strip and consists of a pre-amplifier, limiting amplifier, quadrature detector, carrier squelch, DC volume control and audio output stage. The SL 664 incorporates a power output stage (250mW into 80hms), while the SL 665 has a low level audio output which drives high impedance loads (open collector output). The demodulator and audio amplifier are muted by the squelch output on the SL 664, whilst on the SL 665 the squelch output does not internally mute the demodulator, which means that it can be used for tone decoding.

Both devices are in ceramic DIL packages, but the SL 664 has 18 pins and the SL 665 has 16 pins.

Plessey Semiconductors, Cheney Manor, Swindon, Wiltshire, SN2 2QW. Tel: Swindon (0793) 36251.
Zip dip

A new range of integrated circuit sockets, for use in test equipment or development “breadboards”, has been introduced by BFI Electronics Ltd. Called the ZIP DIP range, the sockets accept multi-lead devices with no insertion pressure, thus eliminating lead damage and distortion which often occurs when leads are forced into sockets operating on the spring contact principle.

The ZIP (Zero Insertion Pressure) DIP socket has a tiny lever at one end which is connected to an internal cam. A multi-lead device is simply dropped into the socket and the lever flicked up to positively clamp the leads inside the socket. This protects the leads from damage and ensures a good electrical connection. When the lever is released the device may be removed without force.

BFI Electronics Ltd., Sinclair House, The Avenue, West Ealing, London W13. Tel: 01-998 2113

New chips for old

That old faithful, the 741 Op-Amp is shortly to become redundant. The successor to this device has recently been introduced by Mogul Electronics and is manufactured by Texas. Available in either single, dual, or quad BIFET modes, this new Op-Amp can be obtained in 8 pin TO99 as well as 14 pin DIL packages and is capable of operating over a temperature range of −55°C to +125°C.

A few of the parameters of this new Op-Amp family, designated the TL080-4 includes an input impedance of $10^{12}$ ohms, supply current of 2-8mA, slew rate of 12V/µs, low input bias and offset currents of down to 0-2nA and 0-1nA respectively and a frequency bandwidth of 3MHz.

Mogul Electronics Ltd., 273 High Street, Epping, Essex, CM16 4DA. Tel: 0378 773666.

10 watt amp.

Very often a small audio amplifier is all that is required to complete or repair a record player or radio etc. Not one that claims ultra HiFi specifications, but one that is adequate for good, clear audio reproduction and is compact in size. Module amplifiers usually satisfy this need, and the new one from Bi-Pak—the AL 30A is said to deliver 10W RMS into an 8 ohm load with a supply voltage of 28V.

The total circuit, which measures 90 x 64 x 27mm, is contained on a single board with the power transistors attached to a small heatsink. The manufacturers recommend that for speech and music applications a total heatsink area of 10 sq.in. be used, and for higher power applications 15 sq.in. These figures are for mono use and should be doubled if two modules are used for stereo reproduction.

Input sensitivity is 90mV for full output, while frequency response is claimed to be from 60Hz to 25kHz. The cost, when they become available will be £3-60 each, and they can be obtained from Bi-Pak Semiconductors, The Maltings, 63a High Street, Ware, Herts. Tel: Ware 3442.

Power module

Audio power Modules, made by SANKEN, are available in three models. Very few external components, a heatsink, and a power supply, are all that are required to complete a high quality (harmonic distortion 0-5% Max.) sound system.

Ideally suited to Hi-Fi systems, tape deck, FM tuners, record players, etc., each module has quasi-complementary class B output, and uses flip-chip transistors in a rugged, compact, lightweight package. The three modules comprise the SI-1010G (10W), SI-1020G (20W) and the SI-1050G (50W).

Further information from Rastra Electronics Ltd, 275-281 King Street, Hammersmith, London W6. Tel: 01-748 3143
ANY hi-fi tuners and receivers are fitted with an AM section and although this is not a source of true hi-fi signals it is a very practical facility. It removes the necessity for a separate set for listening to sports commentaries, Radio Luxembourg, and other programmes which are not available at VHF.

Unfortunately, a surprisingly large number of tuners and tuner/amplifiers do not provide coverage of the long wave band and cannot receive Radio 2 on 200kHz (1500 Metres). There are frequent occasions when such sets are unable to receive Radio 2 at all, because the Radio 1/2 VHF transmitter is devoted to Radio 1 transmissions. For instance, at the time of writing, this happens late most evenings.

The obvious solution to the problem is to construct a LW Radio 2 tuner unit to feed into an unused input of the amplifier. The author has built such a unit to feed the 'Aux' input of his Rotel RX254 tuner/amplifier and it is this simple tuner unit which forms the subject of this article. The unit can be used successfully with most amplifiers since it has an output amplitude which is adjustable from zero to about 2V peak to peak and the source impedance is fairly low at approximately 5kΩ. It is completely self-contained with an integral battery supply and ferrite rod aerial.

DESIGN

Presumably Radio 2 is the only LW station of interest, and the circuit can therefore use pre-set tuning. Since only one station at the relatively low frequency of 200kHz is required this is one application where a superhet circuit has no advantage over a TRF one. This may at first sight seem to be an obvious place to use a circuit based on the popular ZN414 IC but reference to the appropriate data sheet shows that this device is not at its best on these frequencies. This was borne out in practice when a simple test circuit was tried. For use at the author's location the circuit lacked both sensitivity and selectivity.

The controls on the Radio 2 Tuner are not very complicated! Just an on-off switch. The output level is adjusted by means of an internal potentiometer to suit the amplifier used with the Tuner.

The simple circuit shown in Fig. 1 was then tried and this has proved to be eminently suitable. L1 is the ferrite aerial tuned to 200kHz by means of trimmer TC1. Tr1 is used as a common source amplifier and the aerial circuit couples direct to Tr1

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**Fig. 1:** Complete circuit of the Radio 2 Tuner. Tuning is accomplished with the pre-set capacitor TC1 while VR1 is the output level control.

Practical Wireless, July 1977
gate. This is quite acceptable as the input impedance of Tr1 is extremely high and no coupling winding on the aerial coil is necessary. R2 is the source bias resistor and C2 its bypass capacitor. The amplified output of Tr1 is developed across drain load resistor R1.

Tr2 provides a second stage of RF amplification, and used as a high gain common emitter amplifier. T1 is a 465kHz last IF transformer and C4 is connected in parallel with its internal tuning capacitor (C5) in order to reduce its operating frequency to about 200kHz. D1 is an ordinary diode detector which is fed from the secondary of T1. C6 provides RF filtering and the audio output signal plus a DC bias are produced across R5, part of a potential divider with R6 and R4, and Tr2 receives its base bias current from the junction of R4 and R6 via R5. If Radio 2 is received very strongly a comparatively large negative bias will be produced across R5 and the voltage at the junction of R4 and R6 will therefore be reduced. This results in a reduction in the base bias current of Tr2, and in consequence its gain is reduced. This provides the tuner with a conventional automatic gain control (AGC) action, ensuring that neither the detector nor the audio stages are overloaded if the tuner is used in a strong signal area. C9 filters out the audio signal from the AGC circuitry.

