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NOVEMBER 1978
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NUMBER 7
ISSUE 861

BRITAINS LEADING JOURNAL FOR THE RADIO & ELECTRONIC CONSTRUCTOR

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NEWS & VIEWS

FOR OUR CONSTRUCTORS

GENERAL INTEREST

SPECIAL OFFER

Our December issue will be published on November 3rd
(for details see page 36)

P.W. WIMBORNE

is now offering a complete service for this exciting project. Total cost for standard options approximately £110. Comparable price £180.

Using circuits based on this design it is possible to construct:

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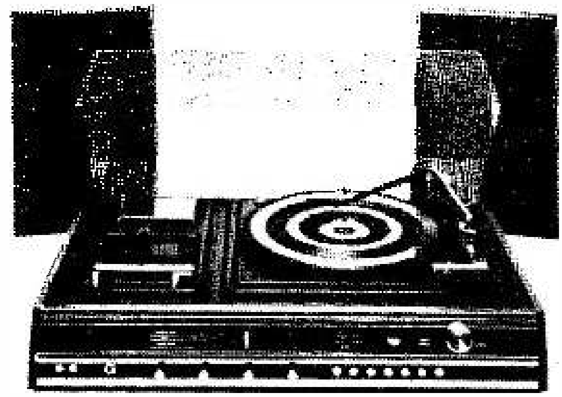

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GIVE AWAY PRICES

MANUFACTURERS SURPLUS EQUIPMENT

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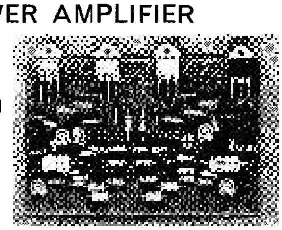
STEREO POWER AMPLIFIER

25 Watts RMS per channel



- ★ Class AB Operation
- ★ 16 Transistor Circuit
- ★ Unstabilised supply required
- ★ Tip 34A + Tip 33A Output
- ★ Supply Voltage 50V DC nominal
- ★ 30 Hz–18KHz @ —1dB
- ★ Output 8 ohm
- ★ Input 50 Kohm **£7·50**

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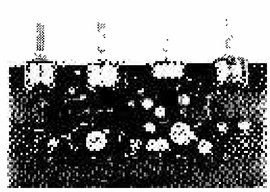

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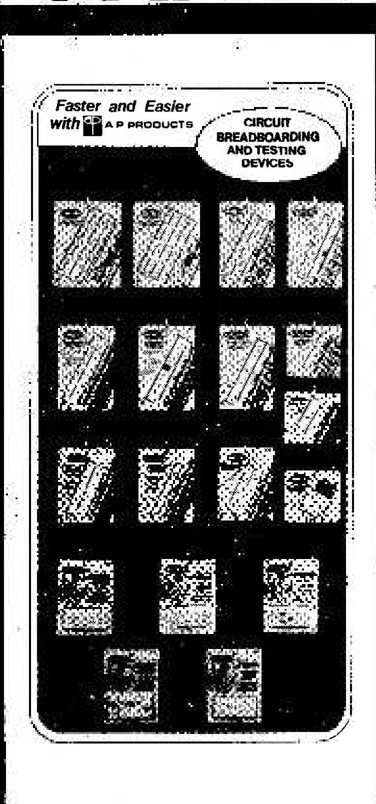

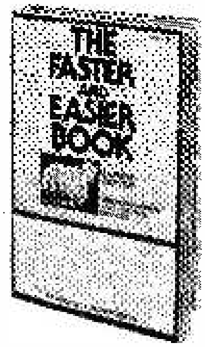

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4026	130p
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4028	84p
4029	100p
4030	55p
4031	200p
4033	180p
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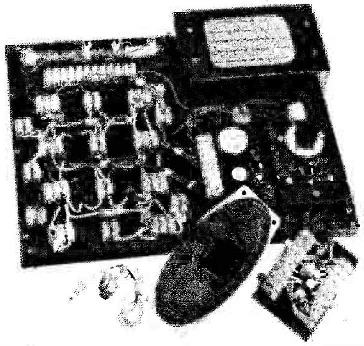

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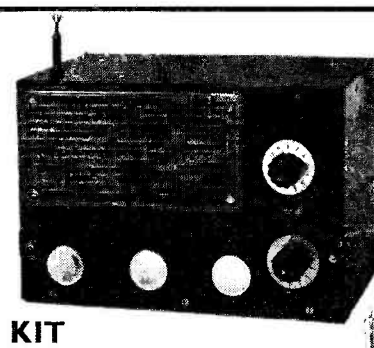
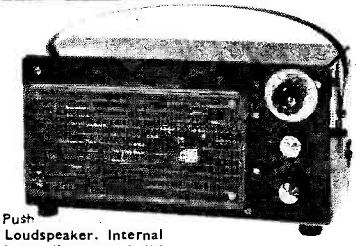


NEW MODEL R.K.1



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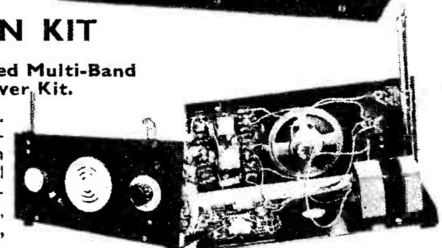

8 transistors and 3 diodes. Push pull output. 3in. loudspeaker, gain control, 7 section chrome plated telescopic aerial V.H.F. tuning capacitor, resistors, capacitors, transistors, etc. Will receive T.V. sound, public service band, aircraft, V.H.F. local stations, etc. Operates from a 9 volt P.P. 7 battery (not supplied with kit)

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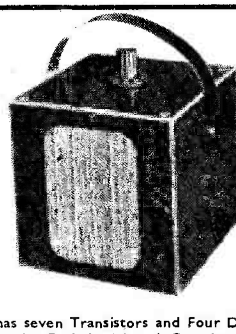

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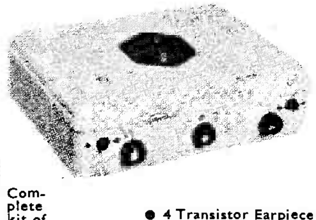

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- 5 Transistor Short Wave Radio
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- Batteryless Crystal Radio
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- Sensitive Pre-Amplifier

Complete kit of parts including construction plans

Total building costs **£9·99** + P & P and Ins. £1·10

● 24 Resistors ● 21 Capacitors ● 10 Transistors ● 5" × 3" Loudspeaker ● Earpiece ● Mica Baseboard ● 3 12-way Connectors ● 2 Volume Controls ● 2 Slider Switches ● 1 Tuning Condenser ● 3 Knobs ● Ready Wound MW/LW/SW Coils ● Ferrite Rod ● 6½ yards of wire ● 1 yard of sleeving, etc.

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Build this exciting new design. Now with 7 Transistors and 4 diodes. MW/LW.
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Total Building Costs **£6·95** + P & P and ins. 90p

ALL PRICES INCLUDE VAT

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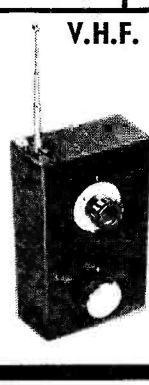

Build this converter kit and receive the aircraft band by placing it by the side of a radio tuned to medium wave or the VHF band and operating as shown in the instructions supplied free with all parts. Uses a retractable chrome plated telescopic aerial, gain control, V.H.F. tuning capacitor, transistor, etc. All parts including case and plans

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Chaos Reigns

EACH new generation insists on wanting to prove for itself that hot things burn, that sharp things cut, that every warning or piece of advice which elders might give really is sound. Perhaps in many ways it's just as well, for otherwise some very useful discoveries might never have been made. There are times, though, when we of more advanced years ponder "Will they never learn?"

The same question, it seems, might well be put to semiconductor manufacturers, who not only go on repeating the mistakes of the valve makers, but have thought up a whole host of new horrors of their own! In the heyday of valves, a multitude of different type-number "house-codes" was in use, and equivalent tables were essential to the serviceman, who might otherwise be looking in his spares holding for what was effectively the same valve under any one of half-a-dozen or more different type numbers. There was some standardisation in the American RMA and European Pro-Electron codes, and at least the "same" valve didn't appear in different shaped envelopes with different bases, with one or two notable exceptions such as the 807.

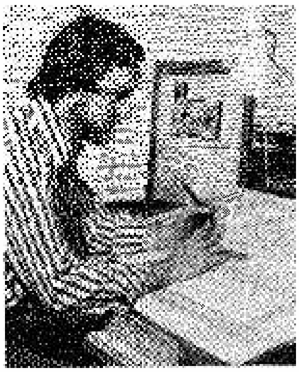
When transistors came along, they were expected to have a much longer life, and could be soldered straight into circuit. Most would have only three leads, so except where power dissipation requirements dictated otherwise, it would be nice and simple to arrange that all transistors had lead-outs in the same pattern . . . wouldn't it? It didn't happen, of course. In fact there are probably more permutations of case outline and lead-out arrangement for the bipolar transistor than there were valve bases ever invented.

It is not too difficult to understand why there should be metal-can and plastics-case versions of the same small-signal transistor. And at least there is some uniformity in the metal-can versions, where all TO-18 (e.g. BC107) and TO-39 (e.g. BFY50) devices have identical lead-out arrangements. When you get to the plastics end of the market, the manufacturers seem to have gone stark staring mad. They take one humble transistor, apparently at the request of some major customers, and produce it in several different shaped packages, with the option of leads pre-formed to match the lead-out patterns of yet other packages, and mark them all in microscopic, rub-off printing, with type numbers differing only by suffix. Is it any wonder that people get thoroughly confused? You need a whole library of data books to cope, and even then there are devices around on which there seems to be no published data. There is a version of that work-horse f.e.t., the 2N3819, which comes into this category.

Still, the manufacturers will have learned their lesson when they come to integrated circuits, won't they? Wait a moment, though . . . what about those 8-pin and 14-pin d.i.l. versions of the 741?

We are sorry that, due to continuing rises in our costs, we are having to ask you to pay more for your copy of *Practical Wireless* commencing with this issue. I hope that we will continue to enjoy your support—we have some great projects lined up for the future.

PW PERSONALITY



Rob Mackie—Technical Artist

Although Rob spent his schooldays in Wantage, Oxfordshire, his professional life didn't begin in earnest until he came to live in Dorset and took a post as a draughtsman with a local company specialising in gas detection equipment. His arrival at *PW*'s editorial office coincided with the magazine's move to Poole from London, only a few months after he had married and settled in Corfe Mullen. He has a son and expects an addition to the family at any moment; his parents still live in Wantage, and his father is an electronics engineer at the Atomic Energy Research Establishment, Harwell.

Rob's interests include kite flying, squash, football, and progressive rock music. He also admits to an occasional thirst for the local brew!

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

The British Vintage Wireless Society

An exhibition of vintage radio and TV equipment is being staged at the Guildhall Museum, off New Orchard Street, Poole from now until about the end of the year. Opening hours are 2 until 5 pm on Sundays, 10 am until 5 pm during the rest of the week.

The RAC Amateur Radio Group Scheme

Membership of this scheme is open to all amateur radio enthusiasts and provides membership of the Royal Automobile Club at a discount of £1·50 below the normal subscription rate. Since 1st June 1978 the annual subscription for members of the group scheme has been £9·50.

Subscription renewal date is 17th May (World Telecommunication Day) each year, and all members renew on the same date. Anyone joining on any other date will pay at the pro-rata rate of 80p per month for the remainder of the year. In addition, the once only joining fee of £2·50 is also payable, regardless of the period remaining in the membership year. Those who are already members of the RAC will not be required to pay the joining fee. A desirable option is the RAC Recovery Service, the annual subscription for which is £7·00 for the whole or part of the year.

The scheme is administered by the *RAC's Scottish Western Counties Office, 242 West George Street, Glasgow G2 4QZ*. Further details from the co-ordinator of the scheme *Mr A. W. Huchinson, 88 Broomfield Road, Chelmsford, Essex CM1 1SS.*

Dinner date

The Wessex Amateur Radio Group are holding a dinner-dance at the Yenton Hotel, Gervis Road, Bournemouth on Saturday 18th November. Dress is informal and those attending should meet at the Hotel around 7.15pm. Anyone in the area wishing to attend can be assured of a warm welcome. Tickets may be obtained by contacting the Secretary *Mr G. D. Cole G4EMN, 6 St. Anthony's Road, Bournemouth or Mr A. Hoggan, G8ASX, 23 Leaphill Road, Bournemouth.*

Good news, bad news

Doram the mail order component suppliers announce the launch in September of their new Electronic Hobbies and Equipment catalogue. Its 40 pages are full of micro-processor based and other kits, electronic project and hobbyist books, electronic and other tools, also audio and car accessories. The service will be supported by the Access credit facility. Order your free copy now.

Doram also give notice of their intention, later this year, to discontinue supplying electronic components. They plan to fully support the component range in the current Edition 4 catalogue until the end of September, after which time they will supply only on a 'whilst stocks last' basis. An end of season component list will eventually be made available.

RAE special

We are informed of a course in the North London area primarily for students who have taken the RAE examination and failed, and do not wish to go back to the start all over again.

The college station is G4GA and special coaching will be given by the senior tutor Fred Barns G3AGP.

Held at the De Beauvoir I.L.E.A. Evening Institute, Tottenham Road, London N1, enrolment will be between the end of September and the end of October.

Further details from *Fred Barns G3AGP, 60 Alveston Avenue, East Barnet, Herts.*

Diary date

The Amateur Radio Retailers Association are organising what they claim will be the 'Biggest and Best Hamfest in Europe', on the 2nd, 3rd and 4th November 1978.

The Seventh Midland National Amateur Exhibition will be held at The Granby Halls, Leicester, and will be open between 10am and 6pm, admission 40p with special concessionary prices for clubs, schools etc.

All the usual stands and events are planned including £500 to be won in voucher prices.

For further information contact *Tom Darn G3FGY, 20 Mount Pleasant, Ripley, Derbyshire DE5 3DX.*

Sought After

A 1977 survey of Technicians and Technical Engineers engaged in electronics in the U.K. shows that they enjoy virtually full employment. In fact, shortages of suitably qualified staff in some types of job, and in some areas of the country, are also indicated.

The survey was conducted by The Society of Electronic and Radio Technicians into the remuneration and occupations of its 8,000 members. Their activities cover radio and television, industrial electronics, technical education and local government, civil service and nationalised industries, and broadcasting.

Other points from the survey show that there has been an increase in Trade Union membership from 36% to 41%. During wage restraint between 1976 and 1977 increases in members salaries were 6% on average.

Sorry!

The article "Wideband Calibrated Attenuator" in our September issue should have been attributed to the joint authors, Mike Tooley and David Whitfield. Our apologies to David for omitting his name from the credits.

RAE reprint

For full details of availability and price, see page 35.

Can I help you!

Are you the secretary, organiser or general dog's body of your local radio club or any other group whose functions may interest readers of *PW*. If so, let me know and I will endeavour to publicise your rally, get-together, whatever, through this column. Remember though, we compile the magazine some time ahead of publication day (e.g. this note was written in mid-Sept.), so, the earlier I can have details, the better. *Alan Martin*

ZL SPECIAL 2m BEAM

F. C. JUDD G2BCX

In my article "Aerial Performance Test Set", (*Practical Wireless, January 1978*) readers may have noticed the photograph of a 12-element beam aerial. This is one of the "ZL" series, developed from the ZL Special, details of which were published in *Practical Wireless,* May 1977. At the time, the principle of employing two driven elements to produce 'end-fire' arrays was examined. The ZL Special two-element system is in fact an end-fire array but with a difference. The element lengths are cut to produce a reflector/director action which gives increased forward gain over that normally obtained with two half-wave elements spaced $\frac{1}{8}\lambda$ and driven 135° out of phase.

The ZL Special, apart from being a small beam aerial in its own right, is also a very useful primary driving system for relatively compact multi-element beams of higher gain. In this respect, the reader may find the article "Three and Five-Element Compact Beam Aerials for 2 Metres" (*Practical Wireless,* May 1977) of interest. The same arrangement can be used for ZL beams of up to five directors—i.e., six or seven elements total.

Beyond this however, if the gain is to be increased by additional directors and the size contained, the construction of the ZL Special as described in the above article must be modified.

The 12-element ZL beam to be described was developed nearly three years ago and up to the present time has been in use in two quite different locations. One of these was my former address in London and the other my present home in the lovely countryside of Norfolk. It has been the means of establishing over 600 direct contacts with more than 10 countries outside the UK on 2 metres f.m. Operation into a number of continental repeaters, as well as distant UK repeaters, has been achieved with only slight tropospheric lift.

The basic ZL Special has a forward gain of about 6dB over a dipole, which is much higher than can be obtained with a single driven element and reflector, the basis of the well-known Yagi. A ZL beam with directors does not require a reflector, as there is nothing from the rear to reflect. With the modified primary driving array and 10 directors as shown in Fig. 2 a forward measured gain of 13·5dB can be obtained with a beamwidth at the 3dB down points of approximately 36°. The theoretical gain was 14dB but calculated parameters are rarely, if ever, realised. For the sake of comparison with the dipole and other ZL beams however, the radiation pattern of 12-element version is shown in Fig. 1; the field intensities are relative.

At this point it should be realised that if a high-gain beam is used the increase in effective radiated power (e.r.p.) over a simple dipole is considerable. For example if 10 watts of actual radiated power is applied to a beam aerial having a gain of 13dB, it will produce an e.r.p. of close to 200 watts (assuming no losses), 13dB being a power ratio of approximately 20:1.

Before the constructor begins to build this aerial

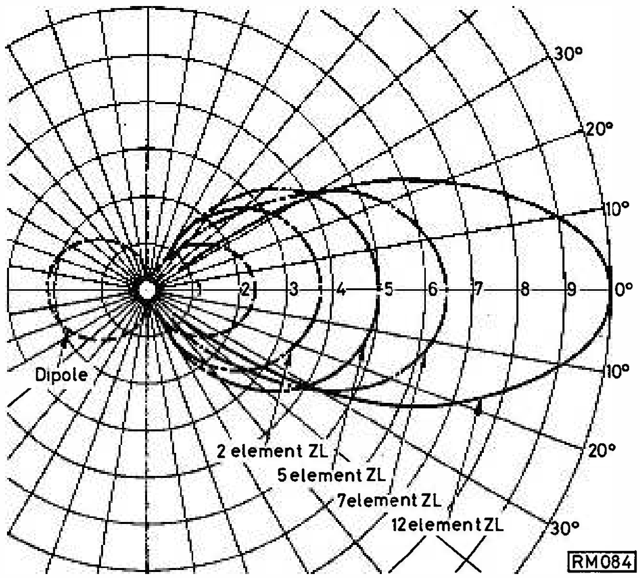


Fig. 1: Field intensity patterns of the 12-element ZL Beam and other ZL Series for comparison. Intensity levels are all relative to each other and a dipole

it should be stressed that only the materials specified must be used. As with most projects of this nature if the text is not followed closely, it is unreasonable to expect the results to function properly. The dimensions are fairly critical, and a tolerance of about one per cent should be aimed for in the longer lengths. In other words, about 2·5mm in 254mm. For shorter dimensions, 1mm is adequate.

It seems a gremlin was at work when copy was written for the announcement about this article on page 43 of our October issue. We apologise for the wrong information given there.

Construction

From Fig. 2 it can be seen that the overall length is some 3·2 metres but if the elements are made as described from 6·3mm diameter aluminium rod or tube, a boom of 20mm square aluminium is adequate for the purpose. The prototype built exactly as described in this article has withstood gale force winds and gusts approaching 90m.p.h., suffering nothing more than one broken director.

The diagrams should be fairly self-explanatory. The layout of the two driven elements, the 300Ω ribbon phasing line, the rear tuning stub and the small coaxial capacitor across the feed point are shown in Fig. 3.

Note that the ribbon feeder forming the phasing line is somewhat longer than the actual spacing between elements and this will lie slack within the protection box. The box may be of pvc or built from hardwood. In the latter case it is advisable to fit sleeves of a good insulating material over the elements and the rear stub where they enter the box.

The small rear stub is made from 6·3mm diameter aluminium rod or tube. The lower parts of the elements run underneath the boom. They must not come into contact with it but extra support could be given with small spacers of Perspex or pvc located between the centres of the elements and the boom.

The small capacitor is formed from a short piece of 50Ω coaxial cable, trimmed at one end by about 20mm for connection to the feed point and with about 12mm of screening braid removed at the far end to prevent short-circuit or r.f. flashover.

The boom is 3·234m long and 20mm square. All the directors are secured to the boom at their exact centre points. For this purpose small clips could be used or holes drilled through the boom to take the 6·3mm diameter rods, which can ultimately be secured by bolts or self tapping screws. Whichever method is finally decided upon it will be necessary to establish that the electrical contact is good.

When the aerial is finally tested, the slots where the elements enter the protection box can be filled with Plastic Padding or similar to prevent the ingress of water. After the lid has been fitted the box should be painted or varnished.

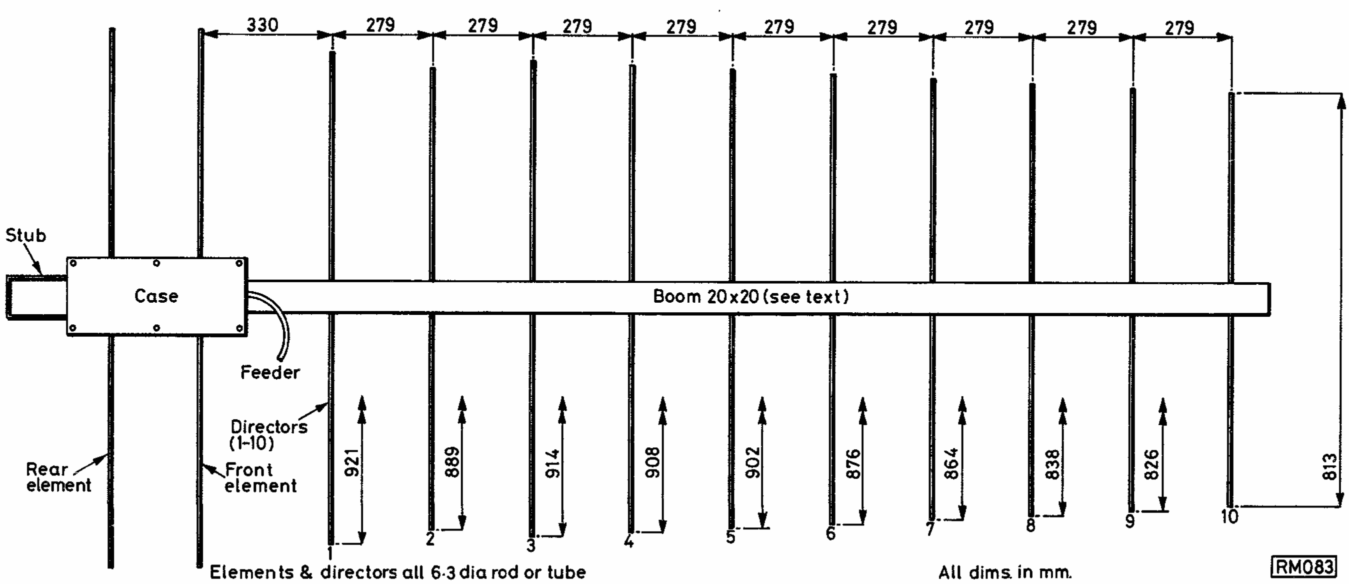


Fig. 2: Details of element and director lengths etc. These are critical and should not be altered in any way

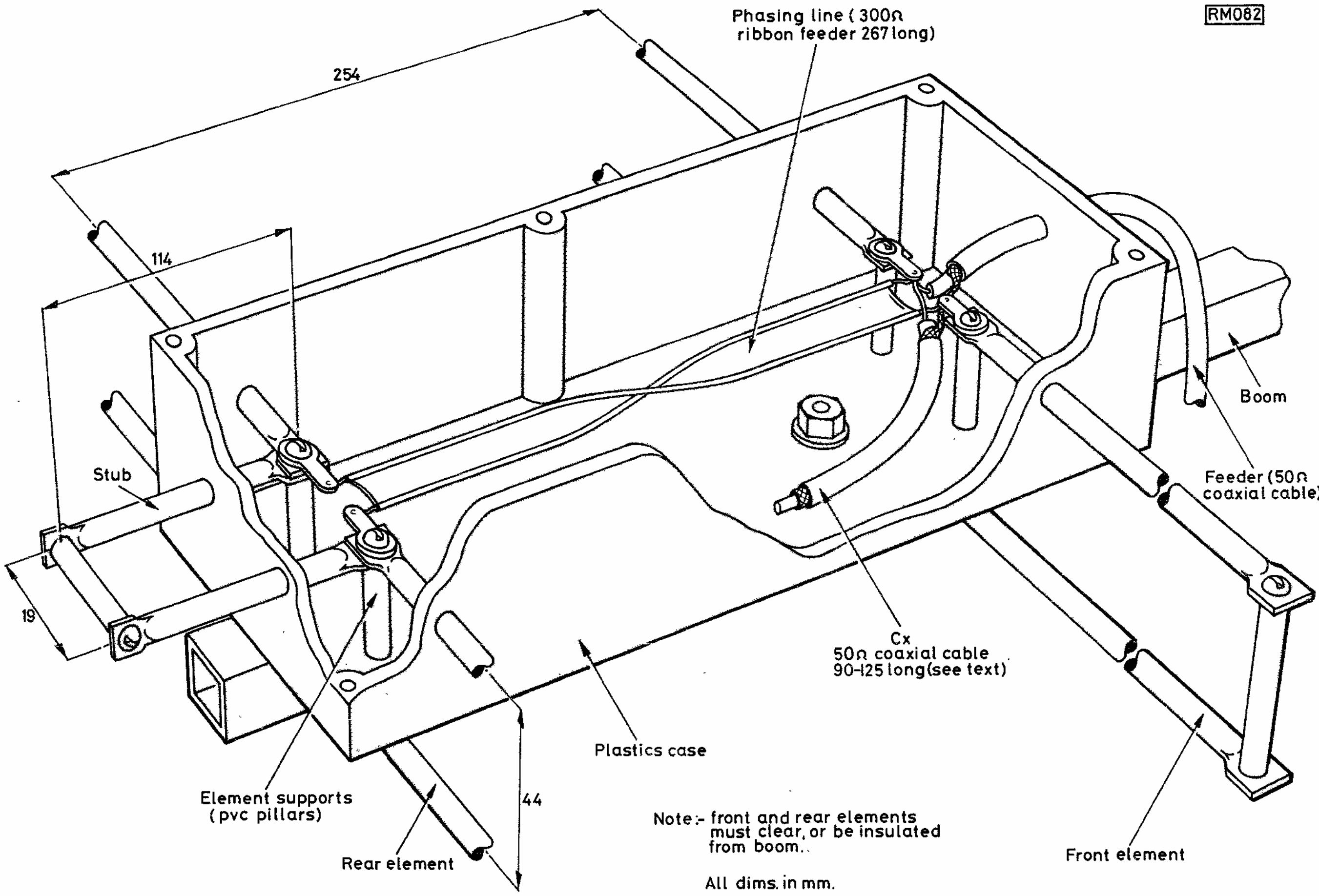


Fig. 3: Details of the driven element assembly

Checking and Operation

This aerial will only operate with 50Ω coaxial cable which should be of good quality. Type UR67 is recommended for long runs but UR43 may be used for lengths of up to 10 to 12 metres without too much loss. It is advisable not to use old cable (eg cable which has been in use outside) as losses develop, usually due to moisture absorption and this will degrade the performance of the aerial.

Before fixing the lid to the protection box make sure all connections are secure. Large soldering tags, say 2BA, clamped under the element ends, are best for good soldered contact of the main coaxial cable, the phasing line and the coaxial capacitor. For testing, the full length of 50Ω cable should be connected. Set the aerial up in the garden, balanced on a pair of steps so that it is about 1 to 1½m above ground. If a v.s.w.r. meter (or power meter) is available and/or fitted to the transmitter, check at mid band (145MHz), that the v.s.w.r. does not exceed 1·5:1. If it is higher then a problem, perhaps with connections, is indicated. If the v.s.w.r. is below 1·5:1 then leave well alone! However, adjustment can be made to the coaxial capacitor length for minimum v.s.w.r. It may mean trying two or three pieces of say 90mm, 100mm and 125mm but the trouble will be worthwhile. If you have available a 6 watt fluorescent tube it should light brightly when touching the ends of the driven elements and most of the directors when 10 watts or more of r.f. is present.

If the v.s.w.r. is plotted across the band the curve should approximate that shown as (b) in Fig. 4 provided the feeder cable is not too long. For runs of 20m or more the curve will tend to flatten out as (c). For comparison, an average v.s.w.r. curve for a long Yagi is shown in (a) and the increased rise at each end is due to the fact that such aerials are sharply resonant. The ZL series are broad-band hence the flatter v.s.w.r. curve. The beam width at 3dB is about 36°, as in the polar patterns of Fig. 5 which were taken from the prototype. The solid line is for horizontal polarization and the broken line for vertical, but note that the spurious lobes in the vertical pattern, due to reflection from nearby conductors,

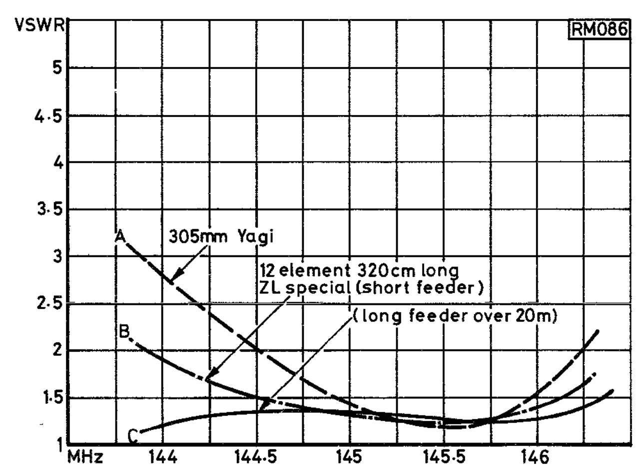


Fig. 4: VSWR plots, ZL Beam by comparison with long Yagi

Continued on page 80

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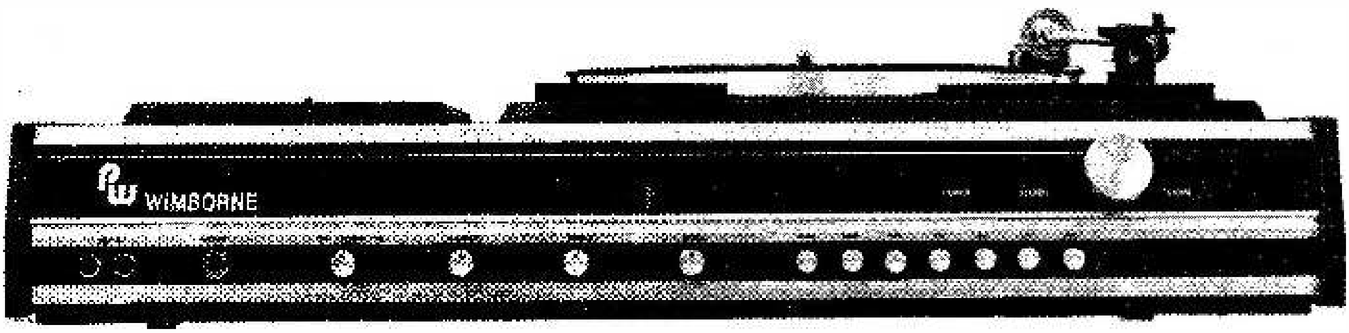
Music Centre

PART 3 FM Receiver & Magnetic Cartridge Equaliser



FM CIRCUITS—PERFORMANCE DETAILS

S/N Ratio: 26dB for 1μV Sensitivity (Worst Case)
Image Rejection: 60dB (Typical)
IF Rejection: 60dB (Typical)
Total Harmonic Distortion: 0·08%
AM Rejection: 50dB
Stereo Separation: 40dB at 1kHz

RF and Mixer Stages

Although the UK is well served in terms of coverage by f.m. transmissions, to achieve the maximum performance a receiver must be capable of resolving a weak station adequately, and a strong station without overloading.

The "front end" (VTO2) was chosen to meet these exacting requirements, and a description of the internal circuit follows.

In keeping with current design techniques, the r.f. stage utilises a MOSFET, which provides good immunity to cross-modulation combined with a low noise figure. Clearly this is an important factor since any noise introduced at this stage will progressively degrade the overall performance. AGC is also applied here, and the r.f. stage is band-pass coupled to the mixer (another MOSFET), which, through its wide dynamic range, presents a high level of immunity to overloading.

The local oscillator, which is tuned 10·7MHz above the signal frequency makes use of a bipolar device resulting in a stable circuit which tracks well. AFC is introduced at this point to combat any drift.

Varicap Tuning

This technique was chosen eventually to suit a number of requirements. Most important of these was the fact that the original mechanical tuner unit shown on photographs in part 1 of the "Wimborne" suddenly became more expensive and of doubtful advantage. Less important, but more interesting in terms of the facilities which we could eventually build into the design, was the varicap pre-set tuning of stations which could be introduced by the constructor at a later stage if required. To some extent also, the physical needs of a fine tuning system are simplified, although it does necessitate a regulated supply. This wasn't a disadvantage however, since the design already incorporated such a supply.

Signal from the VTO2 (the i.f. signal at 10·7MHz) is then amplified by 2 bipolar transistors with one two-pole ceramic filter per stage, thus providing the necessary bandwidth for the entire i.f. amplifier. These two gain stages are important not only because they overcome the insertion loss incurred by the filters, but also because they present a strong signal to the RCA 3189 enabling virtually its optimum s/n ratio to be exploited.

Capabilities

The 3189 provides one of the highest levels of performance currently available in a combined f.m./i.f. amplifier/detector. Apart from a slightly improved s/n ratio, delayed a.g.c., a.f.c. facility, and signal strength meter output, it contains a deviation muting

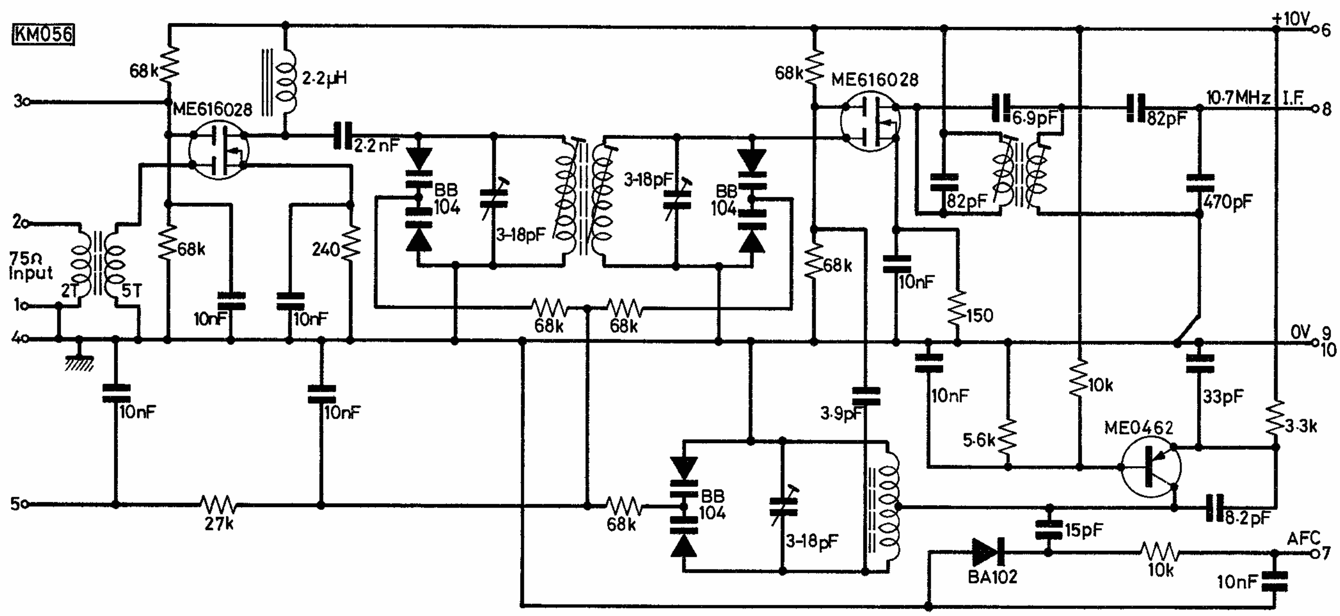


Fig. 1: The internal circuit of the VTO2 f.m. tuner module

circuit which holds down the audio output until a station is correctly tuned. In addition, audio output can be set to any desired level to be compatible with following stages.

Editorial Note: A fuller treatment of the RCA3189's potential is given in our current "IC of The Month" in this issue. Also, the type no. of the BSR record player deck was incorrectly given as "BSR 162" in Part 1 of the "Wimborne Music Centre" (September issue). This should read "BSR 182".

Detector and Decoder Stages

A double tuned quadrature detector is employed, which ensures a very low total harmonic distortion, and the recovered audio is then fed via a capacitor to the MC 1310 multiplex decoder. Extensive low-pass filtering is provided at this point to ensure that the multiplex signal does not find its way into the following amplifier stages. As can be seen from the f.m. performance figures, results are very good and are consistent with those obtained from a commercially-built high quality stereo f.m. tuner. During tests in Wallington, Surrey, the author has been able to listen regularly to the three main national stations of ORTF (France) using a 6 element beam 30 feet above sea level. Yugoslavia was also heard during a tropospheric opening.

Modified Supply Rail

A further stabilised supply of 15V is necessary to supply the varicap bias for tuning, and this is derived from a modification of the existing 13V stabiliser circuit, which also raises the original 13V supply to 18V for the r.f. board. The only changes necessary in this case are that R302 (150Ω) is reduced to 33Ω (½W) and the control Zener (ZD1) is changed to an 18V 400mW type. Tr5 (BD131) will still be operating well below its maximum rated current level, so no extra fuse precautions need be taken.

Constructional Notes

The fine tuner could be a multi-turn potentiometer, and the arrangement of the drive system need not change from that of the mechanical unit, although the tuning drum size or reduction gear (necessary if a realistic tuning scale spread is to be achieved) selection is up to the individual constructor. This does not apply where the kit of parts is purchased.

It is as well to note that those capacitors shown on the circuit diagram with an angled positive connection are specifically for decoupling purposes, and should be mounted as close to the "hot" end of resistor (or active device) it refers to as possible. This applies to C1, C5, C7, C11, C20, C27, C29, and C79.

In some cases, a small amount of Zener-produced noise may find its way into the receiver outputs or the cassette unit output signal. This can be suppressed by including a 100μF 25V electrolytic in the circuit. Connection is made on the back of the main amplifier/power supply module, positive to the junction of R303 (3·3kΩ) and Zener +, and negative connection to chassis.

Magnetic Equaliser Board

This contains the pre-amplifiers (LM387) for magnetic cartridges and should be mounted as close to the output connections of the cartridge as possible in order to minimise hum pick-up. Under certain conditions, not necessarily in the shadow of a transmitter, a condition known as "AM Rectification" may occur. This results in r.f. signals appearing at the output, usually a broadcast band short wave station or co-channel radiation from a t.v. receiver. It is generally caused by pick-up in connecting leads, and poor soldering can often emphasise the effect which is caused by the first high gain stage acting as an r.f. detector—this is quite understandable when it is realised that the upper frequency limit of the humble BC109 is something like 450MHz!

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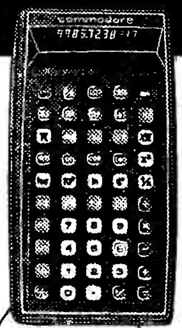

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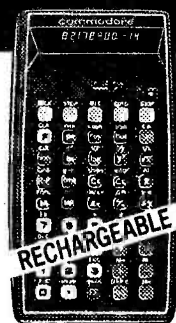

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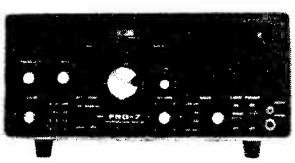

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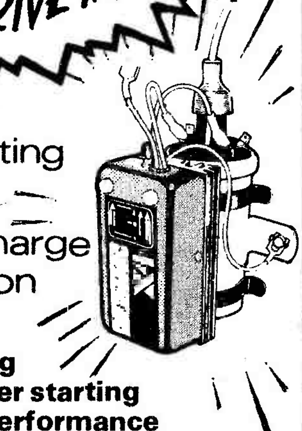

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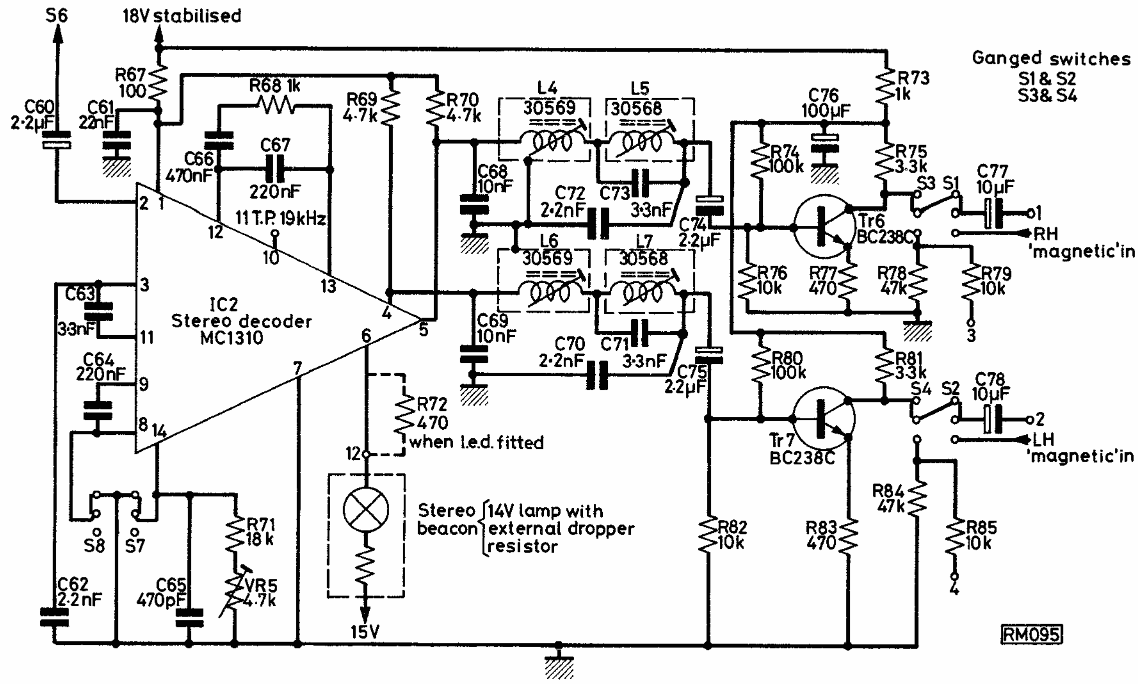

Fig. 2: Complete circuit of the f.m. stereo decoder

The best cure is to prevent, by keeping leads short, taking care over soldering, and running connecting leads close to the chassis. If the condition persists, it can usually be cured by connecting a small choke (about 10μH) in series with the input, or bridging the input close to the LM387 + and − inputs with a capacitor approximately 150 to 300pF.

Magnetic Cartridge Pre-amplifiers

In order to maintain a good performance in terms of noise, and partly to continue the low topographical profile of the "Wimborne", a discrete approach to the requirement for equalisation to the RIAA standard for magnetic cartridges was ruled out, and it was decided that the LM387 should again be used to provide this function.

While it is true that in order to obtain a good match between the two amplifiers contained in the LM387 ("selected" items are clearly to be desired), it is equally the case that the problem exists in the event of opting for the conventional approach using four BC109 or BC149 transistors. The improvement obtained in noise figure for the LM387 made it preferable, as did its compact "image", matching the "Wimborne" character overall.