Tr3 is a common emitter amplifier which is used to provide all the audio amplification. This stage has a response which hardly falls off at all at 200kHz and so it is absolutely essential that the RF signal is not allowed to enter the audio stage. Filter capacitor C8 is therefore used at the input to Tr3. Violent instability would almost certainly result if this component were to be omitted.
The audio output level can be adjusted by means of preset potentiometer VR1. C1 is the only supply decoupling component that is required. The PP3 battery has a very long life as the current consumption of the tuner is only about 2.5mA.

**CONSTRUCTION**

Virtually all the components, including the ferrite aerial, are mounted on a PCB which measures 130 x 70mm illustrated actual size in Fig. 2 together with details of the ferrite rod aerial and other constructional information. Note that the holes for the pins and tags of T1 are slightly larger than for the other components, about 1.8 to 2.0mm in diameter. TC1 requires a 5mm dia. mounting hole while those for the board itself are 3.2mm in diameter.

The ferrite rod aerial is home-made and based on a 127 x 9.5mm (5 x 3/4in.) ferrite rod. This size is readily available from Denco suppliers or direct from Denco. The winding starts 50mm from one end of the rod and consists of 225 turns of 32 SWG enamelled copper wire. Make quite sure that all the turns of the coil go in the same direction. In order to prevent the coil from unwinding, the two leadout wires are taped to the rod. The ferrite aerial is secured to the PCB by two loops of wire which are soldered in place. Try to make these loops fairly tight so that the aerial is provided with a firm mounting.

**THE VEROCASE**

A small Verocase is used as the housing for the prototype was designed to fit it. S1 is mounted in the centre of the front panel and must be a physically continued on page 218
THIS versatile and economical operational amplifier can replace the well-known 741 device in virtually all circuits, but its greatly superior specification also enables it to be used for many other purposes. The input impedance of the CA3140 device is extremely high, namely about 1·5 x 10¹³ (11² million megohms), so it will not impose any appreciable load on the circuit feeding it. The typical input current required by the CA3140 is only 10pA with ±15V supplies or 2pA with ±5V supplies.

The CA3140 is somewhat like the CA3130 (see *Practical Wireless*, April 1976), but has certain advantages which extend its range of uses. For example, the CA3140 can be operated from any power supply line voltages in the range ±2V to ±18V (or 4V to 36V if a single supply line is employed). In addition, the CA3140 device has an internal capacitor for frequency compensation fabricated on its silicon chip, so no additional external capacitor is needed for this purpose.

BiMOS

The so-called 'BiMOS' technique is used in the CA3140. This consists of a p-MOS input stage together with high voltage bipolar transistors integrated on the same chip. The p-MOS differential input stage provides a voltage gain of about 10 times (20dB), but the second stage provides most of the device gain (10,000 times or 80dB). The bipolar output stage has a gain of about unity, but like the 741 output stage it includes circuitry which provides built-in protection against damage from short circuiting of the output to either of the supply rails or to earth.

Although MOS transistors are used in the CA3140 input stage, these transistors are well protected with bipolar diodes. Whilst the normal precautions used in handling MOS transistors are probably unnecessary when using the CA3140, it is nevertheless good practice to ensure that soldering iron tips are well earthed, that CA3140 devices are not inserted into or removed from a circuit with the power supplies connected and that signals are not applied to the inputs when the power supply is off.

**TYPES**

The CA3140 is also available as the more expensive CA3140A and the considerably more expensive CA3140B; these latter 'premium' types have smaller input currents and lower input offset voltage tolerances than the standard CA3140, but the standard type is quite suitable for almost all applications. All three types are available as the CA3140T with straight leads and as the CA3140S with the leads pre-formed into the dual-in-line configuration.

**CONNECTIONS**

The CA3140 connections are shown in Fig. 1. It can be seen that offset nulling facilities are provided as well as on/off strobing facilities. If these facilities are not required, no connection need be made to the pins concerned. The normal non-inverting input (marked +) and inverting input (marked −) are provided in this device.

**APPLICATIONS**

The CA3140 can be used in most circuits for which a normal operational amplifier is required. It can also replace the CA3130 in the impedance transformer circuits discussed in our April 1976 issue, but the greater permissible power supply voltages enable much greater output voltage swings to be obtained. The applications to be discussed below are ones for which the characteristics of the CA3140 are particularly suitable.
BAXANDALL TONE CONTROL

The very high input impedance, relatively wide bandwidth, fairly high slew rate and high output voltage capability are all properties which are very useful in amplifiers used in tone control circuits. A Baxandall type tone control circuit is shown in Fig. 2(a). It provides a gain of about unity and employs standard linear potentiometers to provide bass and treble boost or cut of ±15dB at 100Hz and 10kHz respectively. The gain of the amplifier falls by 3dB at 70kHz relative to the gain at 1kHz in the 'flat' position of the tone controls.

A Baxandall type tone control circuit is shown in Fig. 2(a). It provides a gain of about unity and employs standard linear potentiometers to provide bass and treble boost or cut of ±15dB at 100Hz and 10kHz respectively. The gain of the amplifier falls by 3dB at 70kHz relative to the gain at 1kHz in the 'flat' position of the tone controls.

The high input impedance of the CA3140 device enables economical low value capacitors to be used in the tone control network. A supply voltage of 32V is shown, but smaller voltages can be used if the maximum output voltage swing required is not great. If a 32V supply is employed, the full output voltage swings of 25V peak-to-peak are obtainable at frequencies up to more than 20kHz, since the device has a slew rate of about 9V/µs (some 15 to 20 times greater than that of a 741 device).

BALANCED SUPPLIES

The same tone control network can be employed in the circuit of Fig. 2(b) when balanced ±15V supply lines are preferred. The performance is identical with that of Fig. 2(a) except that the output quiescent potential will be almost earth potential whereas the output potential of the Fig. 2(a) circuit will be approximately half the supply line potential.

The biasing components connected to the non-inverting input of Fig. 2(a) are not required when the balanced supplies of Fig. 2(b) are used. However, an additional capacitor is required to decouple the negative supply line. The typical power supply current of either circuit is only 4mA. In both circuits pins 1, 5 and 8 are left unconnected.