★ components

Resistors		
¼W carbon film 5%		
270Ω	2	R403, 503
2·7kΩ	2	R404, 504
47kΩ	2	R401, 501
100kΩ	4	R402, 406, 502, 506
1MΩ	2	R405, 505
Capacitors		
Polystyrene		
1nF	2	C405, 505
3·3nF	2	C404, 504
Polycarbonate	160V	
100nF	1	C402
1μF	2	C401, 501
Electrolytics 63V		
22μF	2	C403, 503
Semiconductors		
IC3	1	LM387
Miscellaneous		
p.c.b., mic. cable		

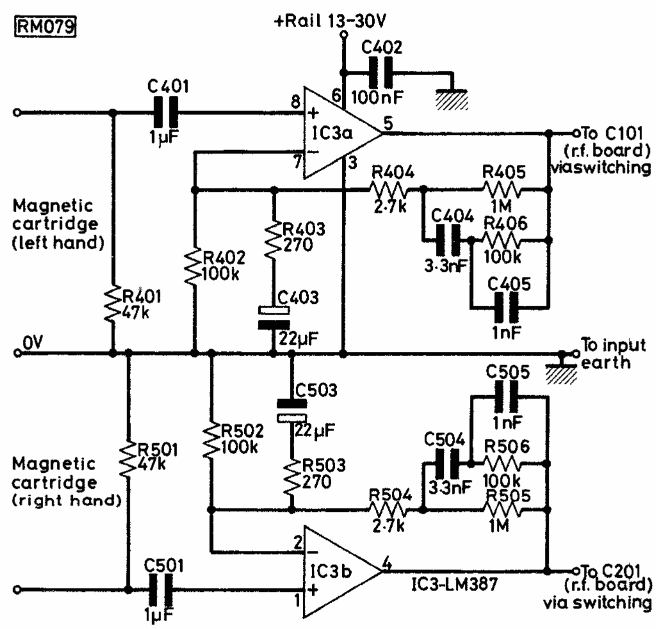

Fig. 3: The dual pre-amplifier (equaliser) circuit for magnetic cartridge inputs (above), and the relevant component list (left). The complete components list for all the receiver circuits will appear in the December issue

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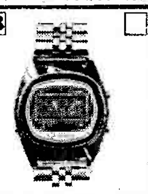
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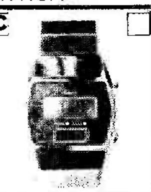
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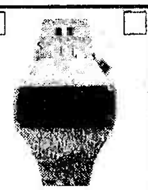
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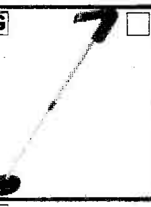
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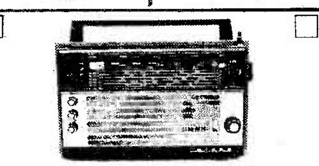
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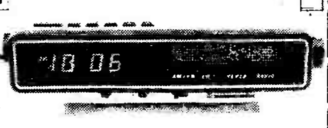
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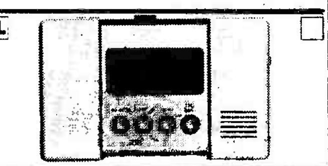

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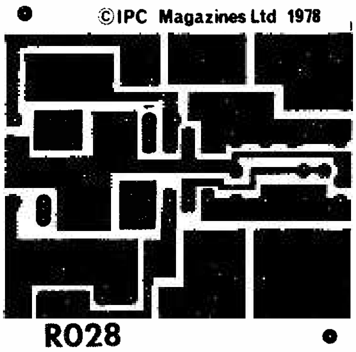


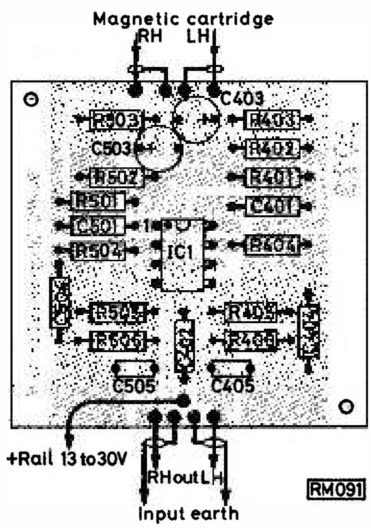


Fig. 4: Copper track pattern and component overlay for the magnetic equaliser board. Both are shown full size

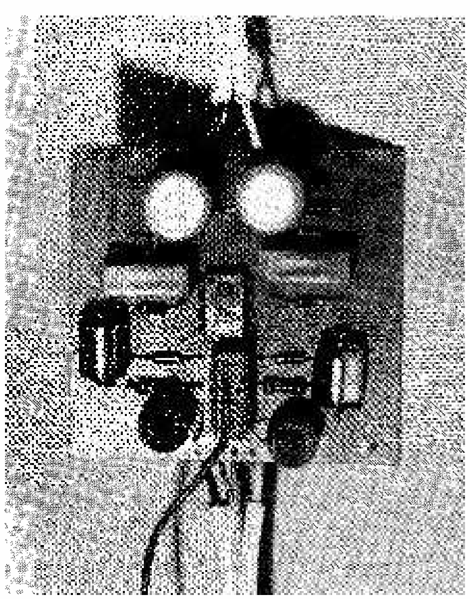
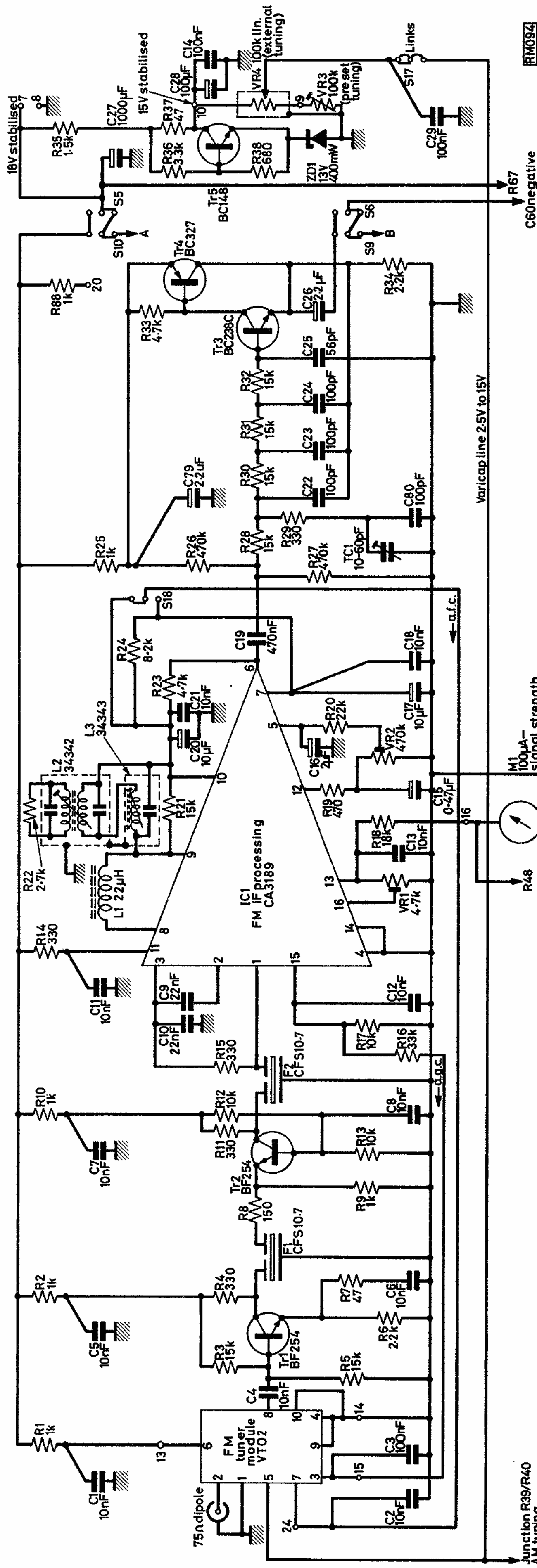


Fig. 5: A view of the equaliser unit (above), and the f.m. amplifier circuit (right)—N.B. "ZD1" should read "ZD2"



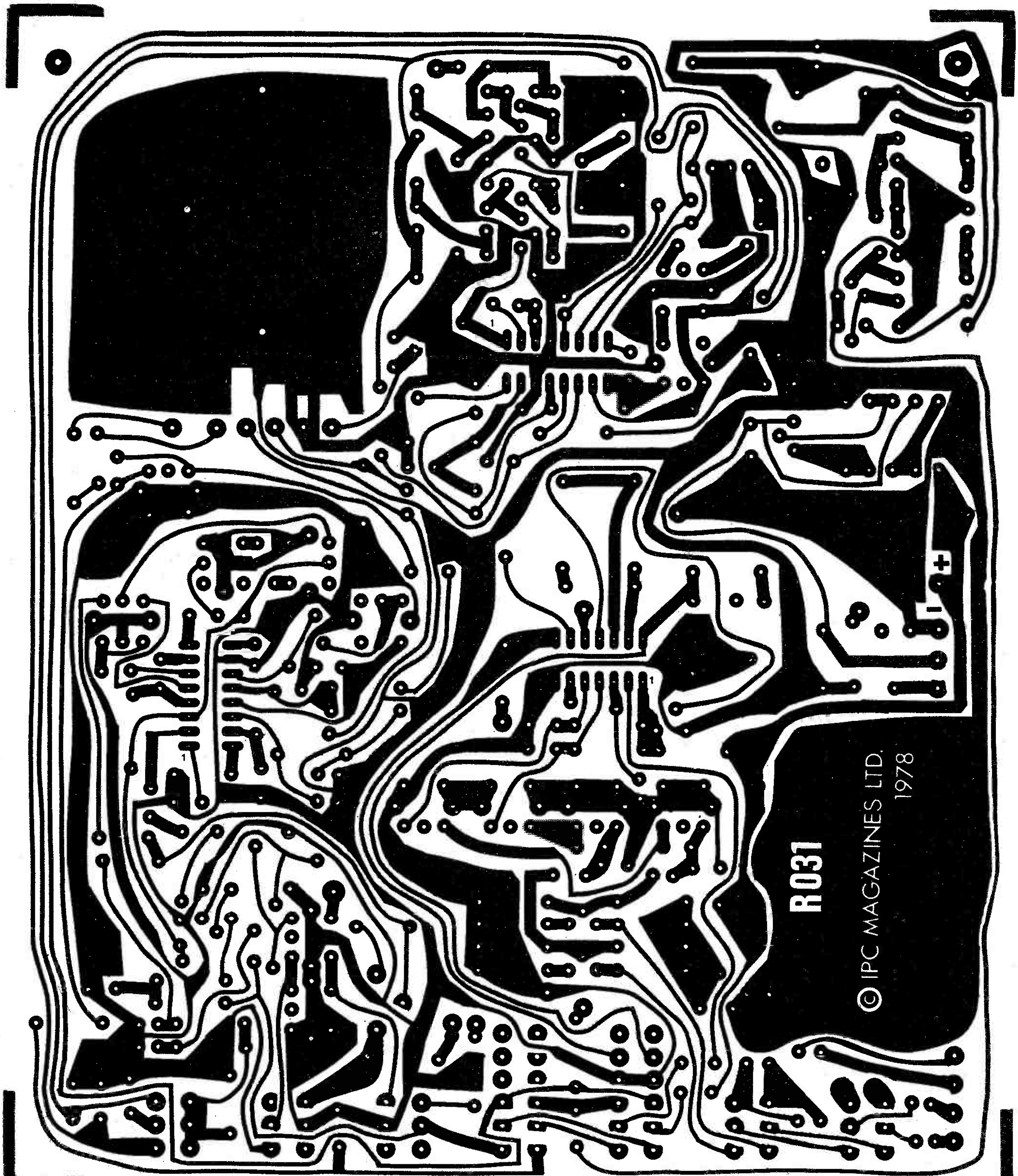


Fig. 6: Copper track pattern (full size) of the *complete* receiver p.c.b. The m.w. circuits will appear in the final part in December

Circuit Approach

The essential features of the pre-amplifiers needed for magnetic cartridge are that account should be taken of the fact that they operate as velocity devices, and that output is directly related to velocity. This means that a compromise has to be reached if the RIAA curve is to resemble a good match at maximum and minimum modulation levels. Eventually, this breaks down to a need for matching to 47kΩ impedance and a cartridge output between 3·5 and 5mV, which should cover the major differences in cartridge response and the velocity range in the original recordings.

A non-inverting configuration was chosen, since

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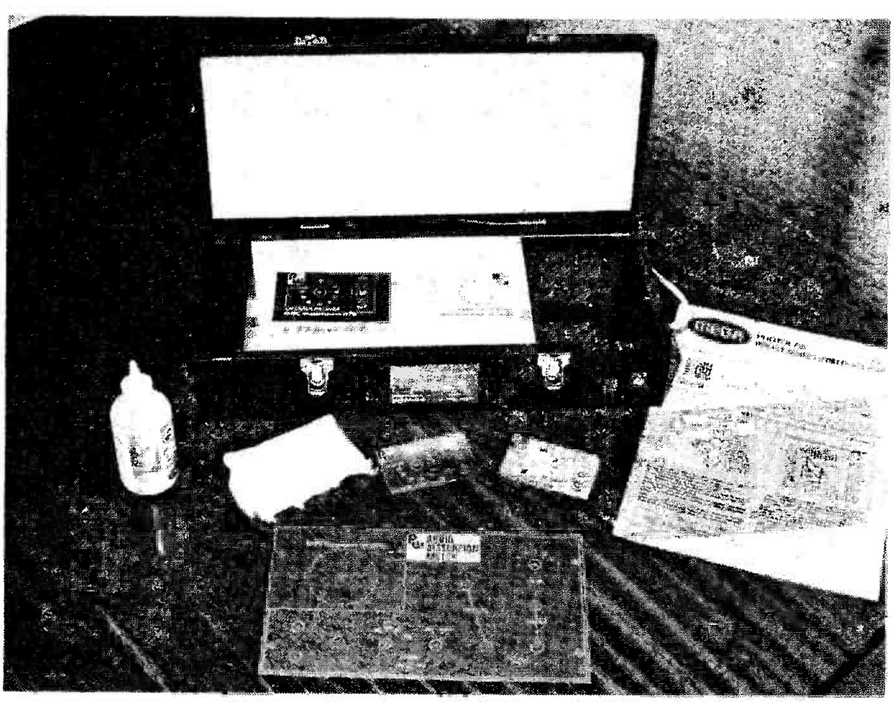
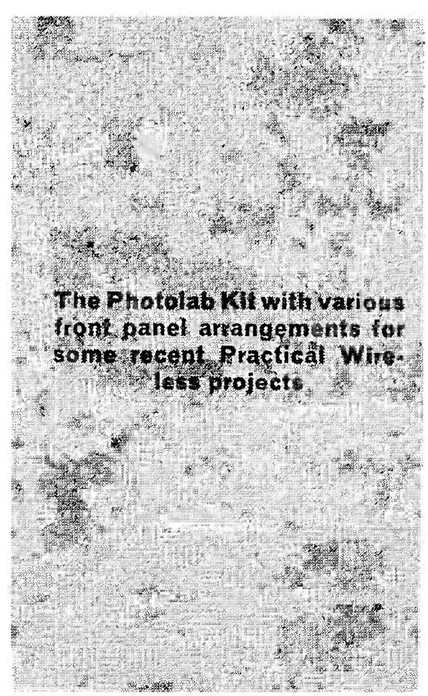
Although the necessary material has been available to produce aluminium panels photographically, they have been almost impossible to obtain in small sizes suitable for the home constructor's projects. This has now changed with the introduction of the Photolab Kit by Mega Electronics.

This kit contains all the equipment necessary to produce aluminium or plastic front panels as well as prototype single and double sided printed circuit boards.

Both p.c.b.s and panels are produced using photographic techniques on pre-sensitised materials available in a wide range of convenient sizes from Mega. An ultra violet exposure box provides the means of exposing the sensitised material and the necessary chemicals, and plastic trays to develop and etch the p.c.b. material are also provided. A small electric drill and a selection of twist drills complete the kit.

The production of p.c.b.s is very simple once a transparent positive has been produced, using the transparent film and rub-down pads and tracks provided or drawn on film with a suitably dense black





The Photolab Kit with various front panel arrangements for some recent Practical Wireless projects ink or paint. It is of course necessary to ensure that you produce a positive, i.e. black where you want copper left. The positive artwork is placed face down on the glass top of the u.v. box with the pre-sensitised copper clad p.c.b. material on top of it. Close the lid and time the exposure as directed in the clear instruction sheet then develop in the developing tray, rinse in water and place face down on the surface of the etchant in the other plastic tray. When fully etched the holes can be drilled for the component leads and the board cut to size.

Care must be taken with the chemicals, especially the etchant, and it is advisable to wear an overall and rubber gloves when using the developing and etching trays.

The quality of the boards produced by the kit is very good and the material seems to be very tolerant of variations in exposure and developing time and the resist appears to stand up to the etchant well. The laminate material is epoxy glass and both single and double sided types are available. The instruction sheet explains how to make double sided boards and following these a sample board was made confirming that the system works and that the registration of the two patterns was good. The resist can be left on the copper tracks after etching and forms an easy to solder fluxed coating.

The 12V d.c. drill supplied with the kit is quite capable of drilling the holes in the finished p.c.b.s but the concentricity of the collet chuck leaves a lot to be desired. Mega are now supplying their own very simple drill holder which improves the true running of the drill. A novel drill stand is available to take the drill, and Mega are about to launch a control unit and power supply for the drill.

A most interesting and exciting use of the kit is for the production of professional quality front panels. The process is very simple and involves the exposure to u.v. of the sensitised material through a negative artwork which can be easily prepared using rub-down letters and numbers and the film supplied. A range of colours is available and the material has a self-adhesive backing enabling the finished panel to be easily fixed to the main front panel.

The transparent overlay films which are available from the *PW* Editorial offices for selected *PW* projects make ideal artworks and produce excellent front panels. Using these films results in a panel which has silver lettering on a coloured background. To produce a silver panel with coloured markings requires the production of a reversed film available from Mega. After exposing the panel material, or reversal film, in the u.v. box the special developer supplied is spread over the sensitised surface and then rubbed with the lint-free pads supplied. This removes the unwanted coloured surface leaving the desired patterns on the surface. The panel can be cut to size easily using scissors or a sharp craft knife, and apertures are also easy to cut. The finished panel should be sprayed with a fixer varnish to provide a scratch-proof finish.

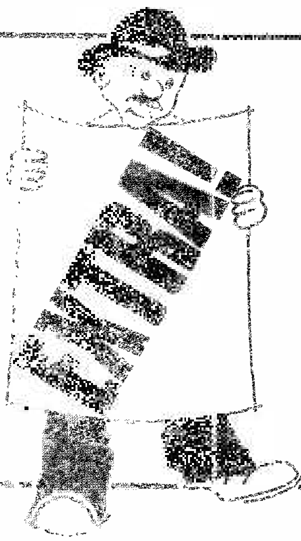
The kit provides a good investment for the home constructor allowing him to make trial p.c.b.s rapidly and economically and to provide his projects with professional quality front panels of which he can be proud.

Mega Electronics Ltd., 9 Radwinter Road, Saffron Walden, Essex CB11 3HU. Tel: 0799 21918

Dick Ganderton

NEXT MONTH IN... practical WIRELESS

ON SALE 3RD. NOV.

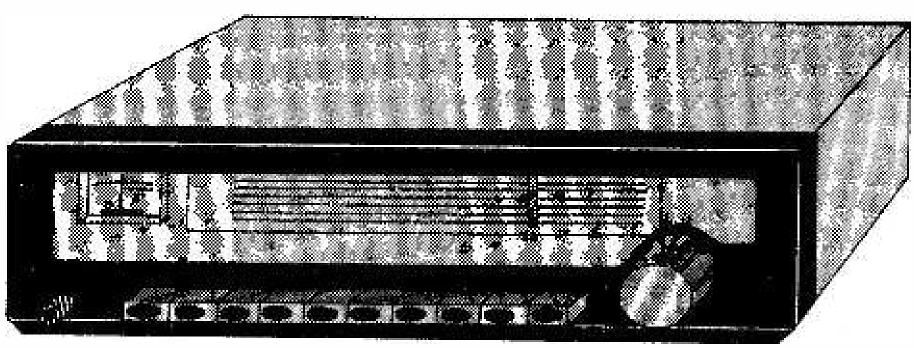


8 Page Supplement 'BREADBOARDS'

Prototyping aids for the constructor

the PW 'Dorchester' ALL-BAND TUNER

State-of-the-art circuitry, long, medium, 3 short waves and stereo v.h.f. make this easy-to-build project an attractive proposition for the avid short-wave listener and music lover. A b.f.o. is provided for the reception of c.w. and s.s.b. signals and excellent overall performance can be expected. To complete the tuner, a commercially made cabinet and tuning scale will be made available.



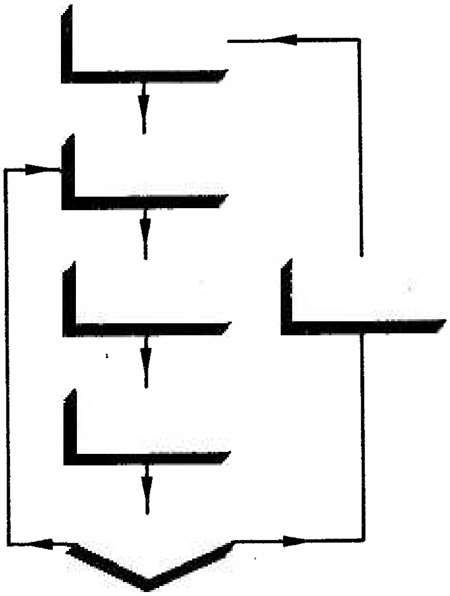
ALSO:

CAR RADIO LONG-WAVE CONVERTER

Those without l.w. facilities on their car radios will now be able to receive the new Radio 4 transmissions. This unit converts 200kHz (l.w.) into a narrow "slot" at the high end of the m.w. band.

DIGITAL DOOR CHIMES

Bring your "early warning" system into the twentieth century with our CMOS-operated "Digital Door Chimes". Delight (or insult) callers with "Colonel Bogey" or any other self-programmed melody.



WHY PROGRAMMABLE?

It is not very many years since the first scientific electronic calculators were introduced. In their speed, they rivalled the slide-rule, and had the advantage of positioning their own decimal point! In accuracy, they were equal to a set of mathematical tables. Thus they combined the best features of both, though functions were generally limited to log, sin, cos, tan and their inverses. Prices of such instruments were pretty frightening—well in excess of £50, which was still quite a lot of money in those days.

Advances in the technology of design and manufacture of large scale integrated circuits soon meant that prices began to tumble, and all the while more functions appeared. Reciprocals, powers and roots, constants, conversions and statistics chased each other into the specifications, while memories and multiple sets of brackets added ease and power to calculations. Algebraic entry (this simply means that a problem is keyed into the calculator just as it would be written down on paper) became almost universal, though an alternative method known as Reverse Polish Notation still has its devotees. It was not long before a machine offering some thirty functions could be purchased for under £30.

The advantages of a calculator with functions such as those listed above were fairly obvious to anyone involved in any branch of engineering, though probably many that were bought were used mainly for the four basic arithmetic functions—for adding up bills, checking bank statements and the like. But there had appeared on the scene programmable calculators, some at prices around £200. Their advantages were not so obvious then, nor are they today for many people, other than those versed in computers. Prices have plummetted yet again, and this month we offer PW readers a scientific programmable calculator for just £26·95.

So, what is a programmable calculator, and what can it do? For those who are frightened off just by the word "program" (which simply means a series of instructions to be followed), it may be reassuring to realise that **all** calculators make use of programs, even if you're just asking them to add one and one! Far more complicated programs are needed in a scientific calculator, for instance to produce the square root of a number, or the sine of an angle. These programs are worked out by the designer and come into operation when you press the appropriate button. They are preset and cannot be altered by the user. When we talk about a programmable calculator, we mean that the user **has** got control over the series of instructions that will be followed by it.

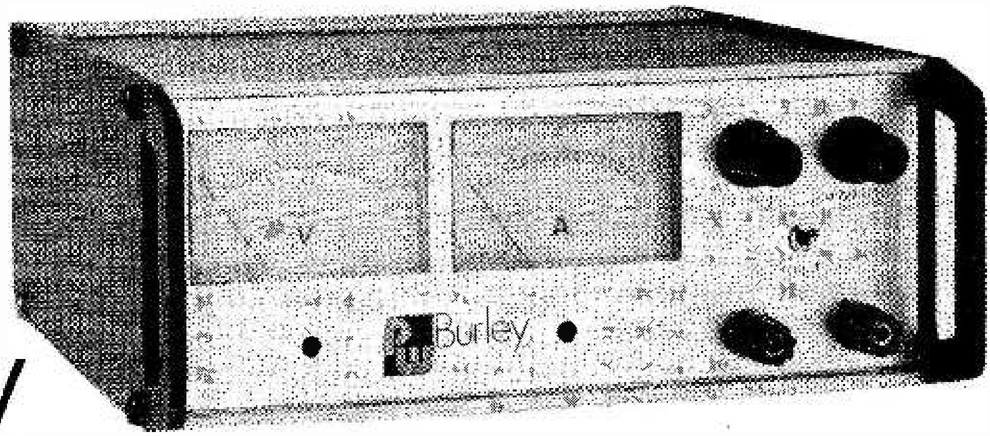
The instruction program is entered by the user as a sequence of key strokes. These are remembered by the calculator for later operation, and can be used over and over again. This is a particular advantage where you want to repeat a calculation with several different sets of data. Obviously, you could key in the instructions afresh with each set of data; this is what you are doing when performing chain calculations on a conventional calculator. The advantage of programming over manual operation is that the instructions have to be entered just once, taking less time and reducing the likelihood of error. All that is then necessary is to enter each new set of data into the appropriate memories, press the "RUN" key and the calculator will do the rest.

A programmable calculator can be used in an even more powerful way, to solve problems which would be impractical on a manual calculator. By means of a repetitive loop, a particular sequence of operations can be repeated as many times as required at the touch of one key. It is also possible to program a decision (called a conditional branch) whereby the calculator can be told to do different things according to the outcome of a previous calculation. Many programs can of course be shortened and speeded up by using standard pre-programmed functions within the program.

Typical applications for a programmable calculator include:

- Solving quadratic equations
- Complex arithmetic
- Matrices and determinants
- Vector problems
- Differential equations
- Co-ordinate geometry
- Statistical analysis
- Probability calculations
- Series

Burley Simple Stabilised Power Supply



W.S. POEL

★ specification of prototype

Output voltage 2·8 to 30V continuously adjustable
Output current—see SOA graph
Output regulation 0·1% at 1·5A
Output impedance $1{\cdot}5\times10^{-3}$ in SOA operation
Output noise voltage 80µV at 1MHz (may be reduced by 55dB with GA1A5). Typically below measurement floor on a spectrum analyser sweeping d.c. to 100MHz

Introduction

Just as most aspects of electronics have advanced mercilessly over the past five years, leaving a trail of prematurely redundant devices and systems in their wake, so the humble p.s.u. has recently received a jolt with the introduction of the L200 current and voltage regulator from SGS ATES. The L200 is supplied primarily in their versatile pentawatt package—although a TO8 can is provided for some applications. The specifications are, however, the same except that the pentawatt package apparently has a better junction/case thermal gradient.

The Regulator Unit

This device provides adjustable voltages from 2·85 to 36 volts, and variable current from 0 to 3 amps, when the input/output voltage differential permits. The regulator includes thermal and safe area of operation (SOA) protection that makes it virtually blowout proof (the actual maximum current being determined by the case temperature), shown in Fig. 4. The L200 does away with many of the past standards of the electronics industry by providing a five-pin regulator that can replace the 723 and "pass" transistor combination, and many of the more complicated discrete approaches that still manage to find their way into modern designs. The 7800 and LM340 series of regulators are still suitable for strictly fixed voltage applications, but the L200's versatility will certainly be favoured in many applications.

The Circuit

The applications circuit of the L200 as a variable current, variable voltage p.s.u. is quite straightforward, and makes some more costly p.s.u. regulator modules look embarrassingly overweight. Precautions are taken in the construction of the unit to eliminate as much r.f. interference as possible.

A mains filter is used, and since this also incorporates an IEC connector, the mains input lead is taken care of at the same time. Such a filter may seem unnecessary to some constructors, but the average level of noise pollution on the 240V mains is quite sufficient to get "through the works" and cause trouble on sensitive r.f. equipment. These units attenuate everything above 400kHz by over 50dB, making their inclusion a useful feature in quite a few mains-operated units.

Further r.f. decoupling precautions are taken close around the L200 itself, since despite its unassuming appearance, deliberate attempts to excite it into misbehaviour produced a very passable 20W topband transmitter. All that was necessary was to misdirect some of the decoupling slightly—so that a simple positive feedback loop existed. For users with a requirement for a very pure output, a second filter may be used—the GA1A5 (5 amp) provides a further reduction 55dB above 500kHz and also keeps r.f. out of the p.s.u. itself. A 5 amp filter provides surge suppression, and the use of the p.s.u. in connection with r.f. transmitter work should automatically include the second filter at the output terminations.

Setting Meters for F.S.D.

The metering circuits are straightforward enough—except to mention that these employ the Ambit "Meter Made 930" series, where the same basic blank meter is used with the scale selected and fitted by the user to suit the application in hand. The meters come with details of shunt and multiplier design, and in this context the calculations are as follows: meter type 930, 200µA f.s.d. unit resistance 750 ohms. To provide a 30V f.s.d., then according to Ohm's Law $30 = (200 \times 10^{-6})\ (R + 750)$ where "R" is the value of multiplier required reducing to $R = 150k - 750$ ohms. To permit accurate trimming of the f.s.d. a 68k and 47k are used in series with a 50k preset—the trimmer is then adjusted in conjunction with a known reference meter.

To provide a 2 amp f.s.d. for the current meter, $(200 \times 10^{-6})\ 750 = 2 \times R$ (the 200μA is insignificant in 2 amps) $R = 0{\cdot}075$ ohms. This is not the sort of value that grows on trees—and so it must be made. The easiest way is to wind a non-inductive resistor using ordinary cored flex ($7 \times 0{\cdot}2$mm). 70cm of a typical RS type was found to be the right value—and by over-cutting it, then trimming back, the exact value can readily be found using the reference multimeter as before.

Bang!

Note the protection diode placed across the output. The only way so far discovered to blow the L200 is to connect a fully charged 1000μF (or greater) capacitor the wrong way across the output pins. When working on equipment, it is going to be quite likely that this can occur if the circuit is momentarily connected in reverse. Be careful about this point, regardless of the protection afforded by the diode.

Construction

The case used is chosen from the Swift series by West Hyde developments. It is a costly approach, but since poor presentation nearly always lets down the home constructed equipment—it is well worth the expense. The rear panel makes an ideal heatsink for the L200, and by virtue of the construction of the case, it is also the best location for the transformer and all the mains connectors and fuse circuit components. The voltage setting potentiometer is a multi-

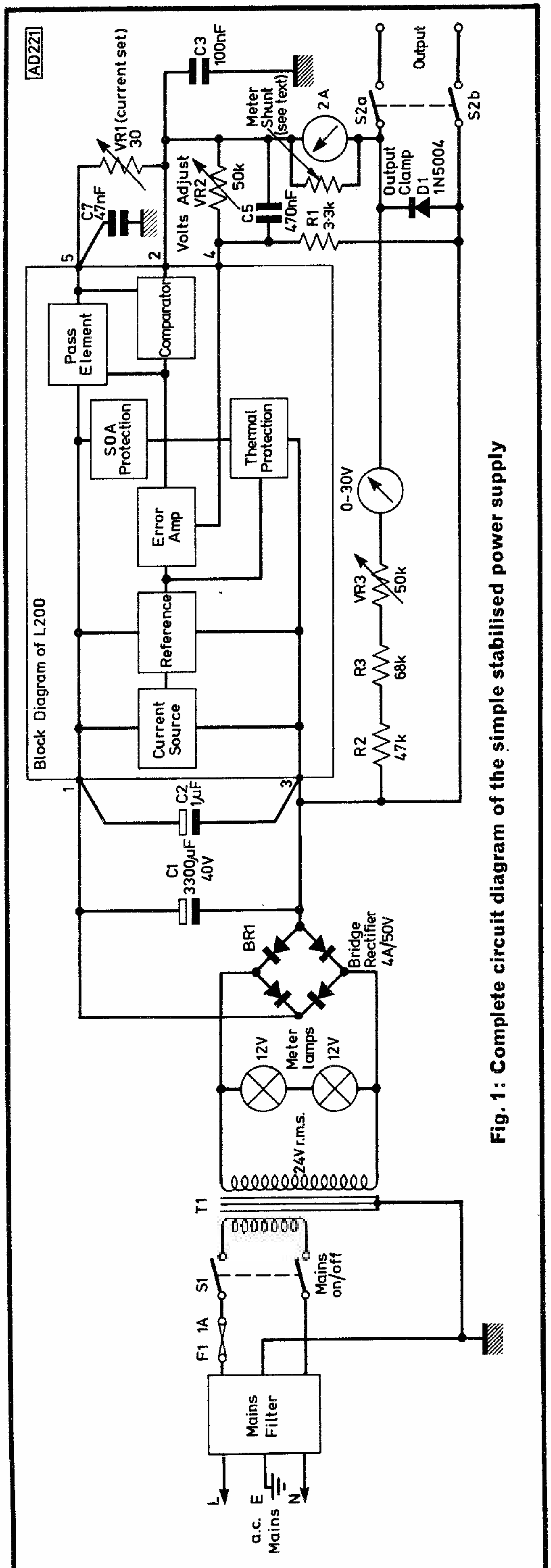
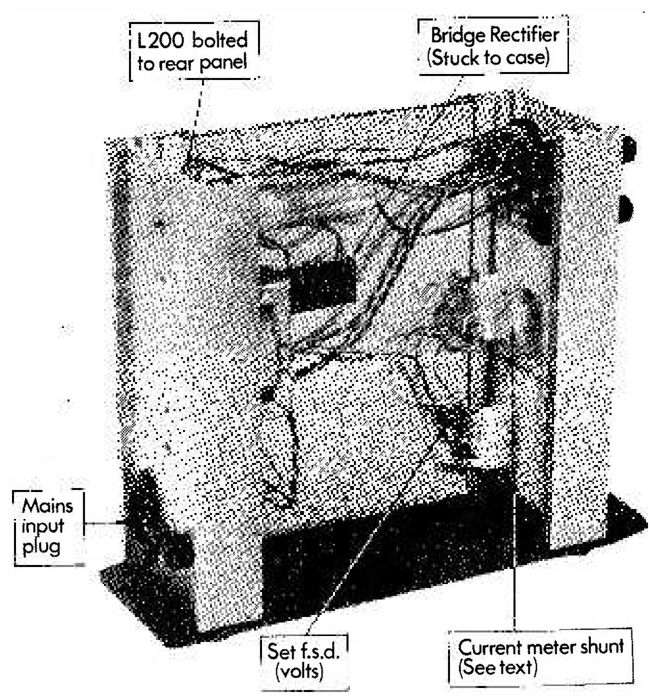


Fig. 1: Complete circuit diagram of the simple stabilised power supply

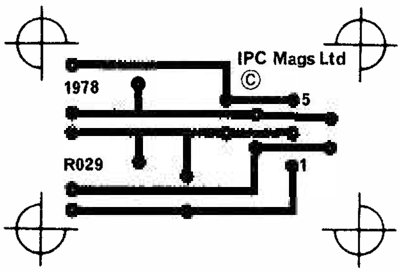


An internal view, showing the location of the major components

turn unit—again this may be substituted by a cheaper component with a loss of setting resolution. The current limit potentiometer must be a reasonable quality wire-wound unit. The current carrying output and input wires on the L200 should be reasonably sturdy to provide as little resistance as possible.

The bridge rectifier and reservoir capacitor are fixed to the base plate with double-sided adhesive tape. The prototype bears one or two scars of misplaced holes, but a brief experiment with the tape revealed that it was more than sufficient for the purpose and so nuts and bolts were omitted. In this way, holes and protrusions from the underside are avoided.

The mains transformer can be a straightforward 240V primary, and 24V (12-0-12 in series) secondary. The 930 series meters have internal 12V illumination which is run from the raw a.c. side of the secondary (in series).



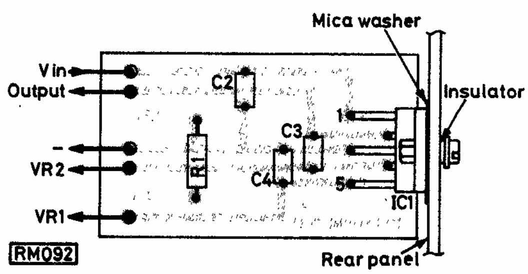


Fig. 2: (above) Copper track layout of the L200 connection p.c.b. (shown full size) and Fig. 3: (below) The component layout

Regulation

The current is regulated according to the value of the current regulator potentiometer where Iout max $= \frac{0\cdot6}{VR1}$. The current limiting is of a foldback nature—so simply short-circuiting the output will not necessarily give an accurate idea of the maximum current available at high voltage. The same effect can be seen when connecting the p.s.u. to an uncharged capacitor, where the voltage at the output falls momentarily to zero, since this may instantaneously cause the Vin/Vout to trip the SOA protection circuit, effectively latching up the whole works.

The "on" current surge of filament lamps will create the same effect again, so keep the d.c. input voltage to below the switch-off point on the SOA graph of around 34V. C5 is used in the circuit to supply a clean reference for the error amplifier—a ten-turn wire wound control will produce a "whirring" effect in the output voltage when spun, if this is not included.

The d.c. output is terminated without direct connection to earth, permitting either positive or negative chassis operation. A series-connected switch is included at the output terminals to isolate the supplied equipment when setting up. The chassis must be at mains earth for the purposes of supply filtering, and in a situation where the transformer is not of the preferred split/isolated bobbin type, it is necessary to provide primary/secondary breakdown fusing.

★ components

Resistors		**Potentiometers**	
¼W carbon 5%		VR1	30Ω wirewound 2W
R1	3·3kΩ	VR2	50kΩ ten-turn variable
R2	47kΩ	VR3	47kΩ miniature preset
R3	68kΩ		

Capacitors

C1	3300µF 40V electrolytic
C2	1µF tantalum 35V
C3	100nF mylar
C4	47nF mylar
C5	470nF mylar or polcarbonate

Semiconductors

IC1	L200 (SGS/ATES)
BR1	4A 50V
D1	1N5403

Mains Transformer
240V primary, 24V r.m.s. secondary

Miscellaneous
Case, West Hyde "Swiftcase", knobs—Sifam collett type, meters—930 series "Meter Made" (Ambit), S1, S2, on/off mains and on/off output—d.p.d.t. 2A rated, screw terminals, fuse holder, 1A mains fuse. Mains filter—Stamford Engineering or RS Comps.

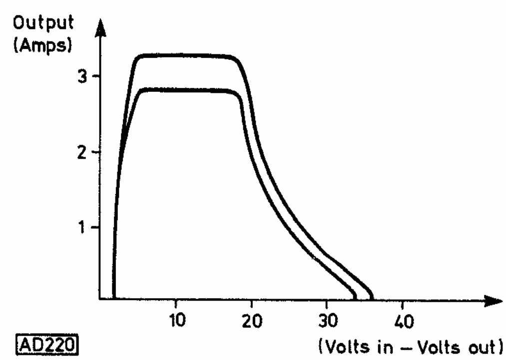


Fig. 4: Graph showing L200's current/voltage link with safe area of operation (SOA)

Using the Unit

The p.s.u. can be used to provide up to 3 amps (with an appropriately rated transformer) according to the limits of Fig. 4. If you have a specific need for high current, low voltage work, then use a transformer to give a lower d.c. unregulated voltage—keeping the Vin/Vout differential across the L200 to the range below 18V where most current is available. The maximum regulated output voltage will be approx. 2V less than the d.c. input voltage to the regulator—and in high current applications, depending on the transformer regulation, this may be increased to 5 or 6 volts at maximum output.

The unit may also be used for charging Ni-Cad batteries, etc. Set voltage to maximum (fully charged) required voltage, and attach the battery, slowly bringing up to the permissable level. ●

Introduction to LOGIC ~ 4

S. A. MONEY

So far we have seen that flip-flops can be used as latches, or as shift registers for converting data between serial and parallel formats. Flip-flops can be, and often are, applied to other useful activities, such as those of counting and frequency division. We shall now investigate these applications of the flip-flop.

Frequency Dividers

When we examined the JK type flip-flop it was noted that an interesting action occurred if both the J and K inputs were held at *1*. Under these conditions the Q output simply changes state each time a clock pulse is applied. If the clock input is a square wave with equal half cycles at the *1* and *0* levels the resultant waveforms for clock input and Q output will be as shown in Fig. 42. Now the output waveform has the same shape as the clock signal but it has exactly half the frequency. We have produced a nice little circuit which will divide frequency by two.

You don't have to use a JK flip-flop to produce a divide-by-two circuit however, because a D flip-flop can also be connected to perform the same action. This is done by connecting the $\bar{Q}$ output back to the D input as shown in Fig. 43. Now when a clock pulse is applied, the $\bar{Q}$ output will take up the state previously held by the $\bar{Q}$ output. In other words the Q output changes state in the same way as it did with the JK flip-flop. We now have another version of the divide-by-two circuit.

Suppose we connect several divide-by-two stages in cascade as shown in Fig. 44. Here the $\bar{Q}$ output from each stage is used as the clock drive for the following stage. At the output of the first stage the frequency is half that of the clock input. At the second stage the frequency will be a quarter of the clock frequency and so on. For four stages we could produce half, quarter, one eighth and one sixteenth of the input frequency (Fig. 45).

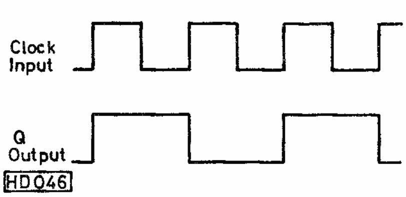


Fig. 42: Divide-by-two stage waveforms

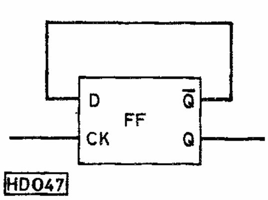


Fig. 43: A D-type flip-flop connected as a divide-by-two stage

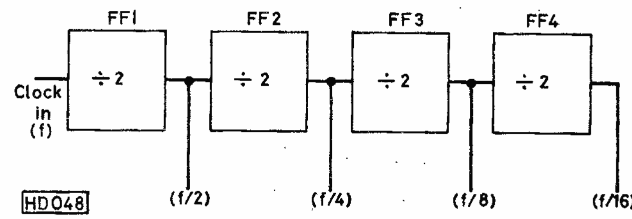


Fig. 44: A 4-stage binary divider

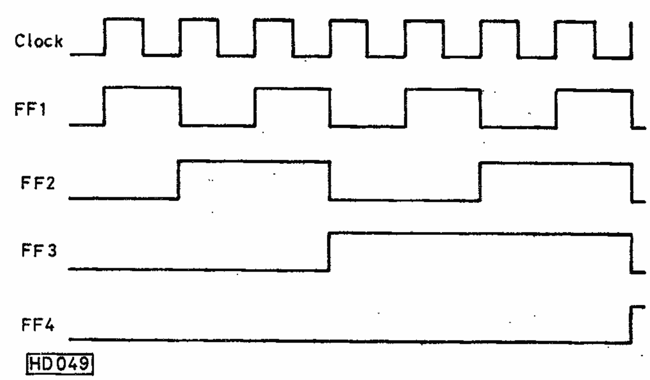


Fig. 45: Normal counter waveforms

If the Q output of each stage were used for the clock of the next stage we should still get the frequency division but each frequency would be in phase with the others. This is shown in Fig. 46.