Practical Wireless, July 1977
ADDED GAIN

Another tone control circuit is shown in Fig. 3(a); this has a similar performance to that of the Fig. 2 circuits except that it provides a voltage gain of about 10 times (20dB) at mid-frequencies. The bass and treble boost or cut available to about ±15dB at 100Hz and 10kHz respectively. Outputs of up to 25V peak-to-peak can be obtained with the supply voltage shown or smaller outputs at lower supply voltages. The gain falls by about 5dB at 24kHz relative to that at 1kHz with the controls in the 'flat' position.

The same tone control network may be used in the circuit of Fig. 3(b) in which balanced ±15V supplies are used. The performance of the circuits of Figs. 3(a) and (b) is identical but it should not be forgotten that the output from the Fig. 3(a) circuit will be at an average of half the supply voltage, so a coupling capacitor is essential in the output circuit.

CURRENT AMPLIFIER

The circuit of Fig. 4 shows how the CA3140 device can be used as a current amplifier to amplify a very small current passing through the load so that it can easily be measured by the meter. The potential from the point A is connected to the inverting input of the CA3140 and the potential at this point will therefore always be very close to the potential of the non-inverting input.

The voltage V drives a current I through the meter; virtually all this current flows through R1, since the current taken by the CA3140 input is extremely minute. Thus a voltage IR1 appears across R1 and this same voltage appears across R2 (since the potentials at point A and at pin 3 are the same). The current passing through R2 and the load is therefore IR1/R2. If the values of R1 and R2 are as shown the current I is divided by 1000. This current may be 100nA or even less and when amplified by about 1000 times, this current is easily measured by the meter. The potentiometer enables the offset voltage at the output to be nulled accurately and a similar offset nulling circuit can be used in other applications if desired.

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RADIO 2 TUNER—continued from page 215

* components list

<table>
<thead>
<tr>
<th>Resistors</th>
<th>Capacitors</th>
<th>Semiconductors</th>
<th>Miscellaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1 1.8kΩ</td>
<td>C1 1000µF 10V</td>
<td>Tr1 BP244B</td>
<td>T1, IFT (Denco IFT465/14), Verobox or similar (6 x 3 x 1 3/16in). Ferrite rod 5in x 1in dia. 32 SWG enameled copper wire. PP3 battery and clip. On-off switch, miniature. 3.5mm jack socket. Knob etc.</td>
</tr>
<tr>
<td>R2 33kΩ</td>
<td>C2 1000µF ceramic</td>
<td>Tr2 BC109</td>
<td>small component if it is to fit into the available space. SK1 is a 3.5mm jack socket mounted in the centre of the rear panel. All the wiring is completed before the front and rear panels are slotted into the lower case moulding and the PCB is screwed down. The latter is mounted on the two mounting pillars at the front of the case using two of the self-tapping screws provided. The battery fits into the space at the right of the on/off switch, but the lid of the case will not fit into place unless the front, right hand side mounting pillar is removed from the lid. It is easily drilled away using a 10mm diameter drill.</td>
</tr>
<tr>
<td>R3 820kΩ</td>
<td>C3 220µF ceramic</td>
<td>D1 OA90</td>
<td></td>
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<tr>
<td>R4 5kΩ</td>
<td>C4 1.5nF polystyrene</td>
<td>BC109</td>
<td></td>
</tr>
<tr>
<td>VR1 5kΩ horizontal pre-set</td>
<td>C5 Part of T1</td>
<td>Tr3 220kΩ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CT1 500pF compression trimmer</td>
<td>10nF 10V</td>
<td></td>
</tr>
</tbody>
</table>

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ADJUSTMENT

With the output of the tuner connected to the amplifier by means of a screened cable, it should be possible to tune to a few stations by adjusting the core of T1. Incidentally, a proper trimming tool such as the Denco TT5 should be used to adjust this core. A wedge shaped tool such as the blade of a miniature screwdriver could easily damage the core. Initially TC1 is adjusted for almost minimum capacitance (the plates not very compressed), and then it is adjusted to peak received signals. It should not be difficult to locate Radio 2 as it lies at about the centre of the tuning range and is stronger than the other signals. Once it has been located, tune to it as accurately as possible by adjusting the core of T1, and then set TC1 to the position which provides the best signal.

VR1 is adjusted towards maximum output (fully clockwise) at the outset. Then it is simply given a setting which provides an output level that is commensurate with those provided by the other items of ancillary equipment. Remember that the ferrite rod aerial is quite directional so turn the tuner round in the horizontal plane until the signal from Radio 2 is at a minimum and then turn at 90° to this position for maximum signal.

The case must be of plastic or wood since a metal case would act as a screen round the ferrite rod aerial.
WITH no Olympia hi-fi exhibition this year, the smaller regional shows are now more important to both the trade and the public. High Fidelity 77 was held within a stone's throw of runway 01, Heathrow Airport, on the first floor of the Heathrow Hotel from April 19 to 24. The last three days were open to the public of whom over 18,000 attended. It was quite obvious that the show wasn't really geared to handle this number of people—many had to wait in the foyer in excess of an hour for a lift to the first floor exhibition area—because of strict observance of the fire regulations. As a result of this it is probable that next year's show will be trade only.

Tape

When people eventually got in, many must have been fairly disappointed with what they didn't see—the number of interesting new products could have been counted on one finger... perhaps a little unfair but it seemed that way. For instance, due to production problems with chrome-based cassette tape, there has been a veritable rash of new cassette tapes using 'superferrite', 'microferrite', 'gamma ferrite', etc. All these are simply brand names for highly refined ferroso-ferric oxide, Fe3O4, with or without a dose of cobalt. Inevitably, all the tapes using this compound are described as being 'low noise, high output'. Similarly the publicised performance figures are measured against a nebulous norm which is different for every manufacturer.

Several new cassette decks were shown but offered no real departure from current design. With so many cassette machines offering such equitable performance the sensible thing is to choose a model by its price and other criteria such as 'does the fascia match the G-Plan?'

Elcaset

Of greater interest were two Sony tape machines using the Elcaset format. Elcaset operates in the same manner as standard cassettes but use a tape width of 6.25mm instead of 3.81mm; the tape speed is 9.5cm/s as against 4.75cm/s. Physically, Elcaset look like overgrown compact cassettes but offer rather better performance as a result of their increased size and tape speed. Substantiated claims indicate a -20 VU frequency response of 20Hz to 20kHz ± 1dB; the 0 VU response is only 2dB down at 15kHz, an open reel standard of performance.

Similarily, wow and flutter performance is improved corresponding to the closer tolerances employed within the internals of the Elcaset transport. For instance, levels below 0.1% are quite commonplace. However, nothing is free. An LC-60 (60 minutes total playing time) cassette is expected to cost about £5 or even more; there are other indications that machines to play them won't be cheap either. Sony and Teac (who are shortly to introduce an Elcaset deck) won't state a final selling price or even when the decks would be available.

Open reel

One worthwhile advance was shown in respect of open reel recorders. The Uher 630SG Logic operates without the use of a capstan/pinch wheel tape drive.

Practical Wireless, July 1977
The longer exhibit speech which are not of the latter speech from video tape recording technique, claims to significantly reduce scrape flutter while improving both short- and long-term speed stability. In both the spool and play modes, the capstan provides the prime motive force, the reel motors simply creating a 'neutral' tape tension.

**Linear phase loudspeaker**

Loudspeaker demos at hi-fi shows are nearly always low in objectivity and high in subjectivity for such is the nature of loudspeakers. Since the listening conditions vary from demo room to demo room (in details such as placement of speakers, size of room, choice of music, etc.) it is impossible to offer any verdict on individual units. Generalising, there was one trend in evidence: linear phase.

Current thinking suggests that phase relationships are all-important in sound image perception; in recent years, speaker manufacturers have tended to market multiple array units with separate drive units for various sections of the frequency range. Inductive/capacitor crossover networks provide the signal split for the individual drivers. The origin of linear phase is this: The initial point of origin of a radiating wave front from a driver unit is the diaphragm (cone) immediately adjacent to the speech coil. In conventional speaker systems, the speech coils of the various drive units (ie, HF, MF and LF) are not in the same vertical plane due to the varying physical dimensions. Step function transients which contains a mixture of all frequencies due to the Fourier transform, will affect all drive units. If the latter are not in vertical alignment in respect of speech coils, then the produced transient will no longer exhibit the same acoustic wavefront of the original. In a nutshell, linear phase means mounting the speech coils in a vertical line.

Technics introduced the first production speaker, the SB700, about two years ago. Since then several more have come on to the market. At this year's show, there were two notable additions. Rank Radio International exhibited the Leak 3030 which was about the smallest linear phase model at the show. It sounded rather bright but never-the-less produced a strong stereo image with a tight bottom end. At a discount price of about £120 a pair, it seems very good value for money. At the other end of the scale KEF were being very cagey about their wedge-shaped linear phase 105. The public weren't allowed to see this one for reasons best known only to KEF. If it sounds anything like the non-linear phase 104 which preceded it, then it will be very good indeed—and cost accordingly.

**Equalisers**

Manufacturers have been working hard in the room equalisation market: several graphic equalisers were on show including one from JVC which was part of a larger pre-amplifier unit. From experience, once one big Jap company goes in for a product, then all the others will follow fairly soon.

The origins of graphic equalisers are in recording studios. It is essential that producers and engineers should be able to listen to master tapes in an acoustic environment uncoloured by individual room responses. To this end, the output from the studio tape recorders is passed through a bank of filters with overlapping frequency responses enabling small sections of the frequency spectrum to be either boosted or cut. This processed signal is amplified through the studio speakers. If enough frequency bands are provided then the listening characteristics of the room can be cancelled out resulting in a 'flat' room without any colouration. Thus the graphic equaliser is adjusted to produce the inverse characteristic of speaker plus room.

A blast from the past it is not. This is the latest product from Onlife, Japan, opening up new frontiers of technology. Whether the concept of a 'valve sound' was born of the same wave of nostalgia that resurrected Glen Miller remains to be seen.
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LCSV EM 49.30

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TTY INTERFACE. Convert your parallel I/O device to TTY compatible and adds parallel in your INTRUKIT or LCDs (or 8000, 8080, 280, etc.). Parallel is TTL or 5V CMOS compatible.

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Electronic Mail Order, July 1977

221

www.americanradiohistory.com
The Royal Naval Amateur Radio Society runs the popular Morse transmissions (QRQ runs) on the 1st Tuesday of each month on about 3520 kHz, depending upon QRM, at 2000 local time (UK) from the RNARS HQ station G3BZU. Speeds are transmitted from 15 WPM to 40 WPM in increments of 5 WPM. All speeds are of a 3 minute duration and must be copied 100 per cent correct. Certificates are awarded for the 15 WPM and 20 WPM copied correctly, with endorsement stickers at all other speeds. It is necessary to obtain the basic certificate before endorsement stickers can be obtained. A charge of 30p is made for each certificate. A stamped addressed envelope is required for endorsement stickers, if not claimed with the basic certificate. The equivalent in IRC's is acceptable from outside the UK.

The initial scheme was started in December 1962 by Dave Pilley G3HLW (now VK2AYD). The 15 WPM run was only introduced to the runs in January 1975 and has since proved very popular amongst the slower Morse readers. At present the manager is Michael Puttick G3LIK, who makes up the texts, operates the transmission, marks the submitted copies and issues certificates and/or stickers to successful applicants. Since the transmission began there has been a total of 859 certificates issued to amateurs from the United Kingdom and all over Europe, where the battle to read through the heavy interference is on the increase. It is not just the amateurs that use the transmissions, as large organisations use them to train their recruits to a high degree of Morse capability.

The equipment used for these runs at G3BZU is the KW Viceroy transmitter and Eddystone EA13 receiver with a dipole aerial. With G3BZU sitting on top of the second highest point in Hampshire, it is not surprising that the site is such a good take-off point. Further details of the service can be obtained from Michael Puttick G3LIK, 21 Sandyfield Crescent, Cowplain, Portsmouth, Hants, PO8 8SQ.

Kindly note!

Tug 'O' War Game April 77

On PCB A030, pin 13 on IC8 should be linked across to the +9 V rail. Amend Fig. 5 similarly. If the 'knot' fails to move check that pin 9 on IC6 is joined to pin 10 and that pin 11 is joined to pin 12, as shown on the PCB foil diagram.

Tech. info. wanted

.. Manual or circuit diagram with component values for Heathkit TV Alignment Generator type HFW-1.—Mike Roberts, 7 Whielden Lane, Winchmore Hill, Amersham, Bucks, HP7 0NF.
.. Any information on a Jason JTV2 VHF tuner (originally a kit).—G. Cobb, 89 Eastwick Park Ave., Great Bookham, Surrey.
.. Circuits or general information wanted on a Minimitter 10-80m amateur band converter.—T. Smithers, 15 Ferenberge Close, Farnborough, Bath.
.. Full manual or circuit details for Swancoicse receiver type 2 AR. Apply R. J. Smith, 42 Woodchurch Close, Sidcup, Kent. Tel: 01-332-0351.
.. Valves VY2 and VC11 required for a 1938 German Peoples receiver. Also any surplus pre 1930 literature on radio and electrical communication. Apply C. Matthews, Museum of Communication, University of Edinburgh, Kings Buildings, Mayfield Road, Edinburgh.
.. Circuit diagram or details of GEC Communications Receiver type BRT 400D.—C. J. Gill, 95, Fosterd Road, Newbold-on-Avon, Rugby, Warwickshire.
.. Circuit diagram or any information on C. F. Lord FM-3 Frequency meter and Elipco AC88 amplifier.—W. Roebuck 16 Elizabeth St. Newsome, Huddersfield, West Yorkshire.
.. Any information on AM/FM 'Juliette' 7-band receiver—J. Pretorius, Jooste Street, 359 PO Kloofskil, Pretoria, South Africa.
.. Information on Mullard RF signal generator that used the following valves—DW2, 164V, 2286. Also copy of PW March 1976 and information on communication receiver type R115A.—W. Dibden, 13 Grizedale Road, Woodley, Cheshire.