This technique of frequency division is in fact used for quartz analogue watches. In this type of watch a tiny electric motor drives the hands and is pulsed at a rate of one pulse per second. For accurate timekeeping a quartz crystal oscillator is used to produce the pulses. Such an oscillator is not really practical at one cycle per second so the primary oscillator may run at a much higher rate and the frequency is divided down to produce one pulse a second for driving the hands of the watch.

Often the crystal frequency will be 32·768kHz which when divided by two a total of fifteen times produces a frequency of one hertz. So the crystal oscillator will be fed through a chain of fifteen divide-by-two circuits to produce the required output signal.

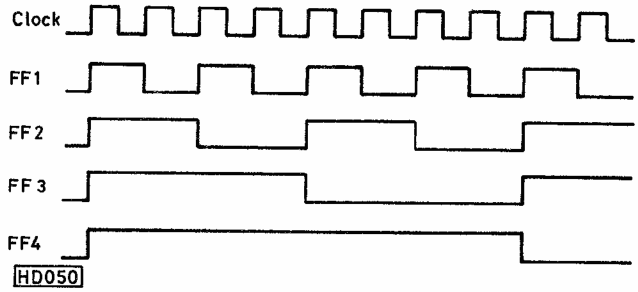


Fig. 46: Waveforms where Q is used as clock drive

Sometimes the crystal may operate at even higher frequencies, such as 2·0968MHz in which case a 21-stage frequency division chain might be used to produce the one hertz output. The same type of divider chain is also used for the initial frequency division in a digital watch or clock running from a crystal.

Normally in our everyday lives we use the decimal system of numbers. Here each of the digits of the number is allocated a weight value so that we have units, tens, hundreds, thousands and so on. If we take the number 103 as an example it can be broken down as follows:

$$(1\times100)+(0\times10)+(3\times1)=103$$

Numbers can also be represented by using a binary system. Here the digits can have only the value *1* or *0* and the weights allocated to each digit will be units, twos, fours, eights, sixteens and so on. Let us now see what our decimal number 103 looks like in its binary form. It will in fact be *1100111* which can be analysed as;

$$(1\times64)+(1\times32)+(0\times16)+(0\times8)+(1\times4)+(1\times2)+(1\times1)=103$$

Why do we need to know about binary numbers? Well our logic system uses the binary states *1* and *0* so it is convenient to represent numbers in binary form. Each of the digits has a weight which is twice that of the next digit. Now we can, as we have just seen, divide frequency or numbers of pulses by two quite readily, and this lends itself to the production of counter systems which present the answer as a binary number.

Binary Counters

Suppose we have a chain of four divide-by-two stages as shown in Fig. 44 and that we start off by having all four stages set at *0*. As clock pulses are applied at the input the four stages will go through the sequence of logic conditions shown in Table 9.

From this sequence of logic states we can see that after each clock pulse the pattern of *1*s and *0*s stored in the four flip-flops represents the binary number of clock pulses that have been applied. Here the state of flip-flop FF1 represents the units digit whilst FF2, FF3 and FF4 give the twos, fours and eights of the binary number.

Let us see how such a counter might be used. Suppose we have a production line making radio sets and we arrange that as the sets leave the line they pass through a light beam falling on a photocell. Each time a set passes the photocell a pulse will be produced and this can be fed as the clock input to the first stage of a binary counter chain. At the beginning of the day the counter can be set at zero and when production stops at the end of the day a binary number will be stored in the flip-flops making up the counter. This binary number represents the total number of sets that have been produced during the day.

If we wanted to count the number of pulses occurring in a second in some electronic circuit a similar approach might be used. Here an input gate is needed to control the application of the pulses at the clock input. The gate is opened for a period of exactly one second allowing pulses to reach the counter and be counted. Assuming that all of the stages of the counter were set at zero before the gate is opened then at the end of one second the gate will stop the incoming pulses and the counter will show the number that occurred in the last second whilst the gate was open. The gate timing might also be derived from a counter chain driven by a crystal oscillator as shown in Fig. 47.

BCD Counters

So far we can divide frequencies and count pulses using the binary system and the answers might be displayed on a series of lamps as a pattern of *1*s and *0*s forming the binary number. Unfortunately, human operators are used to seeing numbers in their decimal form and will generally be confused by patterns of *1*s and *0*s forming binary numbers. What we need is some scheme where we can use binary logic to perform the counting process but where the display is presented in the more familiar decimal form.

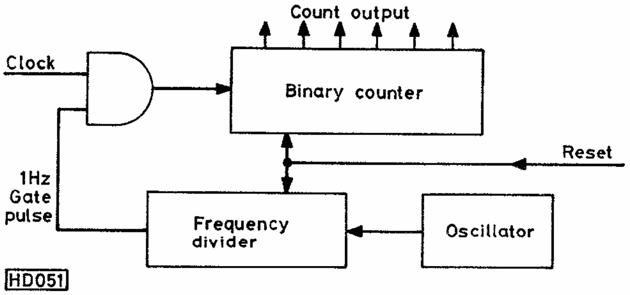


Fig. 47: A gated counter system

Table 9

Clock Pulse	Logic State FF4	FF3	FF2	FF1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

Converting pure binary numbers into decimal numbers is a rather complex process but it is possible to code our decimal numbers into a binary form so that they can be processed by logic. A 4-digit binary number can, as we have seen represent the numbers from 0 up to 15. To avoid confusion between binary and decimal digits let us introduce a new term. The binary digit is usually called a Bit so we can now say that a decimal digit may be represented by a 4-bit binary number. If we apply this scheme to our number 103 it will become;

0001 0000 0011
1 0 3

This method of writing numbers is called Binary Coded Decimal (BCD) and has the advantage that it is relatively easy to convert to and from real decimal numbers whilst giving a binary form of number which can be handled by logic systems.

So let us see how we might build a counter system using this Binary Coded Decimal numbering scheme. For the units digit of the decimal number we can use a 4-stage binary counter. Starting off with all stages set at *0* the clock pulses will cause the 4-bit binary pattern from the counter to step through the numbers 1 to 9. On the tenth clock pulse we must arrange that the pattern returns to zero and a clock pulse must be produced to drive the tens decade of the counter chain. The return to zero after the ninth clock pulse is achieved by using a gate to detect the pattern for 10 and using its output to reset the four counter stages. This is shown in Fig. 48.

For the tens decade a second group of four divide-by-two counters with a reset gate is used and this pattern is repeated for the hundreds, thousands and so on. Thus there will be a 4-bit binary pattern from the counter for each decade of the decimal count.

In the reset gate only two inputs are used. Looking at the table of logic states in Table 9 it will be seen that only at the count of 10 will both the "2" and "8" bits of the binary number be at *1* together. The other two bits of the pattern do not matter since they are only effective for counts above ten and we are going to reset the counter at ten anyway. When bits "2" and "8" go to *1* the output of the NAND gate falls to *0* and this is applied to the reset lines of all four stages to force them into the *0* state. Here a TTL type counter has been assumed. If the counter requires a *1* input to the reset line to produce the reset action the gate would be replaced by an AND type.

As the counter resets at the tenth clock pulse the $\bar{Q}$ output will go from *0* to *1* and this transition can be used as the clock pulse drive for the next decade counter.

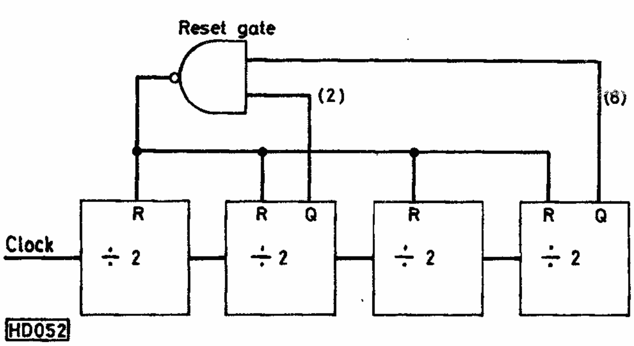


Fig. 48: A decade counter

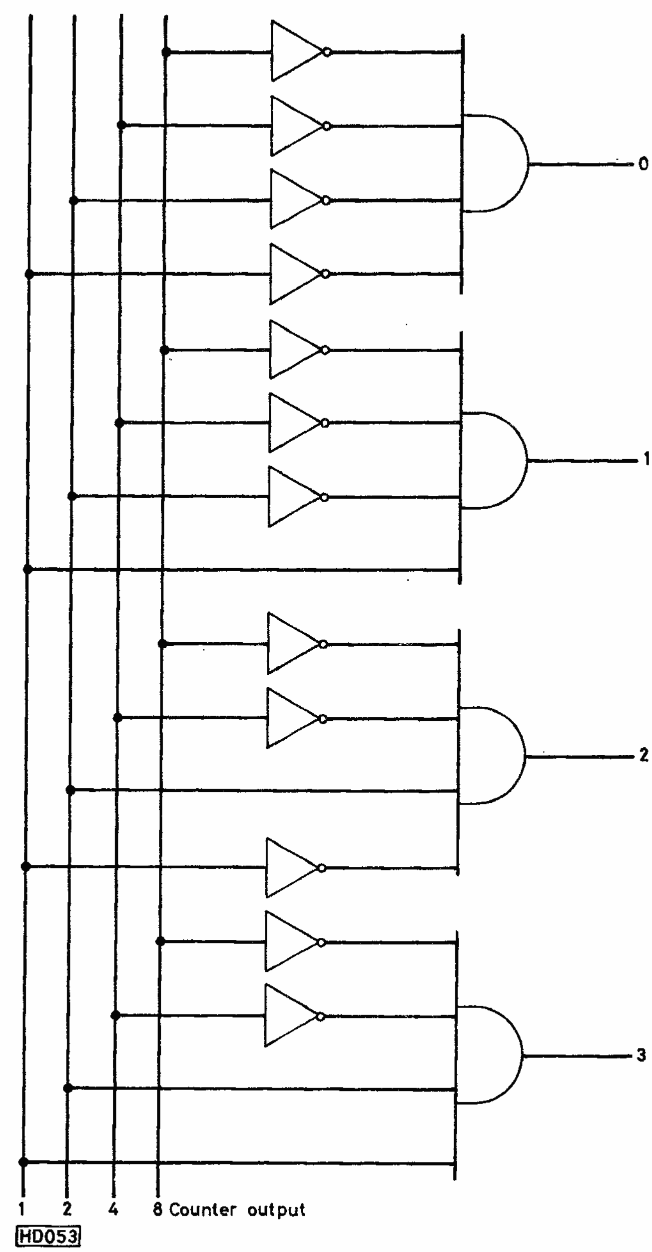


Fig. 49: Principle of a decimal decoder

Because decade counters are regularly-used devices it is common to find a complete decade counter with its reset gate built into a single package. Typical of these is the 7490 in TTL which provides one decade of a BCD-type counter chain. The 7493 contains just the four divide-by-two stages and can be used as a simple 4-bit binary counter. In CMOS similar functions are found in 4518 (BCD) and 4520 (binary) counters except that there is a pair of decade counters or binary counters in the single package.

Display Decoders

Having produced a decimal count and obtained the binary pattern for each decimal digit the next problem is that of displaying the answers. One solution is to use each bit output to light a lamp and read off the binary pattern of *1*s and *0*s from the array of lamps, but this is not very attractive.

By using a series of gates we can select out each of the binary combinations from 0 to 9. In Fig. 49 we show how this is done for the first few digits. The basic scheme is to use a 4-input AND gate to detect the pattern. Where the bit should be a *0* the input to the AND gate is inverted so that when the desired pattern occurs all of the inputs to the AND gate go to *1* and the gate gives a *1* output. Now as the output from the counter stages is stepped through from 0 to 9 each gate will produce a *1* output in turn as its particular count pattern occurs.

A simple display scheme is to have a bank of ten lamps, numbered 0 to 9, for each decade. Now the answer can be read off by simply noting which lamp is lit in each decade to give the hundreds, tens and units of the result. In TTL the 7442 provide this one-from-ten decoding system in a single chip. The 4-bit outputs from the counter are fed to the 7442 and one of its ten outputs will go to *0* according to the binary pattern at the input.

A more convenient display system makes use of Nixie-type display tubes. These consist basically of a neon lamp which has a common anode and ten separate cathodes. Each cathode is formed in the shape of one of the numbers from 0 to 9. With a suitable supply to the anode, if one of the cathodes is taken to 0 volts a discharge will strike between it and the anode. The glow will be in the shape of the symbol formed by the cathode selected.

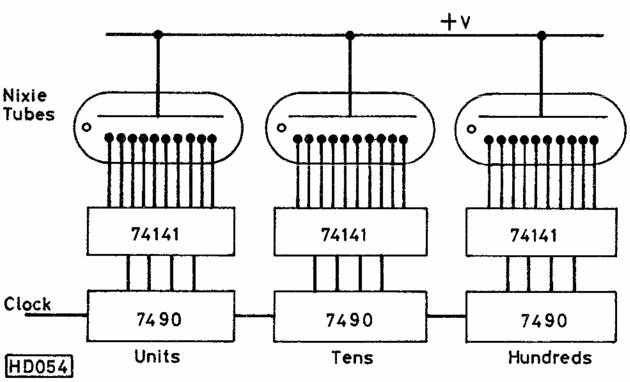


Fig. 50: A typical counter with Nixie displays

The Nixie tube can be driven by a special logic decoder such as the 74141 in TTL which carries out a one-from-ten selection and provides the appropriate drive for the cathodes of a Nixie tube. The system for a 3-decade BCD counter system and display might now be as shown in Fig. 50.

Seven-Segment Displays

Although Nixie tubes are still used for displays a more popular technique today is to use a light emitting diode or liquid crystal display. In this type of display the numbers are formed by selectively lighting up seven bar segments as shown in Fig. 51 and the resultant number shapes will be as shown in Fig. 52.

The segments of the display are switched in much the same way as the cathodes of a Nixie tube but a rather more complex decoder is required. This consists basically of a one-of-ten decoder to select the numbers to be displayed and each output of this drives a further set of gates to select the pattern of segments needed to display that number. Typical devices of this type are the 7447 in TTL and the 4511 in CMOS. In some 7-segment l.e.d. displays the anodes are separate with a common cathode, and for these a 7448 decoder might be used.

Fig. 51: Seven segment display layout

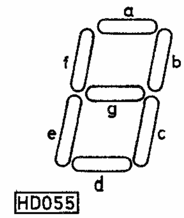
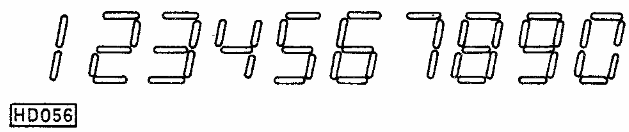


Fig. 52: Seven-segment number patterns



Sometimes for multi-digit displays a single 7-segment decoder is multiplexed to feed all of the displays. The general idea of such a scheme is shown in Fig. 53. The segments of all of the displays are fed in parallel from a 7-wire bus driven by the 7-segment decoder. At the input to the decoder the 4-bit pattern for each decade of the counter chain is switched in sequence and at the same time the anode voltage to the appropriate display is also switched on so that only the selected display digit will light. The displays are now continuously scanned at a rate fast enough that persistence of vision will eliminate flicker as the displays flash on and off. This type of display scheme is often used on the large scale integrated circuits since it reduces the number of pins needed on the package in order to drive a bank of displays. A similar scheme can be used equally effectively with the Nixie tube type of display.

Often in such devices as digital clock circuits or multi-stage counters in one integrated circuit the display decoding, multiplexing and drive circuits are built into the chip giving only the seven cathode outputs and the anode outputs to the display system.

Digital Clocks

Having produced decade counters and displays we now have the basic ingredients for a digital clock. However, we do need one more type of counter which will divide by six. This can be achieved in much the same way as a decade count but in this case the reset gate is arranged to respond to the binary pattern for six instead of ten. So for the seconds

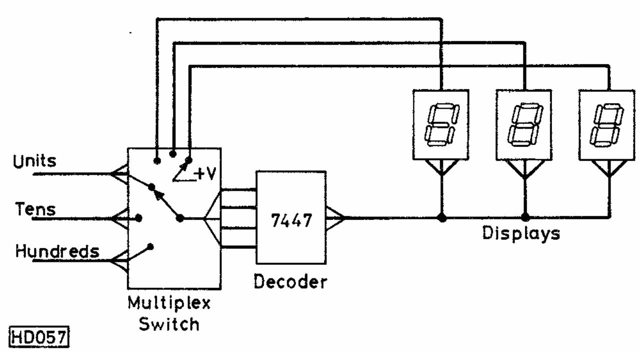


Fig. 53 Principle of a multiplexed display system

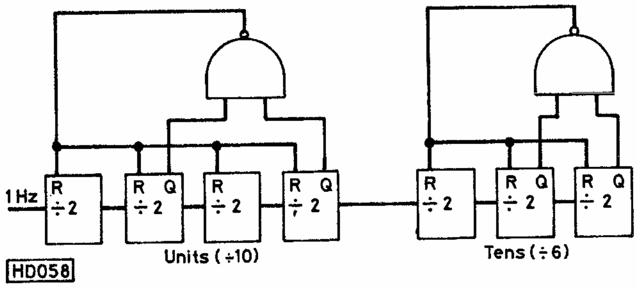


Fig. 54: A seconds counter system

section of the clock the system might be as shown in Fig. 54. Here the seconds are counted off by using a 4-bit decade counter whilst for the tens of seconds a 3-bit counter is used since it will only count up to five and then will be reset to zero on the sixth count. The 8-bit input to the tens of seconds display driver is permanently set at *0* to produce the correct display. A pulse is taken from the tens of seconds counter each time it resets to *0* and this pulse is used to clock the minutes stage of the clock.

The overall system for a digital clock would be as shown in Fig. 55. In the hours stages, assuming a 24-hour system, both the tens of hours and hours must be set to zero when their combined count reaches 24. This is done by gating the "2" bit from tens of hours and the "4" bit from hours into an AND gate and using its output to reset both counters. For a 12-hour clock system a similar scheme is used, but this time it is arranged to reset the hours counters when the total count reaches 12 instead of 24.

Most digital clock and watch systems use special large scale integrated circuits to carry out the counting, decoding and display drive functions. In some cases these circuits may also include further counters for day, month and year to provide an automatic calendar as well as time.

Identity Gates

Suppose we want to build an alarm clock. How can the alarm be organised? Basically the scheme is to compare the binary pattern representing the alarm time code with the count pattern coming from the clock counter chain. When the two patterns are identical a flip-flop can be triggered. This flip-flop will then control the alarm circuit itself. The alarm code may be selected by a multiway switch or it may be entered into a bank of flip-flops in the clock system.

To compare two binary numbers for identity we can use a set of EXCLUSIVE OR gates as shown in Fig. 56. In the EXCLUSIVE OR gate you will recall that if both of the inputs are at *1* or both are at *0* the gate output will be *0*. In an identity gate one bit from one of the numbers to be compared is fed to one input of the gate, whilst the other input is fed by the corresponding bit in the second number. This is done for all of the bits in the numbers to be compared, one EXCLUSIVE OR gate being used for each bit in the numbers. When the two numbers are identical all of the outputs of the EXCLUSIVE OR gates will be at *0*. These signals can now be inverted and gated together in an AND gate to produce a single output which will be *1* when the input numbers are identical and *0* when there is a mismatch. For an alarm system the output of the AND gate is used to set a flip-flop which then operates the alarm device.

This technique of comparing two binary or BCD numbers may be used in other applications where identity between a pair of numbers is to be detected.

Synchronous Counters

In the counters we have considered so far each stage produces the clock pulse for the following stage in the chain. Because of propagation delays in each stage the clock pulse to the next stage will be delayed slightly. Suppose we have a 3-stage binary counter set at *111* and apply a clock pulse. In theory the counter should switch to the *000* state immediately but in practice the sequence of logic states shown in Fig. 57 will occur. Here the delays have been exaggerated to show the effect more clearly. The stages switch one after another to give a rippling action and for this reason this type of counter is usually referred to as a "ripple-through" counter.

Problems can arise when gates are used with ripple-through counter chains to detect a particular count state. In Fig. 57 it is seen that the states *110* and *100* appear briefly at the output of the counter and any gates set to respond to these patterns may be activated. As a result a short pulse, usually referred to as a "glitch", may appear at the output of these gates. This can cause havoc in a logic system by mis-triggering of other logic circuits by the glitch pulses.

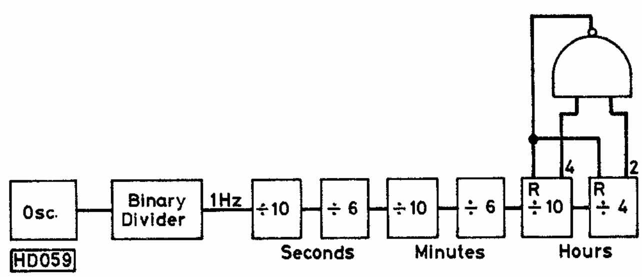


Fig. 55: A typical digital clock counter

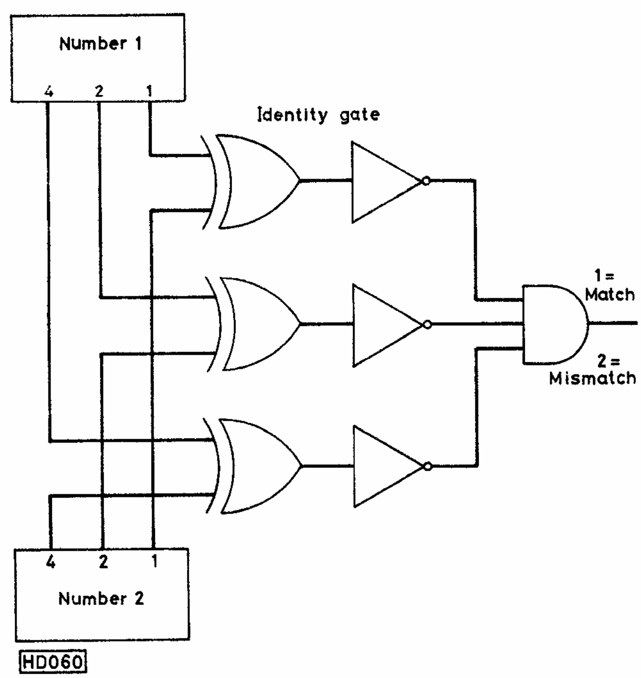


Fig. 56: An Identity gate

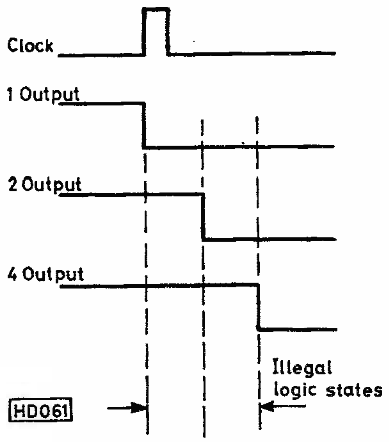


Fig. 57: The effect of propagation delay in a "ripple-through" counter

To overcome the problem of glitches caused by ripple-through counters an alternative type of circuit known as a synchronous counter may be used.