Back issues and equipment for disposal

.. Copies of PW dating back to October 1946 for sale. G. LeFlem, 11 Millmount Lane, Lilebourne, Nr Rugby, Warwickshire, CV23 OSS.
.. Free gift of back copies of PW to any Radio Club/Boys Club/School.—W. Ferguson, G3KMH, 9 Woodbine Terrace, Hexham, Northumberland.

Back issues and equipment wanted

.. June 1971 issue of PW.—Sidney Coles, 2 Cross Farm, Alcombe Road, Alcombe, Minehead, Somerset.
.. Morse keys for collector and overseas collector friends—G3IRM, 14 Linton Gardens, Bury St Edmunds, Suffolk, IP33 2DZ.
.. October and November 1975 copies of PW wanted.—J. R. Juniper, 28 Rabett St, French's Forest, NSW 2086, Australia.

Practical Wireless, July 1977
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Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived—offers bargains which you may not hear about before our advertisement appears—It's an interesting list and check it out. Here are a few of the Bargains still available from last month.

SHORTWAVE CRYSTAL SET

Are you able to offer the electrical equipment of this month's Bargains List? We pay a very special price of £10-£20, carriage paid. We are seeking male and female models to test out electrical equipment and offer advice on it's use. Each £25.00 overtime.

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G3CED 63VFA
Box 5, Partridge House, Prospect Road, Broadstairs, CT10-ILD. (Callers by appointment).
by Eric Dowdeswell G4AR

IT IS very nice to get a letter from Neil Whiteside G8MXF, formerly A8899, of Hitchin and to know that he has not forgotten the column! Wisely he is working on the code and ought to have his G4+5 in the near future. At present he is active on 2m with a Pye F27 and a Hudson FM208. Among his 700 QSO's so far has been another of our earlier contributors Paul Turner, now G8MWV. I hope all this will act as a spur to those of you who are thinking of taking the RAE!

Alan Doherty BRS34968 of Portrush, Co. Antrim has got back into the listening groove again after his return from New Zealand, and an Eddystone 940, newly acquired, plus a 300ft wire has put things like C21NW on Nauru Is. and HM11V in Seoul into his log. In Harrogate Steve Cotton A8961 has been admiring some recently received QSLs from V5SA, 6W8FZ, WB6EWH/VQ9 and 9X5SM. He comments on the 15m band which has been producing DX from all continents.

Other readers of this column could well emulate Paul Cowburn in Leyland, Lancs and spend time copying the RSGB slow morse transmissions. Paul is now up to around 10wpm and mentions that past contributor to this feature Tim Charles G4EZA sends the slow stuff out on 2m W4BRB/C6A in the Bahamas plus PJ8CO and FG7AR/FS7 might not seem very extraordinary unless I told you that Paul has been copying them on Top Band! Paul has joined the RSGB and started on a one-man course for the RAE. Stick to it, Paul, others have made it on their own, so why not you?

Yet another Paul reports in. Paul Bradbeer in Brauntown, Devon is also a recruit to the RSGB and to the North Devon Radio Club. His CR70A plus RF amplifier and 33ft wire have been mainly employed on 15m with forays to 20m. If you manage to copy a lot of those Jubilee GE callsigns you might be able to qualify for the Bromsgrove and District ARS Silver Jubilee award. Copy GE3VGG the club station plus another in Bromsgrove plus 23 others and send the log to J. K. Harvey G6KLO, 22 Elm Grove, Bromsgrove, B61 0EH by 31 Dec. Send an SAE to KLO if you have any queries or need fuller details.

In Cambridge David Peck BRS37621 complains of the QRM by CW stations on the RTTY channel 14065kHz, David’s favourite spot. It is a pity but I doubt whether many op’s realise it significance and probably curse that ‘QRM’ on the choice bit of DX that they’re after! David’s FBG7 plus homemade terminal unit, Creed 7B printer and 130ft of wire seem to get him RTTY copy from most parts of the world.

If you happen to be five miles SE of Derby on Sunday 12 June you will be in the middle of the Elvaston Castle Mobile Radio Rally run by G5EEO, G5BZI, G8KGC and others for the Nunfield House Community Assoc. Trade stands, sideshows and all the fun of the fair. Don’t miss it!

The bug has bitten again for John McFadden in Belfast who had a Trio 9R59 a couple of years ago but sold it now. With a 100ft of wire indoors he is active on the amateur bands again, this time with an FRG7. Nothing special to report so far but John is persisting. Brian Harrison of Hastings used his AR88 and ATU with a vertical to get such stations as FH8CJ in the Comoro Is., on 20m. Plans for a 300ft wire came to grief with planning permission problems. Following the note in this column Michael Waller in Leeds heard from several clubs and then discovered that G3WWF lived only a few streets away! So he is not alone any more.

Long-time correspondent Robin Bayley A9203 writes that he copies slow code from G4EYY and with his RAE course starting in September he ought to be well on his way to the RAE. He monitors all bands from 10 to 80m with his EC10 and R1475 plus a Microwaves Module converter for 2m. A warm welcome to I. Radford in Derby, who, in a very brief letter indeed, says he is using an Eddystone EC10 plus a whip aerial. We’d like some more info OM. Alan Doherty, already mentioned, would like to hear from other SWLs, DX or local. He’d really like to form a local club but the only known amateur in his area is G3ONZ who is inactive at present. Write to Alan at 21 Romore Street, Portrush.

My thanks to Edgar Janes G2FWA for a copy of the Cheltenham RSGB Group newsletter, a nice blend of local news and technical tit-bits. If you happen to live in that very pleasant part of the country why not drop a line to Hon. Sec. Derek Lively G3KII, 26 Priors Road, Cheltenham or drop in at the Old Bakery, Chester Walk, on the first Thursday of any month at around 8pm.

The Worldwide SSTV Contest brought much joy to Paul Barker up in Sunderland with HC1BU and JA1PSS providing the best DX pictures. At the White Rose Rally he managed to swop his FRDX500 for a Trio JR590 which proved itself by copying all continents on 15m during one afternoon. Although he has been reading the column for some time, Philip Ackroyd in Peterborough at last sent in a letter and log. Glad to have you with us Peter, and I’m sure you will enjoy your membership of the Greater Peterborough ARC. Rig is an FR50B plus 60ft wire. By the time you read this I hope to be on the air with my Pye 125 transceiver, on 80m to start with, SSB and CW reports will be welcomed.

Log Extracts

P. Bradbeer:— 20m C6AEY (Bahamas - QSL WB8HAK) HR3JJR YV0DL 15m EA8NO FG7AS P21DR S2/4R 6W8AK (QSI, F6AXP) 7P8BC.

P. Ackroyd:— 20m FL8CP KV4MV 15m KZ5UH.

A. Doherty:— 80m HS1BG HV3S1 KAIY0 (Ogasawara Is) KA6Y1 KH6I1 PZ9AB ZP5AO 20m C21NW HM11V 5T5DY 9D5D 15m FG7AR/FS7 FR7ZL/T.

P. Barker:— 20m SSTV CN8BF FG6EJ FC1BU JA1PSS KOZOL LZ1MH OH5BM FY2WE W8DX 9K2DO 15m K9TQ/C6P OA8CD ZD7SD ZP5WU 7P8BC 9J2CW 9Y4NP.

I. Radford:— 80m KH6I1 TY2HKY ZL3NE.
MEDIUM WAVE DX
by Charles Molloy

LATIN American DX appears again, this month with a really fine log from Aurich-Sandhorst in West Germany. Joachim Gutschke, who is an old-established SW enthusiast came in contact with Practical Wireless and this column while on holiday in the UK and he has now been converted to the medium waves. Highlights of his log are Radio Liberacion in Havana Cuba on 640kHz, La Voz de Cuba in Camaguey on 740, Radio Demerara Guyana 760, 4VEH Cap Haitien, Haiti 840, Onda de Pacifico Ecuador 975, Radio Commercial Santo Domingo on 1010, Radio Conquistador Puerto Rico on 1480. All were heard on a homebrew receiver and two fixed remotely tuned loops located in the loft.

A heterodyne is produced on a signal when two carrier frequencies separated by a few hundred Hz or more, enter a receiver and reach the detector stage. This heterodyne, which is equal to the frequency difference between the two signals, is rectified and heard as an audio tone similar to a tuning note. It can be distracting to the DXer and in some cases it makes reception rather difficult. The writer had experience of this effect recently when listening to the new Nigerian outlet on 945kHz which is separated by only 1kHz from the European channel on 944kHz. At the time 944 was occupied by a Russian station which was somewhat stronger than the African. The result was a strong audio note of 1kHz which made DXing almost impossible. One method of reducing this trouble is to increase the receiver selectivity until speech becomes muffled. Then detune, away from the interference, when the interfering signal and the heterodyne will both be reduced in strength and the desired station will be heard on one sideband only.

A more effective method of dealing with heterodyne is to use an audio notch filter. The writer recently purchased a tunable audio notch filter from Cambridge Kits, who advertise in Practical Wireless. This device is connected to the receiver headphone sockets in place of the headphones, the latter being plugged in to the notch filter. The source of power is a PP3 battery and there are two controls, an on/off switch and a tuning control. The result on 945kHz was startling. When the notch filter tuning control was rotated a position was found where the heterodyne disappeared completely, leaving a nice clean signal which was now relatively easy to identify. For the technically minded the notch filter is a band stop filter with a narrow rejection band. It is tunable over the range 350Hz to 6kHz and the sharp "null" ensures that it has little effect on speech.

An interesting situation arises when two stations nominally on the same channel are in fact separated by one or two Hz. When this occurs and the two stations are of comparable strength then the 'heterodyne' becomes a beat of considerable magnitude which can be observed on the 'S' meter. Unfortunately, the receiver's AGC will respond to the beat, adjusting the receiver gain in sympathy with it and producing audio distortion which is most unpleasant to listen to. The remedy of course is to switch off the AGC.

A weak inaudible station will produce a visible beat on top of a much stronger station if there is a slight frequency difference between them, as is often the case. The effect can be very useful to the DXer. He may, as your scribe did some years ago, stay on the channel in the hope that the strong station will fade and the weak one will come up. KOMO Seattle on 1000kHz was heard this way after observing a beat on WCFL. The DXer, if he has a loop, may even take a bearing of the inaudible station by rotating the loop until the beat disappears. This too may be an indication as to whether the inaudible companion is worth watching for.

A long and interesting letter from L. W. Spedna of Basingstoke mentions that he started DXing on the medium waves in 1925 with a one-valve receiver. By 1930 he was operating a four-valve Osramp Music Master in Buckingham with a good, high wire aerial and a well watered lawn. Best DX recorded was Pittsburg (KDKA) and Boston (WBZ). On trying this receiver again in 1975 he logged 50 continental stations plus Algiers and Oran. Dr. H. S. Brodribb from St Leonards-on-Sea writes "I am challenged to do all my DXing on vintage radio and I get good results on a 1935 Philips 745 and roof aerial". The good doctor does have a CR100 and a long wire though and with this set-up he pulled-in the 50kW WINS in New York City on 1010kHz.

The committed medium wave DXer will, when on holiday, take a receiver with him just to check out the band from a new location. In Spain, where there are several chains of low power local stations it can be an interesting exercise to try to identify some of the many locals that can be heard. A Philips jack-in-car radio/portable and a copy of the World Radio Handbook invariably accompany yours truly when on holiday either at home or abroad. DXing Spanish locals from the UK can be an absorbing occupation during the summer months. Listen around midnight, which is sign-off time for many stations, which can be heard leaving the air one after another on some occasions. Channels to watch for local radio outlets are 1106, 1133, 1394, 1412, 1475, 1520 and 1570kHz. Stations logged recently are EFJ19 Radio.
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SHORT WAVE BROADCASTS
by Derek Bell

LONG-TIME friends of this column will remember our recent quest for information on the oldest working short wave set. A recent letter from Joe Owens of Dolgelau in North Wales set me to wondering if it is possible to find the oldest reader of PW; Joe's memories go back to 1929 which is not bad since the first PW saw the light of day on 1932. However, let us hear from someone who can remember PW's first issue which was published weekly and cost 3d!

Peter Grant from Sheffield has rescued a Convair 10 set from a dustbin. After a repair to the case and several new items of electronic 'innards' Peter had the set back working. Came the day when, due to an injury at work, he had time on his hands and limited mobility. This time was filled with twiddling the knobs of the set rather than his thumbs and Peter found that the DX bug had really bitten. The net result is the following:—15440 WYFR Mass, at 2050, 6480 VOA to Africa at 1930 and 1700 Radio Kiev at 1945.

Peter is a little confused since the set is calibrated in metres and he wants to know how to convert this to frequency. Well, the simple answer is to use the formula:—Frequency (kHz) = 300000/wavelength in metres. For, say, 19-34m this produces a sum of 300000/19-34 this when resolved gives 15512kHz or 15-512MHz.