In the synchronous counter a master-slave flip-flop is used for each divide-by-two stage. Now the input clock is applied to all stages simultaneously and hence output logic states tend to change synchronously for all stages, thus reducing the problems of glitches in selector gates operating from the counter.

Most synchronous counters come as 4-bit units and may be designed for either pure binary or decade counters. Typical devices are the 74160 and 74162 decade counters and the 74161 or 74163 binary counters in TTL. In the CMOS range the 4518 and 4520 provide dual decade or dual 4-bit binary counters.

Up/Down Counters

Sometimes instead of counting upwards we may wish to count downwards, say from 9 down to 0. In a simple binary counter this is easily achieved by inverting the output signals from the counter stages. This effect is shown in Table 10 where the binary counts and their decimal equivalents are shown for both the normal and inverted outputs of the counter stages.

An alternative approach is to take the clock drive for each stage from the Q output of the preceding stage instead of from its $\bar{Q}$ output. Now assuming we start with say the count state *000* when the clock pulse is applied the first stage will set to *1*. This will in turn clock the other stages to *1* to end up with the count *111* which gives a count of 7 after the 0 count. On the next clock pulse the count will reduce to 6 and so on. You can work through these states to check that the count decreases for each clock pulse.

For a decade counter things are a little more complex. Now after the counter reaches 0 its next count is to 15 (*1111*). This must be detected by the reset gate and then the counter must be forced into the 9 state to produce the correct count sequence.

Fortunately Up/Down counter devices are available as single integrated circuits with the required control logic built in. Sometimes a control line determines whether the counter will count forwards or backwards. In TTL the 74190 (decade) and 74191 (binary) counters use this technique. Alternatively two separate clock inputs may be used, with one for up counting and another for down counting. This is the case for the 74192 (decade) and 74193 (binary) types.

Presettable Counters

Many of the integrated circuit counter devices have facilities for direct parallel loading of data to force the counter into a desired count state. This can be of use where a variable time delay is required such as in a darkroom timer. The technique is to preset the counter to the desired number of seconds and then to count down until the zero count is detected. At this point the alarm or other circuit may be triggered. For other count times the value preset into the counter is altered but the reset detection gate remains set for the zero state. This count down to zero technique may be used for any application where a variable number of pulses must be counted, before another circuit is triggered.

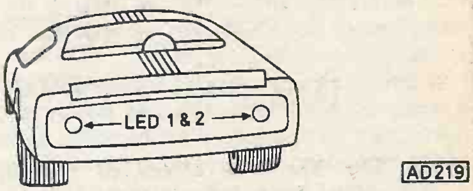
TO BE CONTINUED

Table 10

Binary Digits "8"	"4"	"2"	"1"	Decimal Digit	Inverted Bits "8"	"4"	"2"	"1"	Decimal Digit
0	0	0	0	0	1	1	1	1	15
0	0	0	1	1	1	1	1	0	14
0	0	1	0	2	1	1	0	1	13
0	0	1	1	3	1	1	0	0	12
0	1	0	0	4	1	0	1	1	11
0	1	0	1	5	1	0	1	0	10
0	1	1	0	6	1	0	0	1	9
0	1	1	1	7	1	0	0	0	8
1	0	0	0	8	0	1	1	1	7
1	0	0	1	9	0	1	1	0	6
1	0	1	0	10	0	1	0	1	5
1	0	1	1	11	0	1	0	0	4
1	1	0	0	12	0	0	1	1	3
1	1	0	1	13	0	0	1	0	2
1	1	1	0	14	0	0	0	1	1
1	1	1	1	15	0	0	0	0	0

Gadgets around the House

Slot Car Brake Lights



This simple, but effective, circuit adds working brake lights to slot racing cars. The brake lights are out when the car is accelerating or running at constant speed, but come on as the car slows down.

The circuit is shown in Fig. 1. When the motor is drawing current, diode D1 is forward biased, and LED1 and LED2 are both off. If power is removed the motor acts as a generator and current flows through LED1 and LED2, R1 and R2. The two l.e.d.s light and stay lit until the car is almost stationary. Capacitor C1 stops the l.e.d.s flashing as the car passes over dirty track, and prevents them lighting on the troughs in the normally unsmoothed supply. Diode D2 protects capacitor C1 from reversed supply. This diode will short the supply, but slot racing supplies are protected by a current limit or cut-out. Diode D1 introduces a 1 volt drop to the motor, but this has not been found deleterious in normal home sessions. It might make a small difference in a serious slot car competition but could probably be compensated for in the motor design. The weight of the components might be advantageous if correctly positioned inside the car.

Although the circuit has been shown driven from a positive supply, reversal of all polarity sensitive components will allow operation from a negative supply. The l.e.d.s can, of course, be replaced by other suitable indicators. The unit can be built on a small piece of 0·1in Veroboard, but the components could be positioned anywhere convenient inside the model car if space is at a premium.

The circuit has been tried on Revell and the more powerful of the Scalextric range of cars, but some experimentation with the value of R2 might be necessary in individual cases.

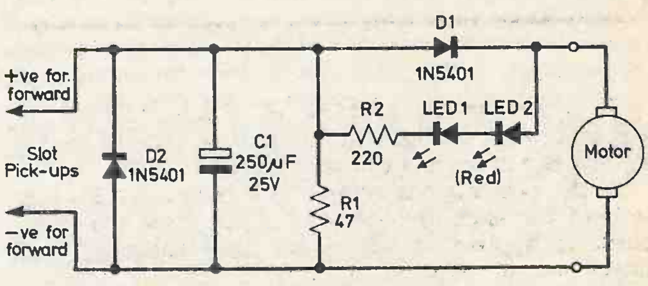


Fig. 1

★ components

Resistors
¼W 5%

R1	47Ω
R2	220Ω

Capacitor

C1	250μF 25V electrolytic

Diodes

D1, 2	1N5401
LED1, 2	Any suitable l.e.d. (TIL209)

Porch Light Timer

This simple timer was originally designed for the purpose of switching on an outside light for about five minutes by simply pressing a bell-push once. It was connected in parallel with the original light switch and does not affect its normal function, but, by providing a means of running the light for only a specified period it has proved to be most convenient for getting the car out during hours of darkness.

The five minutes of illumination given by the timer has proved to be adequate to cover removal of the car from the garage and the embarkation of the family in the driveway.

The timer could also be used as a delayed "on" switch, so that, for instance, a car alarm could be made to switch on after five minutes delay allowing the motorist ample time to alight, close doors etc., and eliminating the need to drill the car body for the mounting of an external key-switch. The circuit is convenient in that it uses the popular NE555 i.c. It is also adaptable in that by varying the values of two components the delay can be adjusted to anything from a few milliseconds to an hour.

A bell-push is connected across SK1 (see Fig. 1) so that a press on the button supplies power to the timer circuit from the 9 volt supply. At this stage, capacitor C1 is discharged, making a short circuit between pin 6 of the i.c. and 0 volts. This causes pin 3 of the i.c. to rise to the supply voltage, energising the relay and shorting out the push button. At the same time, it causes capacitor C1 to charge up via resistor R1 until pin 6 of the i.c. reaches two-thirds of the supply voltage, when the i.c. drops the output at pin 3 back to 0 volts. This switches off the relay and in turn the power supply to the timer circuit. Capacitor C1 then discharges itself via R1 and the relay coil so that the timer is ready for the next cycle of operation.

In this application, the timer is used to hold the mains contacts on the relay closed for the specified period, but it is of course a simple matter to reverse the action of the timer by using a relay having contacts which are normally closed.

In the prototype, a 700Ω relay was used, but any type which will operate comfortably on 9 volts is satisfactory provided that its resistance is not below about 180Ω, otherwise the i.c. will be damaged. With a 700Ω relay the current drain from the battery is only about 9mA, so a small capacity 9 volt battery will last for some hundreds of operations. A mains power supply could be used quite easily providing the output was well smoothed and between 5 and 15 volts d.c., but the prototype uses a PP9 battery which has been in use for about a year and shows no sign of needing renewal.

The circuit was constructed on a piece of printed circuit board as shown in Fig. 2, but 0·1in Veroboard could easily be used as an alternative. The circuit board and battery are mounted rigidly in a suitable box, with a 4-way terminal block mounted on the outside of the box for SK1 and SK2. If the box is made of metal and the device is to be used for mains switching, the box should be properly earthed and the relay contacts suitably insulated from the casing.

An i.c. socket should be used so as to avoid the risk of damaging the NE555 by overheating.

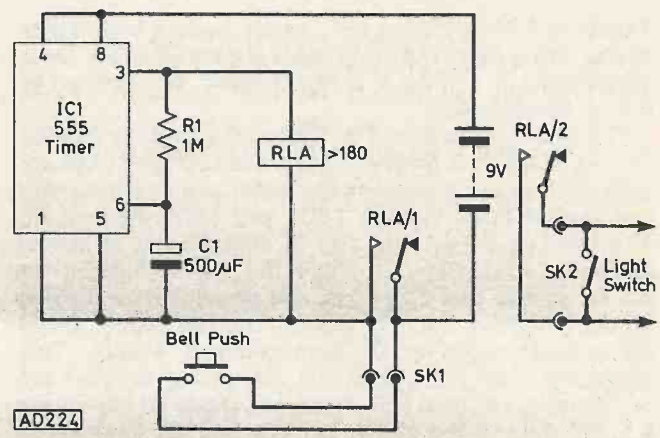


Fig. 1

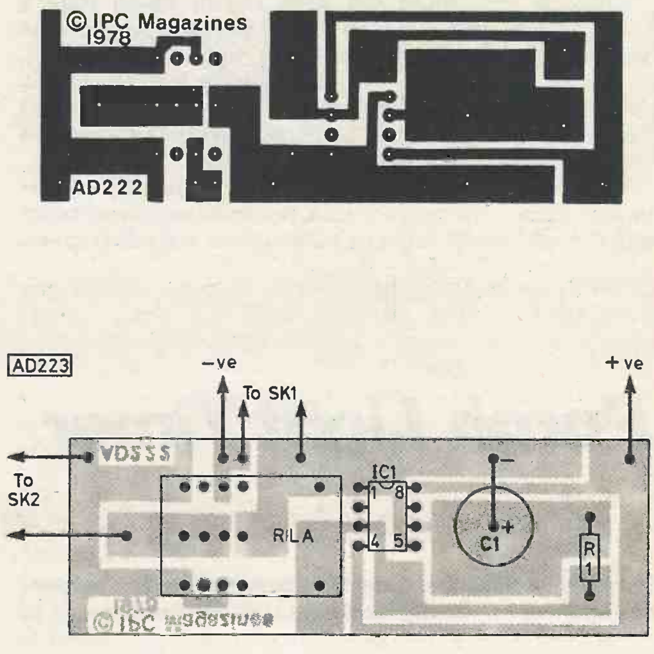


Fig. 2

★ components

Resistor
R1 1MΩ ¼W

Capacitor
C1 500µF 15V electrolytic

Semiconductor
IC1 NE555 timer

Relay
RLA 2-pole changeover, 185Ω coil, R.S. type 348-908

Miscellaneous
Bell push, PP9 battery and clips, 4-way terminal block rated 2A, p.c.b. approx. 25 × 65mm, suitable case.

STD Charge Timer

Most telephone calls within Britain are made using subscriber trunk dialling (s.t.d.) these days, and this system is faster and more convenient than its predecessor. One problem with this system is that it can be difficult to calculate the cost of a call.

STD calls are charged in units which have a uniform cost (3p at the time of writing) regardless of the distance over which the call is made. However, the length of time which constitutes one unit does vary with the distance of the call, and there are three main categories; 'L' or local area, 'A' which is for calls up to 56km, and 'B' for calls over 56km. The time allowed per unit also depends on the time of day, with three categories; peak rate, standard rate, and cheap rate. Detailed information on this can be found in the telephone directory or dialling code booklet.

In order to calculate the cost of a call it is necessary to check the applicable time per unit, time the call, and then calculate the number of units used (parts units being charged as whole units). The charge timer simplifies the procedure slightly. Having looked up the time per unit for the call, a switch on the timer is set to the corresponding position. Then when the number has been dialed and the call answered, the timer is switched on, displaying digitally the number of units used.

The timer is especially useful where a telephone is used by a number of people as it enables each person to keep an accurate account of their share of the phone bill. It can also be very useful when making calls at the higher charge rates. A unit can be as short as 10 seconds, and losing track of the time when making such a call can prove very expensive. Using the timer avoids this possibility.

The Circuit

On the face of it the circuit merely needs to consist of a simple C—R oscillator of some form to provide the clock signal, and a straightforward two digit counter circuit. There are a couple of complications though.

The clock frequency is very low, being between a few seconds and a few minutes per cycle. In order to generate this kind of frequency with a C—R oscillator it is necessary to use high valve components in the timing network, and this necessitates the use of an electrolytic capacitor. Unfortunately, electrolytics tend to have comparatively high leakage resistances and do not always work well in this type of circuit. Another problem with many C—R oscillators is that the first output cycle is longer than subsequent cycles (this is the case with the NE555 for example).

The second complication is that subscribers are charged the full rate for any part units that are used. Therefore, the counter must start at one rather than zero, since one unit is charged as soon as the phone is answered.

★ components

Resistors

¼W 5%

330Ω	1	R2	4·7Ω	1	R4
390Ω	1	R6	10kΩ	1	R5
1kΩ	1	R1	18kΩ	1	R8
2·2kΩ	1	R3	27kΩ	1	R9

¼W 2%

56kΩ	1	R10	220kΩ	1	R13
82kΩ	1	R11	330kΩ	1	R14
110kΩ	1	R12	1·2MΩ	1	R15

Sub-min. horiz. preset

220kΩ 1 R7

Capacitors

Ceramic plate

1·5nF 1 C1

Polyester 250V

0·1μF 3 C3, 4, 5 47nF 1 C2

Polycarbonate 5%

0·1μF 1 C6

Semiconductors

Transistor

BC109 1 Tr1

Integrated Circuits

CD4026AE	1	IC2
CD4033AE	1	IC1
ZN1034E	1	IC3

7-segment l.e.d. displays

FND500 2 Display 1, 2

Switches

1p. 12w.	1	S1 (adjustable end-stop)
s.p.s.t.	1	S2 (sub-min, toggle)

Miscellaneous

Plastics case 150 × 80 × 50mm (Verobox 65-2520J or similar). Printed circuit board. PP3 battery and connector. Red Perspex or display filter material. IC sockets (2 off 16-pin d.i.l., 1 off 14-pin d.i.l.). Control knob.

Fig. 1 shows the complete circuit diagram of the call charge timer. The clock signal is generated by a ZN1034E precision long timer i.c. consisting basically of a high quality C—R oscillator feeding a twelve stage binary divider circuit. The oscillator thus operates at over 4,000 times the output frequency, and the necessary low output frequencies can be generated without using a high value timing capacitor. C6 is the timing capacitor.

The eight unit times (not nine as standard 'L' and cheap 'a' rates are both 3 mins), are produced by eight different timing resistors (R8 to R15) with the appropriate resistor being selected using S1.

R7 enables the output times to be trimmed to the correct values, although there will be small descrepancies between ranges due to small errors in the timing resistor values. The ZN1034E has an integral 5 volt regulator circuit of the shunt type, and R6 is the load resistor for this. The ZN1034E is actually a monostable, but it is made to perform as an astable by coupling the Q output to the trigger input via R—C network R5—C5.

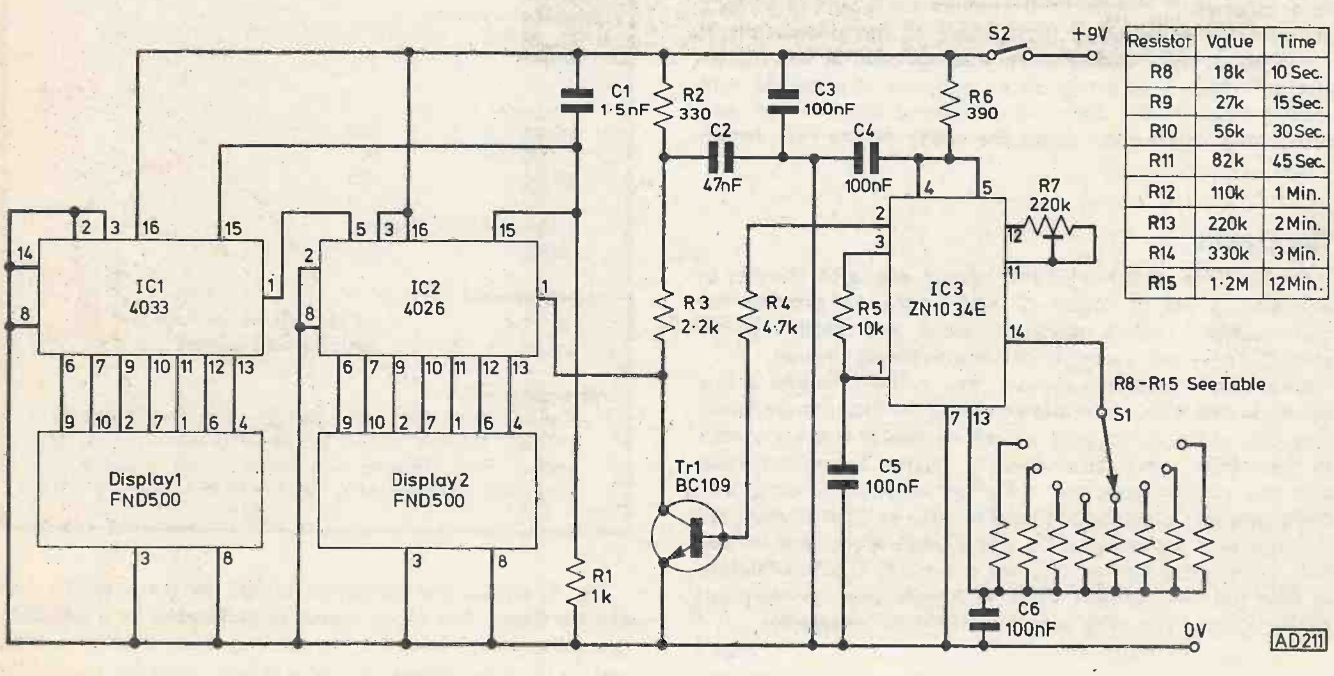
The counter circuit consists of two c.m.o.s. decade counters/seven segment display decoders directly driving two low current seven segment l.e.d. displays. No current limiting resistors are needed between the decoders and the displays due to the low output current drive capability of the c.m.o.s. i.c.s. The output current of about 5mA per segment is a good match for the specified FND500 displays. A 4033 device is used in the IC1 position as this has zero blanking, and will not drive the display until the count reaches ten. This eliminates unnecessary battery drain displaying a superfluous zero.

When switch S2 is initially closed and power is applied to the circuit, C1 and R1 produce a brief positive pulse which resets both counters to zero. Tr1 is used as an inverter, and is fed from the $\bar{Q}$ output of IC3 by way of current limiting resistor R4. The $\bar{Q}$ output will be at logic 0 at first, and so Tr1 will be cut off. Its collector voltage will therefore rise to the positive supply rail voltage. It will be delayed slightly by the presence of R2 and C2 in the collector circuit, and so the counters will rest before this positive pulse is applied to the input. The purpose of this pulse is, of course, to make the counter circuit effectively start from one rather than zero.

Each time IC3 reaches the end of a timing period the $\bar{Q}$ output will briefly go positive and switch on Tr1 until C5 discharges to a sufficient level via R5 to retrigger the timer. Tr1 is then cut off again and a positive pulse is fed to the counter circuit, causing it to be incremented by one.

Construction

The project is built into a Verobox and most of the components, including the two displays, are mounted on a printed circuit board. Fig. 2 shows both the copper side of the board and Fig. 3 the component layout. IC1 and IC2 are c.m.o.s. devices and normal handling precautions should be taken when dealing with these two devices. The completed panel is mounted on two of the threaded pillars on the base section of the case using long M3 screws. Spacers are used over the mounting screws to raise the panel so that the displays are close to the lid of the case when it is fitted into position. This also provides a space for the battery beneath the circuit board. It is a good idea to fix some self adhesive foam material to the



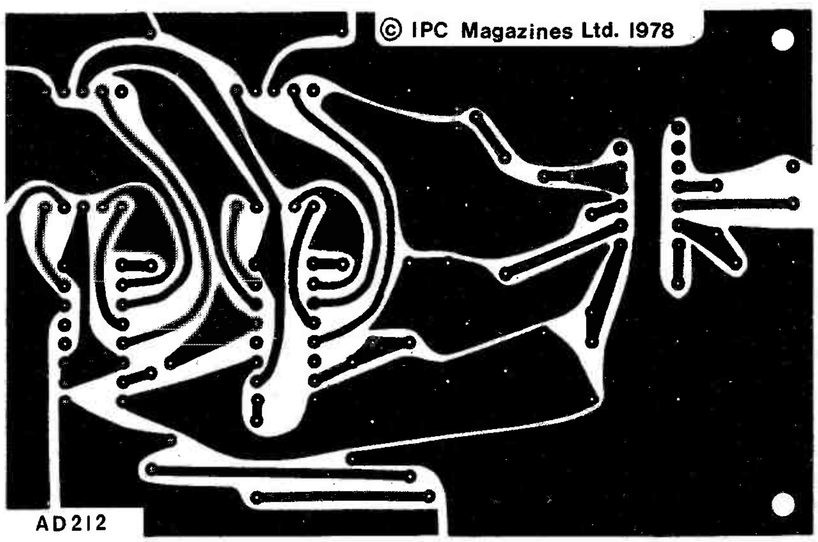
Resistor	Value	Time
R8	18k	10 Sec.
R9	27k	15 Sec.
R10	56k	30 Sec.
R11	82k	45 Sec.
R12	110k	1 Min.
R13	220k	2 Min.
R14	330k	3 Min.
R15	1·2M	12 Min.

Fig. 1

underside of the p.c.b. to prevent the metal case of the battery from short circuiting any of the connections on the underside of the board, and to hold the battery in place.

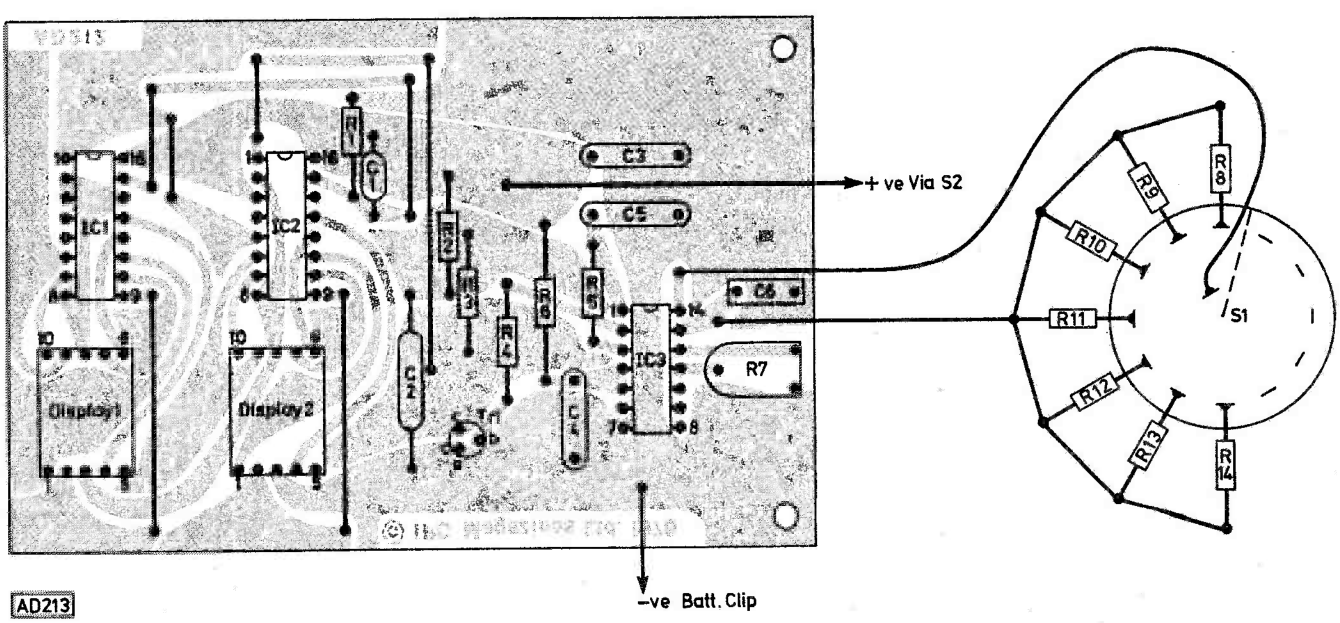
S1 and S2 are mounted on one side of the case, but R8 to R15 are mounted on S1, and these should be soldered into place before finally mounting S1. There is not a great deal of space for the resistors and S1 will probably have to be orientated so that they are partially beneath the p.c.b. It is just possible that a switch having a large amount of contact bounce could cause the initial circuit action to malfunction if it was to be used in the S2 position. It is therefore recommended that a miniature toggle or slide type should be used here rather than a standard toggle or rotary type.

A rectangular cut-out measuring about 42 × 19mm is made in the lid of the case so that it forms a window for the display. The edges of the display can be bevelled slightly using a small flat file to produce a better appearance. A piece of red tinted perspex or display filter material is glued in position behind the cut-out.



◀ Fig. 2

▼ Fig. 3



Adjustment

Start with the slider of R7 set at about the middle of its track. Set S1 to the ten second position, turn the unit on, and measure the actual time taken between each increment of the display. It will almost certainly be necessary to adjust R7 to obtain the correct clock frequency, clockwise rotation decreasing the length of each clock cycle.

With the clock frequency reasonably accurate on the ten second range, S1 is switched to one of the longer ranges so that R7 can be adjusted more critically. When good accuracy is achieved on the longer ranges the unit is ready for use.

It is possible that at some future date it will be necessary to amend some of the times provided by the unit. Assuming C6 is left at 100nF, the required timing resistance is equal to 1·8kΩ per second. Where the calculated value does not coincide with a preferred value, choose the nearest value in the E24 series and use a close tolerance component to minimise the maximun possible error. Alternatively the required value can be made up from two resistors wired in series.

Door Bell Changeover Unit

This circuit was designed to meet the conflicting requirements of a door bell loud enough to be heard when working in the garden, yet not ear-shattering in normal use. The repeater bell operates only on the second operation of the push.

When the bell-push is operated, RLA makes and C1 is charged to supply voltage. At the same time the solenoid of the Ding-Dong bell moves to strike the first note. When the bell-push is released, the solenoid returns, to strike the second note, RLA releases and the charge on C1 is applied to base of Tr1 which conducts and switches Tr2. Tr2 in turn operates RLB, and the trembler bell is then in circuit via the bell push if required. With values of C1, R1 as shown, RLB holds on for about 75 seconds. When the charge on C1 falls, Tr1 and Tr2 switch off, RLB releases and the circuit reverts to its original state. The circuit could be assembled on a small piece of Veroboard.

The circuit could also be used to switch on a light for a deaf person's door call.

★ components

Resistors
¼W 5%

R1	47kΩ
R2	4·7kΩ
R3	1kΩ

Capacitors
Electrolytic

C1	220µF 25V
C2	100µF 25V

Semiconductors

D1	1N4001
Tr1	BC183L
Tr2	BC183L

Relays
RLA 2-pole changeover (only one pole used), 185Ω coil, RS type 348-908
RLB 2-pole changeover, 185Ω coil, RS type 348-908

Miscellaneous
T1 12V bell transformer. Bell push. F1 250mA fuse. Suitable piece of Veroboard for mounting components. Case.

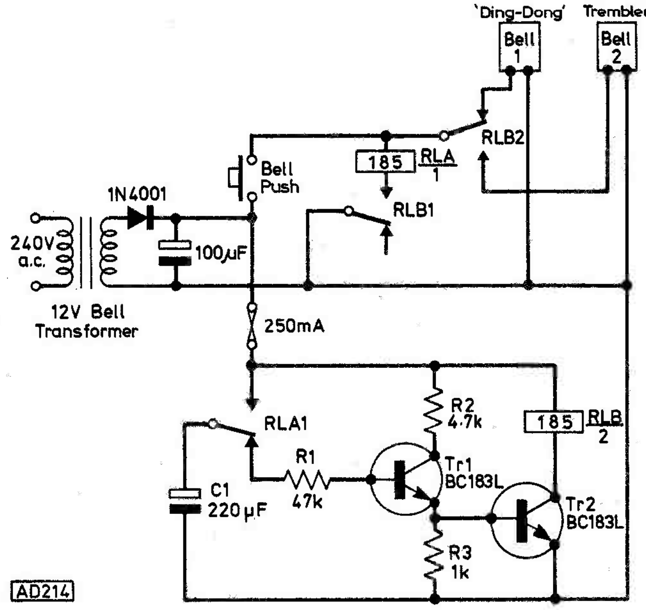


Fig. 1

Automatic Outside Light

This simple circuit will turn your outside light on as darkness approaches and turn it off again at dawn, unless you decide to switch it off earlier.

The design is based around the ORP12 light dependent resistor a useful component which changes resistance with the amount of light falling on its active surface. This change in value is used to switch a BC109 transistor which in turn switches a 2N3053 transistor to operate a small relay.

The required threshold level at which the relay switches is set by VR1 and the amount of hysteresis, the difference between the switch-on and switch-off levels, is varied by VR2.

The unit is powered from the mains via a small 6V transformer and a full wave rectifier system.

The circuit can be built on a small piece of Veroboard and fitted inside a waterproof bulkhead fixing outside light fitting. The ORP12 l.d.r. should be mounted through a small hole drilled in the top or one side of the light fitting with a suitable tube to act as a shield to prevent the unit being switched off again by the light from the unit.

Care must be taken in positioning the unit inside the housing to avoid a position where it will be affected by the heat generated by the lamp. If the housing is physically small then it would be better to err on the side of safety and mount the unit in a small plastic case away from the light.

★ components

Resistors			**Capacitors**		
¼W 5%			*Electrolytic*		
150Ω	1	R1	470µF 16V	1	C1
2·2kΩ	1	R2			
47kΩ	1	R3	**Semiconductors**		
			Transistors		
Potentiometers			BC109	1	Tr1
Preset skeleton			2N3053	1	Tr2
4·7kΩ	1	VR1	*Diodes*		
100kΩ	1	VR2	1N4001	2	D1, 2

Miscellaneous
6-0-6V transformer 100mA (1), 3A fuse and holder, d.p.s.t. mains switch S1. Relay 2 p.c.o. 185Ω coil. 240V neon indicator. Outdoor light fitting. LDR ORP12

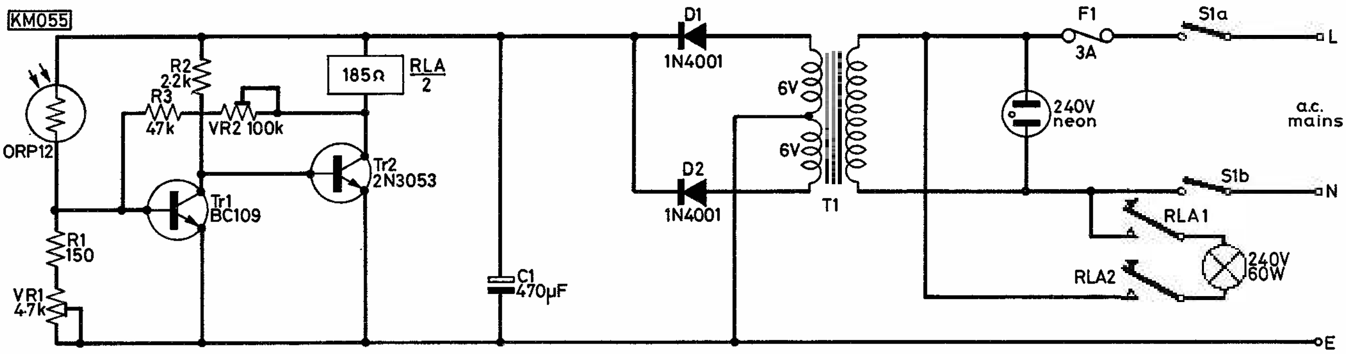


Fig. 1

Battery Indicator

There have been many designs for battery state monitors and indicators published in various magazines and journals. These are a very useful addition to any piece of battery operated equipment, but most seem to suffer from one major disadvantage; their quiescent current consumption is of the order of 10mA or so and is often as great or greater than that consumed by the equipment in which they are incorporated. The current consumption of the unit described is a mere 8µA in its quiescent state. Fig. 1 shows the circuit diagram of the complete indicator.

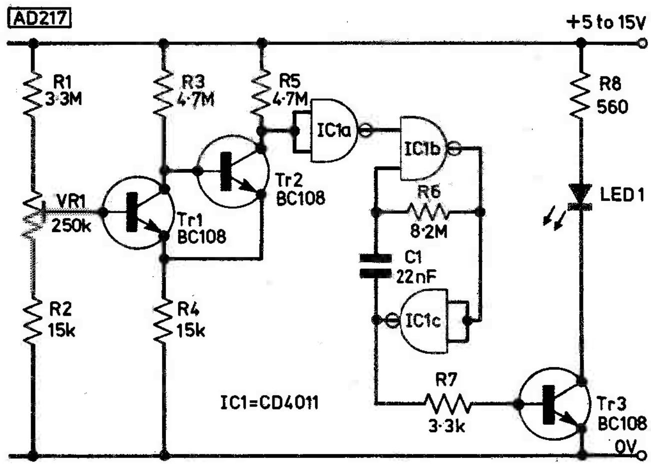


Fig. 1

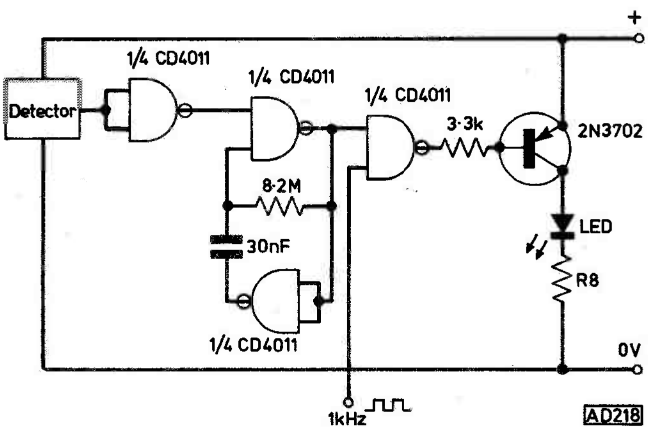


Fig. 2

★ components

Resistors		**Capacitor**	
¼W 5%		C1	22nF 160V polycarbonate
R1	3·3MΩ		
R2	15kΩ		
R3	4·7MΩ	**Semiconductors**	
R4	15kΩ	LED1	TIL209
R5	4·7MΩ	Tr1	BC108
R6	8·2MΩ	Tr2	BC108
R7	3·3kΩ	Tr3	BC108
R8	560Ω	IC1	CD4011
Potentiometer		**Miscellaneous**	
VR1	250kΩ preset	p.c.b. 32 × 58mm	

Transistors Tr1 and Tr2 form a Schmitt trigger. R1, VR1, and R2 are connected across the supply rails and form a potential divider. This provides the reference potential for the base of Tr1 and determines when it changes state. With the values shown the switching point of the Schmitt can be varied between about 5V and 15V.

The output of the Schmitt, which is normally high and goes low when the battery voltage falls below a preset level, is fed to the input of a CMOS inverter (actually a NAND gate with its inputs connected together). The output of this is connected to the control input of an oscillator constructed from two of the remaining gates in a CD4011 package. The output of the oscillator is connected to the base of Tr3 which turns the l.e.d. on and off at a rate of about 2·5Hz as a visual indication that the battery voltage is low. The time-averaged current consumption of the indicator is approximately 5mA when in this state. This can be reduced further, with a corresponding decrease in l.e.d. brightness, by increasing the value of R8.

The inputs of the remaining gate in the CD4011 should be connected to either supply rail in this version. In the original version, the remaining gate was used in conjunction with a 1kHz signal to turn the l.e.d. on and off rapidly to indicate that the equipment was switched on. This is shown in Fig. 2.

The time averaged current for the battery low indication in this case is reduced to about 2·5mA.

The unit can be built on a simple p.c.b. as shown in Figs. 3 and 4. It is recommended that you use a socket for the i.c. and observe the usual precautions when handling c.m.o.s. devices.

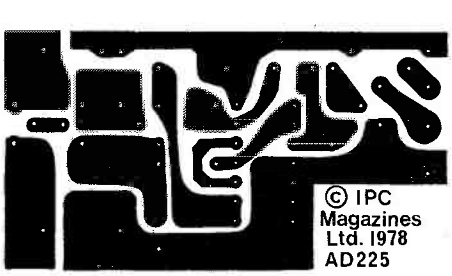


Fig. 3

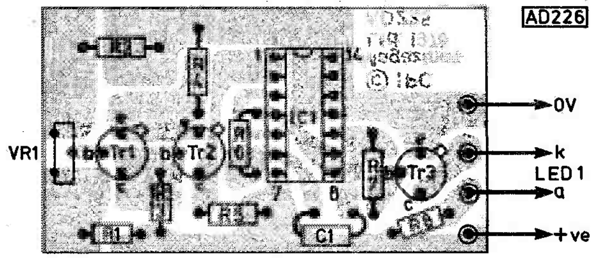


Fig. 4

IC OF THE MONTH 71

Brian DANCE M.Sc

RCA CA3189E FM DEVICE

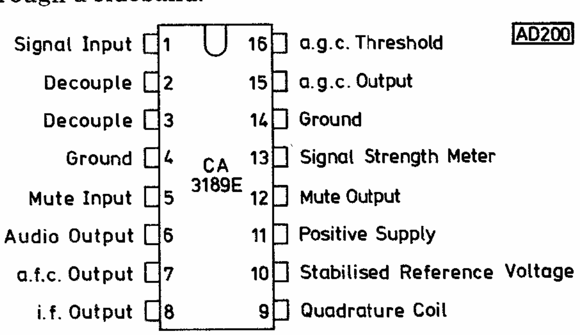
Many of our readers will be familiar with an f.m. device used as a 10·7MHz amplifier/limiter and demodulator which is marketed as the type number 3089 and as the TDA1200. Quite a number of designs using this device have appeared in our pages, since it offers a wide range of facilities on a single chip. Although first introduced by RCA in 1971 as their CA3089E, the 3089 has since become an "industry standard" type which is available from many manufacturers; indeed, it is probably the most widely used of all f.m. i.f. devices.

The CA3189E

The new RCA type CA3189E has been developed as an improvement on the 3089 type device. RCA have had prolonged discussions with many manufacturers of high quality f.m. receivers who use the 3089 before designing the new CA3189E to meet the manufacturer's requirements as closely as possible. The CA3189E was conceived and designed by RCA at Sunbury-on-Thames, England, but the wafer and device fabrication is carried out in the USA.

The CA3189E is encapsulated in a 16 pin dual-in-line package. The connections are similar to those used in the 3089 device except for pin 16 (which is not used in the 3089), but both the internal and external circuits differ from those of the 3089.

The internal circuit of the CA3189E is quite complex and provides the following functions: (i) a high gain i.f. amplifier (ii) a quadrature demodulator circuit (iii) an a.f.c. output (iv) an a.g.c. output with an adjustable threshold (v) an output to drive a signal strength meter (vi) a noise muting circuit to reduce inter-station noise (vii) a deviation muting circuit to mute the audio signal as the receiver is tuned through a sideband.



Pin-out details of the CA3189E

Typical Circuit

A typical circuit for the use of the CA3189E which provides a very high performance is shown in Fig. 1. The 10·7MHz input signal from the output of an f.m. tuner is fed to the base of the BF594 transistor amplifier stage and then to a pair of Toko type CSFE ceramic filters connected in cascade. A similar transistor amplifier stage follows and the output from this second stage is fed into a further pair of cascaded CSFE filters.

The circuit shown provides a signal-to-noise ratio of 40dB for an input of only 3μV. A somewhat simpler circuit can be made by employing only one transistor stage and one pair of CSFE filters. In this case the input signal is fed through C1 to the base of Tr2 and the Tr1 circuit is omitted. However, the signal-to-noise ratio with a single transistor input stage is about 20dB for a 3μV input signal, so it is wise to use two transistors if you wish to receive any weak signals.

The signal from the two transistor pre-amplifier is fed into pin 1 of the CA3189E, this being the input of a high gain amplifier/limiter. The bandwidth of this internal amplifier has been limited to 15MHz (as opposed to the 25MHz typical bandwidth of the 3089 device), since this not only improves circuit stability and renders the printed circuit board layout less critical, but also improves the noise performance of the circuit. Two signals outside the receiver pass band can interact to form noise in the band, but this is reduced by restricting the bandwidth.

The Demodulator

Two coils are required in the demodulator circuit. A 22μH coil is connected between pins 8 and 9, the Toko coil type 144LZ 220K having been found very suitable for the purpose. A tuned circuit resonant at 10·7MHz must be connected between pins 9 and 10, but the miniature Toko type KACS K586 HM is ideal for this purpose; it was designed for a similar function with the 3089 type device.

The typical third harmonic distortion with the circuit of Fig. 1 is about 0·3%. It is possible to reduce it to less than 0·1% by the use of a double tuned circuit between pins 9 and 10 instead of the single tuned circuit so as to obtain better phase linearity over a wider bandwidth. Although Toko offer suitable components to make a double tuned circuit, the alignment requires an oscilloscope and the writer would advise readers to use the single tuned circuit unless they have the necessary equipment and experience.