More information has come in regarding the HAC problems of reader Tony Cook. C. M. Lindars of Wallington has some information that may be of help to other sufferers. It seems possible that Tony has connected the top of the top of the tuning coil to the moving vanes of the tuning capacitor instead of to the fixed vanes. I must admit that I have never had the chance to evaluate the HAC or indeed have I read any test reports so I am in no position to help Mark Cox of Stanford le Hope Essex whose letter is rather vague. He has logged as follows:—1178 Radio Sweden at 2300, 9605 Radio Prague at 2015 and 7260 Radio Berlin International at 1945, also on an aforementioned HAC hung on the end of a 35ft wire aerial but the problem is that Mark asks "what do I do when the set stops oscillating?" This statement is so vague that I must ask Mark to supply more details.

Ken Willis of Scarborough has supplied a few items of transmitter news. The first is that FEBC are announcing their address as PO Box 2041, Mahe, Seychelles and not 2141 as printed in WRTH. The second also concerns a WRTH misprint, the Radio Israel DX Show is on Sundays and not Saturdays as printed. Ken seems to have been sucking in quite a few good catches in these days of low sunspot counts namely:—8585 HCJB Quito at 0715, 13120 V. of Nigeria at 0730, 15220 Radio Japan at 0800 and 11740 Radio Australia at 0800.

At the time of writing it is reported that the BBC is to seek a channel for a "Europeservice", to be grafted on to the BBC World Service to cater for the European community. I have not heard any frequencies mentioned but I suspect that it will be in the medium wave band in 'Charles McMillan country'.

A letter that dropped on the mat recently asked me to mention a new DX club that is just getting off the ground so I will therefore crave your attention for the Halstead Youth DX Club. The title does belie its name however, for its spokesman, Matthew Phillips, assures me that they welcome members of all ages. So contact him at 4 Nether Court, Halstead, Essex. Our QSL news is by way of Roy Patrick of Derby who tells me that HCJB has issued a new series of twelve cards one of which is a diorama while others feature shots of the transmitter equipment.

A happy return to DXing was experienced by John McFadden of Belfast recently. He had to give up DXing for some two years but the 'disease' was only dormant and recently he had the symptoms return! The itching forefinger, the twitching ear and the urge to stay awake all night. He used the event as an excuse to purchase a receiver different from his previous one and he ended up with a Yaesu FRG7. For an aerial he wound 100 feet of wire three times round the room; difficult to open the door, if I may say so! The return also brought about a rethink of John's interest and resulted in him taking an interest in the Latin American bands. As a result of this he is surprised that a 1kW station can be heard in Britain. "Is it possible, he asks, for a less powerful station to be heard in the United Kingdom?" I would think not but having said that there will be readers who can prove me wrong since this old hobby of ours is a funny thing. Very often, given the right combination of refraction from the ionosphere or perhaps the right darkness path, a very weak station can propagate with very little attenuation over fantastic distances. To prove this and to put myself well in with the many LA fans I append a handful of John's loggings:—

4800 R. Lara, Venezuela at 2345
4823 R. Reloj, Costa Rica at 0615
4920 R. Progreso, Honduras at 0410
4965 R. Santa Fe, Colombia at 0440

John comments that he pulled in eleven LA stations in one night and I can understand the fever that gripped him, but I will comment that he was lucky in getting so many IDs. In my experience LAs tend to let the IDs fall by the wayside.

A four-page broadsheet from Radio Finland frankly admits they can only afford one foreign language service. They announce however, that the external service will be relayed in future from the Turku and Helsinki medium wave transmitters as well as from the main Pori station. That about wraps it up for this month so I wish you and yours 75s.

Please note that my correct address is Derek Bell, 169 Max Road, Chaddesden, Derby.

Practical Wireless, July 1977

229
by Ron Ham

On arrival home at 0045 on April 7th my phone was ringing and Alan Baker G8LGQ Newhaven, was shouting "aurora" in my ear and by then he had already heard a strong signal from Graham Knight GM8FFX in Aberdeen on 2m SSB, plus some tone-A CW. A quick call to Charlie Newton G2FKR London, (RSGB auroral co-ordinator) who said that the event began around 2200 on the 6th and activity was "very patchy". By 0115 I was back on the line to G8LGQ in time for us to compare notes, and later, for both of us to record a very clear auroral signal from GM8FFX while he worked LABWT, SM4DLT and G8JXN. It appears that 2m was not the only band affected as Mark Turnbull, G4ESA, Southsea, heard auroral CW on 20m during the evening of the 6th and Andy Mepham G4CBZ heard the same on 80m. This aurora may well have been caused by a spray of gas and a filament seen by Cmdr. Henry Hatfield, Sevenoaks, through his spectrohelioscope around noon on the 3rd. Unfortunately, further visual observation of the sun before the aurora was prevented by overcast skies. However, indication of more solar activity came from the BBC World Service when they reported an ionospheric disturbance at midnight on the 4th. During the afternoon of the 6th, Roy Bannister G8LXR Lancing, accompanied by G8LGQ heard solar noise on 2m. Throughout the event, which for us in Sussex ended around 0200, both G8LGQ and myself found that the beam heading (due north) was critical for the auroral signals.

John Smith, Cranleigh, recorded several bursts of solar noise with his 142MHz radio-telescope between the 8th and 13th and the largest of these, during the morning of the 12th, lasted for almost an hour, which ties up nicely with a report from Cliff Ranft, Guildford, who was making a routine cosmic noise observation at the time with his home-brew equipment at 30MHz. Cliff recorded a sharp decline in this noise (SCNA Sudden Cosmic Noise Absorption) due to sudden absorption of signals in the D layer. This may well be the first SCNA recorded by an amateur astronomer. Mark Bennett G4DIX Sevenoaks is studying propagation at 21 and 28MHz and reports that during the mid-evening on the 8th it was unusual to hear strong signals from north-American stations coming through on 21MHz.

Both Henry Hatfield and John Smith reported seeing a medium size sunspot group appear on the east limb on the 11th and by the 15th Henry had counted 7 spots. On the 16th I recorded solar noise at 136MHz and on the 17th I heard on the "grape vine" that 80m was upset. This was confirmed by Nigel Golds BR56910 West Chiltington, Sx, who said that signals were very funny and that the band was noisy. Nigel had a job to hear stations which are normally very strong with him.

We are always pleased to hear from readers about their special interests. For the past six months John Smith has been using his 182MHz radio telescope, comprising a 30ft dish aerial, built by Ken Tapping and himself, and a home-brew mosfet front end, Dicke switched and all temperature stabilised for making a radio survey of the Milky-Way. To date John is very satisfied with the results.

The Blackwater Valley Group G8ARO, G8BCO and G8ECO aim to study the relationship between the prevailing weather and microwave propagation while they enjoy QSOs with other amateur stations on 10GHz. Peter Kerry G8ARO Farnham is out with the group most Sundays, subject to weather, at their P location in the Hindhead area using his home-brew wide-band FM equipment. Their best 2-way DX so far is 70km and recently Peter worked G8BDJ/P (50km) who was located on Ditchling Beacon (Nt. Brighton).

Interest in microwave activity is growing and G8ARO says that the Blackwater Valley Group would be pleased to help others get going. There are beacons on 10-1GHz situated on the Isle of Wight GBS1OW and in Romford G82LBH and it is hoped that GBS1ALN will soon be operational from Alderney in the Channel Islands, which will enable 10GHz enthusiasts to study propagation on an overseas path. Arrangements for the group's Sunday activity can be heard by listening to their SSB net at 2200 on Saturday evening on 144-33MHz. They intend to be active on June 5 with a GE call sign to celebrate the Queen's Jubilee. More reports about microwave activity would be welcome.

The Portsmouth repeater GB3PH on 70cms (RB2 Input 434-65MHz and output 433-05MHz) began operation on March 26th and so far Constance Hall G8LY Lee-on-Solent has worked mobile stations near Dorset, Salisbury and on the Isle of Wight plus fixed stations in Fareham, Portsmouth and Southampton via PH. More reports are wanted from users east of the repeater.

I observed the first signs of the sporadic-E "season" during the early mornings of the 12th to 19th April when strong bursts of signals from the R1 television system were heard on 49-75MHz and at 1355 on the 16th I received a s99 signal from the German beacon DLOG1 (28-195MHz). Strong Continental broadcast signals interfered with Band II BBC stations in southern England on the 4th and 5th due to a fall in the prevailing high atmospheric pressure system. The AP was just above 30" from April 6 to 14 when it rose to 30-25" and began to fall around noon on the 16th providing a variable VHF opening. During the evening on 2m G8BCO heard GC8AZ, and G8LGQ periodically heard strong signals from northern G and GW stations. I heard several French broadcast stations in Band II and around midnight, I heard amateur stations commenting about the strange conditions on 2m.

![VHF](VHF.png)

**BROADCAST BANDS**

**Short Wave** Reports by the 15th of the month to Derek Bell, 169 Max Rd., Chaddesden, Derby.

**Medium Wave** Logs to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

**AMATEUR BANDS**

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

**VHF**

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

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<td>AC116</td>
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CMOS

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<td>CN74HC04</td>
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INDEX TO ADVERTISERS

A.H. Supplies .......................... 225
Alben Engineering ...................... 166
Ambit International ..................... 235
Astro Alarms ........................... 237
Astro Electronics ........................ 244
Bamber B. ................................ 232
Barrie Electronics ........................ 196
B.B. Supplies ............................. 239
Bentley Audio Corp. ...................... 236
Bi-Pak Ltd. .............................. 178, 179
Bi-Pre-Pak Ltd. (Stirling Sound) ....... 175
Birkett J. ................................ 237
British National Radio & Electronics 239
School ................................... 174, 195
J. Bull (Electrical) Ltd. .................. 223
Bywood .................................. 221
Cambridge Keys .......................... 241
Carnac C. ................................ 239
Copper Supplies .......................... 249
Cox Radio (Sussex) Ltd. ................. 238
C.R. Supply Co. ........................... 238
Crescent Radio Ltd. ...................... 170
Crofton Electronics ...................... 176
D.E.W. Ltd. ............................... 240
Doran .................................... 166, 168
Electronic Design Assoc. ................. 237
Electronic Computers Ltd. ............... 172, 240
Electronic Mail Order .................... 221
Electronude .............................. 172
Fiddletone Fastenings .................... 170
Flairline ................................ 232

G2DYM Aerials & Project ................. 239
Greenwell Electronics .................... 166
H.T. Technical Information Service ...... 239
H.A.C. Short-Wave Supplies .............. 234
Harversons ................................ 177
H.M. Electronics .......................... 241
Heatkit Ltd. .............................. 227
Home Radio ................................ 233
I.L.P. Electronics Ltd. .................... 191
Insertex I.C.S. ........................... 227
James Cooper (Electronics) Ltd. ........ 240
Kramar & Company ....................... 712
Linear Products .......................... 176
Lion House ............................... 239
Lectropeaks .............................. 224
Lyric Electronics ........................ 234
Manor Supplies ........................... 172
Magnum Publications ..................... 240
Maplin Electronic Supplies ............... cover iv
Maroto Trading ............................ 238
Marsall, A. (London) Ltd. ............... 196
Metae Ltd. ................................ 174
Micromo Electronics ..................... 240
Minikits Electronics ..................... 240
Monolithic Electronics .................... 172
Newmant Electronics ..................... 221
Newnes-Butterworth ...................... 233
Partridge Electronics Ltd. ............... 224
P.B. Electronics .......................... 171
P.K.G. Electronics ....................... 241

Precision Pectine .......................... 176
Pulse Electronics (Boreen) ............... 233
Radio Book Services ...................... 239
Radio Components Specialists ............ 231
Radio Exchange Ltd. ..................... cov III
Radio Society of St. Briga ............... 244
Ramar Construction Services ............. 229
R.S.C. (Hi-Fi) ............................. 167
R.S.T. Valve Mail Order ................... 228
Radio & TV Component Ltd. ............ 169
Salopek Electronics ...................... 240
Saxon Entertainments .................... 173
Scientific Wire Co., Ltd ................... 241
Sinclair .................................. 224
Sonix Hi-Fi ................................ 192
Southern Valve Co. ....................... 232
Southern E.A. Ltd. ....................... 238
Sweeney Electronics ...................... 241
Tamba Electronics ....................... 176
Tempus .................................. 168
Technomic Ltd. ............................ 192
TeleRadio Electronics ..................... 241
Technomark .............................. 239
T.K. Electronics ........................... 238
Tunepus Electronics ...................... 236
Tudor Rees (Vintage) Services .......... 238

Watford Electronics ...................... 242, 243
Web Europa ................................ 224
West London Direct Supplies .......... 241
Wilmslow Audio .......................... 227
Williams, Michael Electronics .......... 168
Xoraxa .................................. cov II
Z & I Aero Services ....................... 244

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<th>SUB-MIN TOGGLE</th>
<th>JACK PLUGS</th>
<th>SOCKETS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOGGLE; 2A, 250V</td>
<td>SP Changeover £1</td>
<td>Screened chrome</td>
<td>Open mint</td>
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<tr>
<td>SPST 3A</td>
<td>DPDT 6-way £1.25</td>
<td>Plastic body</td>
<td>Moulded with break contacts</td>
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<td>DPDT 5-way £1.50</td>
<td>DPDT Centre off £1</td>
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<td>DPDT Biased £1.50</td>
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</tbody>
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Practical Wireless, July 1977
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