Noise

Great efforts have been made in the design of the CA3189E to reduce the noise level at the audio output. We have already mentioned how the noise has been reduced by restricting the i.f. amplifier/limiter bandwidth, but further improvements have been made by using a Zener diode in the regulator section of the device which produces very low noise. Unlike

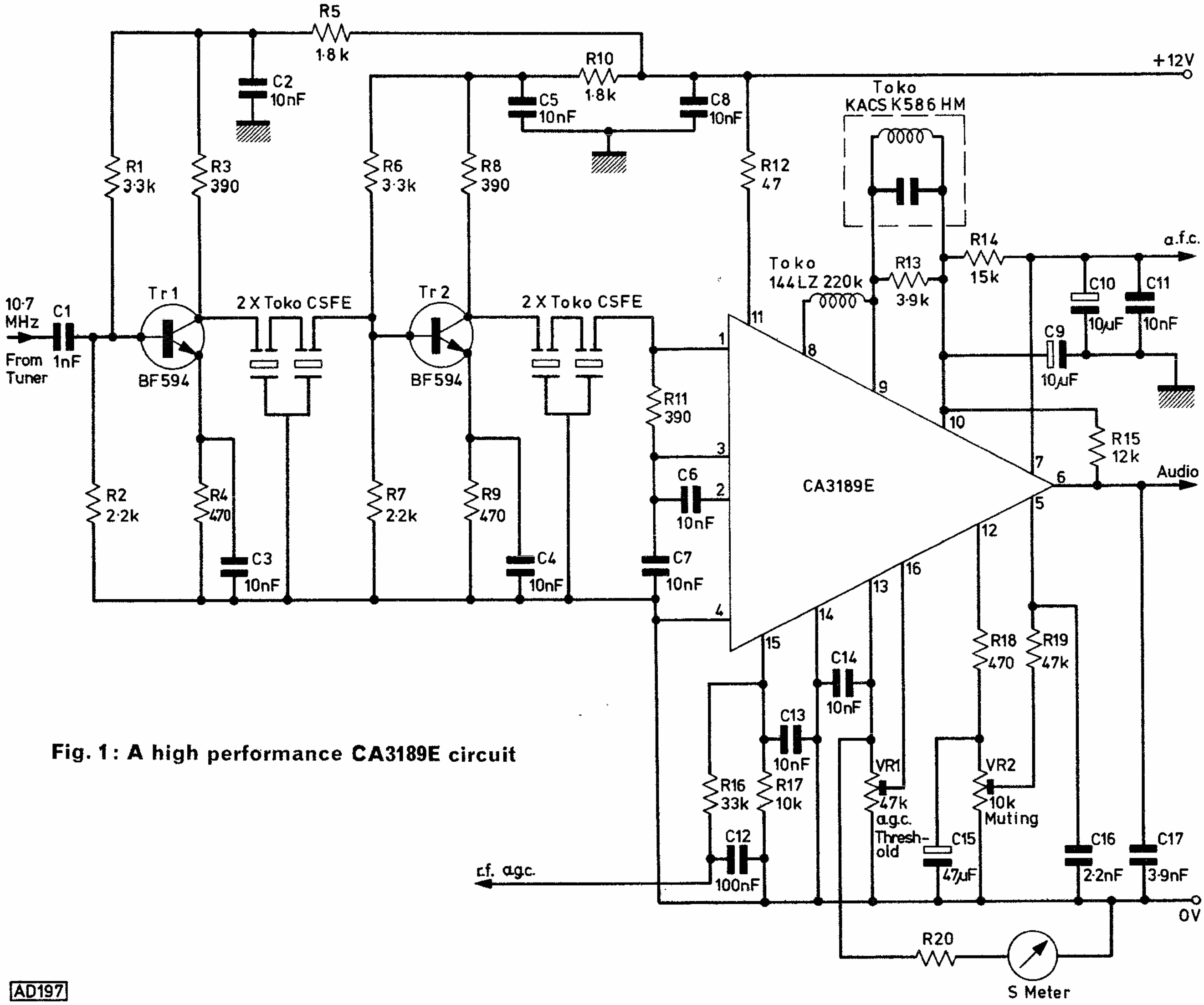


Fig. 1: A high performance CA3189E circuit

the 3089, the CA3189E requires an external audio load resistor (R15 in Fig. 7) so that pin 10 can be decoupled by C9; this produces a small improvement in the noise level.

Muting

A noise muting circuit is required for silencing the receiver when tuning between stations. A noise muting circuit in the CA3189E detects the absence of a signal or sufficient holes in the limited carrier wave and produces a voltage change at pin 12; a portion of this voltage is tapped off by VR2 and is fed to pin 5 where it is used to reduce the audio output to zero.

This noise muting circuit alone is sufficient to produce excellent inter-station muting, but unfortunately it is not very satisfactory for providing the muting required when tuning through sidebands rapidly. The sudden voltage changes at the audio output produce a "thump" in the loudspeaker when passing through the station frequency. The deviation muting circuit incorporated into the CA3189E reduces the maximum voltage shift at pin 6 when the circuit switches to or from the muted state and provides a considerable improvement over the 3089 type of device which has only noise muting. When R14 has the value shown in Fig. 1 the circuit will stay in its muted state until the tuning comes within ±40kHz of the correct tuning point for the station; this resistor controls the sensitivity of the deviation muting circuit by determining the deviation at which muting ceases.

A.G.C.

There was considerable disagreement as to the optimum threshold level at which the automatic gain control circuit should start to become effective. This threshold level had been set at about 10mV r.m.s. input to pin 1 in the 3089 device, but to meet the requirements of the various circuit designers RCA decided to provide a variable a.g.c. threshold level in the new CA3189E. They use pin 16 for this purpose, the only pin which is not used in the 3089 device.

As shown in Fig. 1, the control voltage tapped off by VR1 is fed to pin 16, so VR1 controls the a.g.c. threshold level. When the control voltage is obtained from pin 13, as shown, the threshold of a.g.c. action can be varied from a signal level of 200µV up to as much as 200mV at pin 1. The a.g.c. characteristic shown in Fig. 2 has a very sharp "knee" and is therefore very satisfactory.

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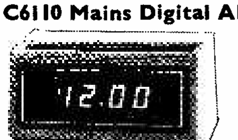

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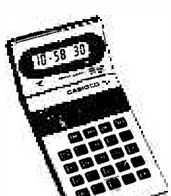

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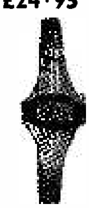

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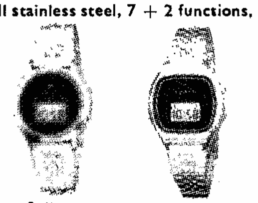

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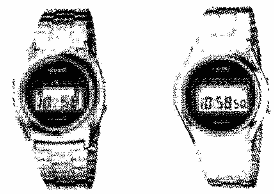

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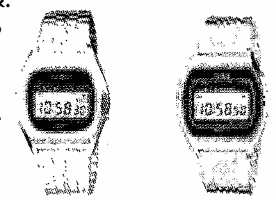

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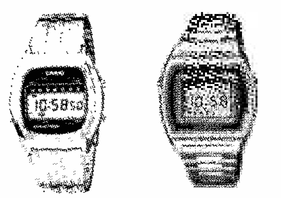

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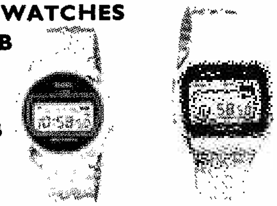

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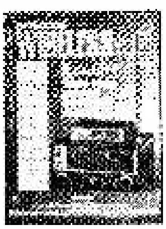

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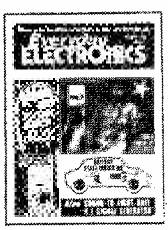

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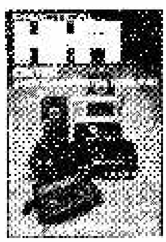

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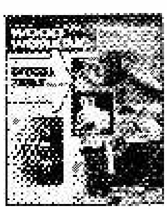

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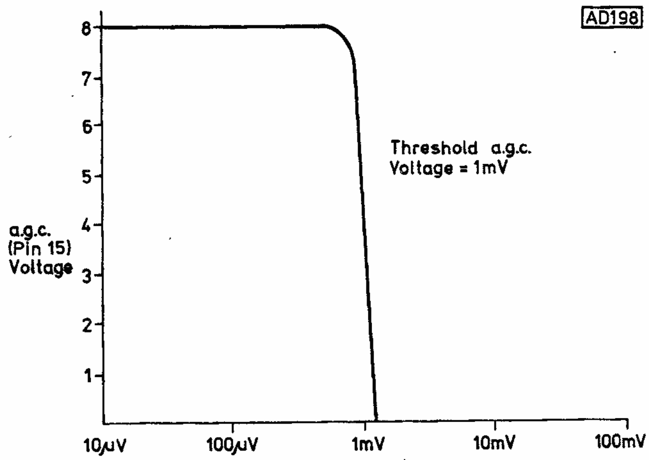


Fig. 2: The a.g.c. characteristic of the CA3189E

S Meter

The voltage at pin 13 increases in a way which approximates closely to the logarithm of the input signal to pin 1. Thus a voltmeter may be connected from pin 13 to ground to provide an indication of a very wide range of signal levels. The S meter characteristic is shown in Fig. 3.

The S meter may have a full scale deflection of 150 to 200μA, in which case R20 of Fig. 1 may have a value of about 33k, since a voltage in the region of 5 to 7V will then produce a full scale deflection. However, any high impedance voltmeter or a voltmeter made from the resistor R20 in series with a suitable microammeter may be employed.

A centre reading voltmeter connected between pins 7 and 10 can be used as a tuning indicator. When the circuit is correctly aligned, the meter will swing through zero when passing through the correct tuning point.

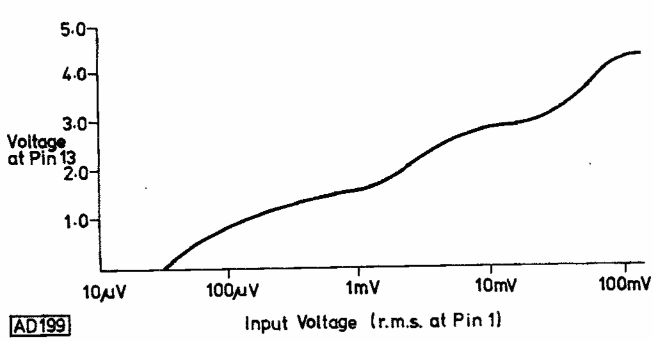


Fig. 3: The S meter characteristic of the CA3189E

De-emphasis

The capacitor C17 in conjunction with the load resistor R15 provides the de-emphasis time constant of about 50μs which is required for the correct frequency response in Europe. This capacitor must be removed if the output is fed to a stereo decoder, since two separate de-emphasis capacitors will then be required at the outputs of the decoder.

The audio output amplitude from pin 6 increases in a fairly linear fashion with the value of the load resistor R15, but the signal will be distorted to a greater extent if the value of R3 is too high. An excessively low value of R15 will result in a noisy output. A change in the value of R15 will also necessitate a change in the value of C17 in a monaural system, since the product of the values of these components must provide the required time constant for de-emphasis.

When R15 has a value of 12k, the audio output level is about 1V r.m.s. (or about 3V peak-to-peak). The signal-to-noise ratio is typically about 75dB for input voltages exceeding 1mV at pin 1, whilst a.m. rejection exceeds 60dB for similar inputs.

In order to preserve stability, all decoupling capacitors except C7 should be grounded at pin 14. Only C7 should be grounded at pin 4.

Conclusion

The wide range of facilities and the high performance offered by the 3089 type device have resulted in it being adopted for many high quality receivers. The CA3189E offers all of the facilities provided by the 3089 together with an improved performance. One may therefore expect that it will be widely used in high quality f.m. receivers during the next few years. The use of complex i.c.s together with ceramic filters has greatly simplified the task of the f.m. receiver constructor. ●

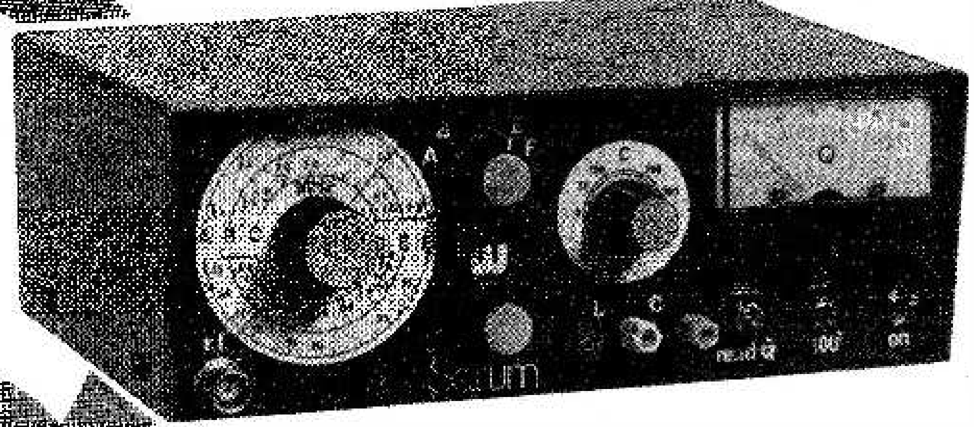
KINDLY NOTE!

Point motor supply August 1978
The circuit shown in Fig. 4 for operating more than one point motor shows a single pole rotary switch in the common return line. This could prove troublesome due to parallel paths through the other solenoid coils. To eliminate this a two pole rotary switch should be used with one pole switching the left hand coil supply line after S1 and the other pole switching the right hand coil supply after S2. All the commons from the motors should be taken straight back to the c.d. unit.

Simple High Resistance Voltmeter, September 1978
Pages 52, col 2, the reference to "10μA flowing through point X" should read "100μA flowing ...". On the circuit diagram (p. 53) R8 is shown short-circuited—this link should be removed.

PW "Avon" Part 3, September 1978
In Fig. 1 of the power supply, the emitter and collector of Tr2 are shown reversed. The input connection to the regulator is from the base of Tr2 and the output is the connection taken to the collector. The connection to the 0V rail is the common.

SARUM Q Meter



M. TOOLEY

The manufacture and testing of radio frequency inductors often poses problems for radio constructors. It is not easy to obtain a specified inductance value and, even if an inductance bridge is available, it is usually a matter of "trial and error" before satisfactory results can be obtained. Furthermore, since most r.f. inductors are usually associated with resonant circuits, a simple form of 'Q' meter is a more convenient instrument for use in the construction of coils.

A 'Q' meter provides a variable radio frequency signal source together with a calibrated capacitor and an r.f. voltmeter. It may thus be used to determine the resonant frequency and 'Q' factor of a capacitor/inductor combination, to establish the tuning range of a variable resonant circuit, and even to measure unknown capacitance or inductance. The instrument described forms a most useful addition to the range of test equipment in any radio constructor's workshop and will certainly help to alleviate the frustration which is often associated with "trial and error" coil winding. The r.f. output of the 'Q' meter, in the frequency range 1MHz to 30MHz, is available so that the instrument may also be used as a signal generator.

Theory

A series resonant circuit is shown in Fig. 1. This consists of a coil connected in series with a capacitor. The coil possesses both inductance, L, and a series loss resistance, R. If the circuit is supplied with a low voltage at the frequency of resonance, magnified voltages are developed across both the capacitor and the inductor. The amount of voltage magnification depends on the 'Q' or "magnification factor" of the circuit. The greater the 'Q' factor of the circuit, the larger will be the voltage magnification. The 'Q' factor of the series resonant circuit is defined as the ratio of capacitor (or inductor) voltage to the applied voltage. In most resonant circuits the capacitor can be considered to be "loss free" and the loss can then be entirely attributed to the d.c. resistance of the coil together with a resistance due to losses at r.f. The bandwidth and selectivity of a tuned circuit are dependent on the 'Q' factor and, in order to obtain a high 'Q' factor, the loss resistance of the circuit must be very small. The higher the 'Q' factor the narrower the bandwidth will be and the greater the selectivity achieved.

★ specification

'Q' ranges:	0 to 20 and 0 to 100
Frequency range:	1 MHz to 30 MHz in the following six overlapping bands; A 950 kHz to 1·6 MHz B 1·5 MHz to 2·6 MHz C 2·5 MHz to 4·6 MHz D 4·5 MHz to 8·5 MHz E 8·0 MHz to 17·0 MHz F 15·0 MHz to 32·0 MHz
Internal capacitor:	variable from 20pF to 365pF
RF output:	500 mV r.m.s. typical over the above frequency range measured in an open circuit
Measurements:	Resonant Frequency (using either internal or external capacitors), 'Q' factor, Inductance, Capacitance and Quartz Crystals (see text).

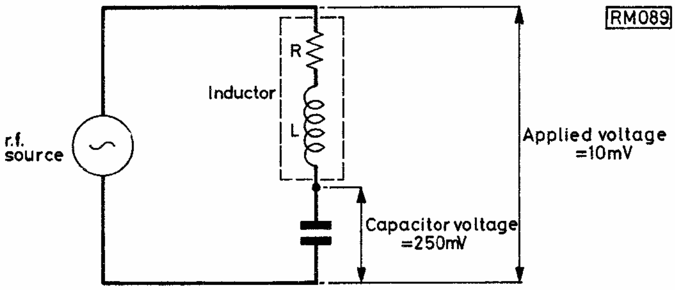


Fig. 1: This example illustrates a resonant circuit with a 'Q' factor of 25

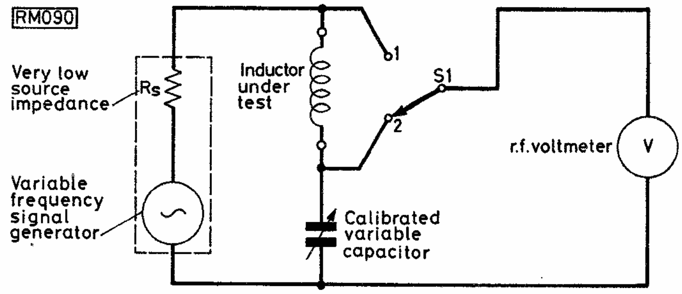


Fig. 2: Basic arrangement of a 'Q' measuring device

Fig. 2 shows the basic arrangement of a simple 'Q' measuring device. This consists of an r.f. signal and a high impedance r.f. voltmeter connected to the resonant circuit. The variable r.f. signal source must have an output impedance which is very low compared with the series loss resistance of the coil. The exact resonant frequency of the tuned circuit is first determined for a specified capacitor value by varying the signal generator frequency and noting the point at which the voltage in position 2 rises to a maximum. S1 is then switched to position 1 and the r.f. voltmeter then reads the voltage applied to the resonant circuit. In position 2 the voltmeter measures the magnified voltage developed across the capacitor and thus the ratio of the voltages in the two positions of S1 gives the 'Q' factor of the curcuit.

Circuit Description (Fig. 4)

Tr1 operates in the common base configuration and forms a wide range r.f. oscillator, the frequency of which is varied by VC1. The oscillator operates in six switched ranges with a different inductor, selected by S1b, for each range. In order that adequate output with low harmonic content is obtained over the entire frequency range, S1a selects capacitors to vary the feedback conditions and, on the two highest frequency ranges, the emitter current of Tr1 is increased by means of R4. Tr2 forms a buffer stage and also acts as an impedance converter. This emitter follower stage presents a high impedance to the oscillator tuned circuit and a low output impedance. This arrangement helps minimise loading effects on the oscillator tuned circuit and improves frequency

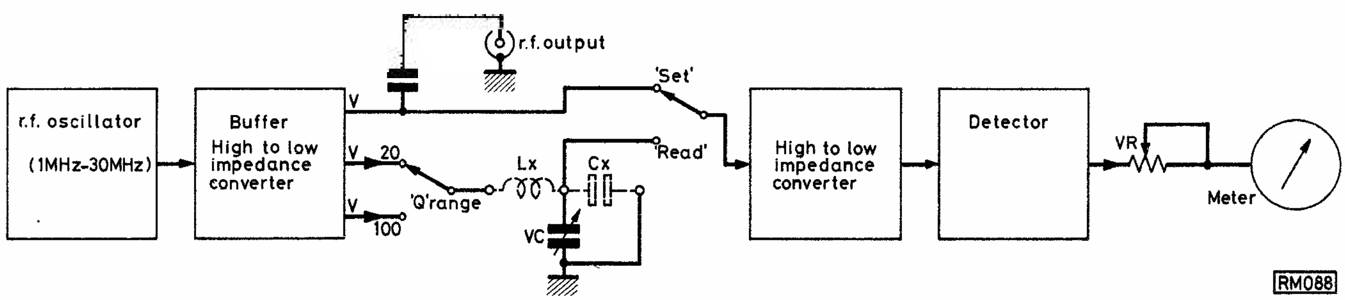
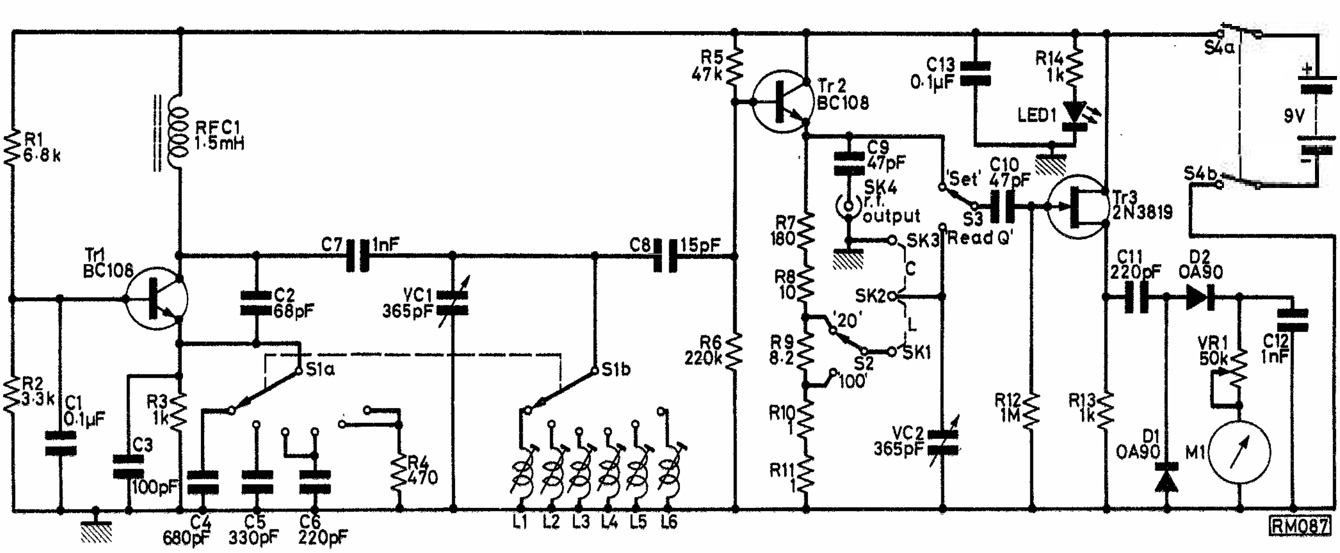


Fig. 3: (above) Block diagram of the 'Q' meter

Fig. 4: (below) Complete circuit diagram of the 'Q' meter



stability. The resistor chain, R7 to R11, provides an attenuation of twenty or a hundred times depending on the setting of S2. VC2 is a calibrated capacitor for use with the inductor under test. Tr3 operates as a source follower and acts as a buffer stage with a very high input impedance and low output impedance. This arrangement is vital in order to prevent loading effects which would otherwise reduce the 'Q' of the circuit under test. D1 and D2 form a conventional voltage doubler rectifier and act as a wideband r.f. detector. The rectified current is measured using a moving coil meter. VR1 is used to set the meter current to full scale deflection with S3 in the 'Set' position.

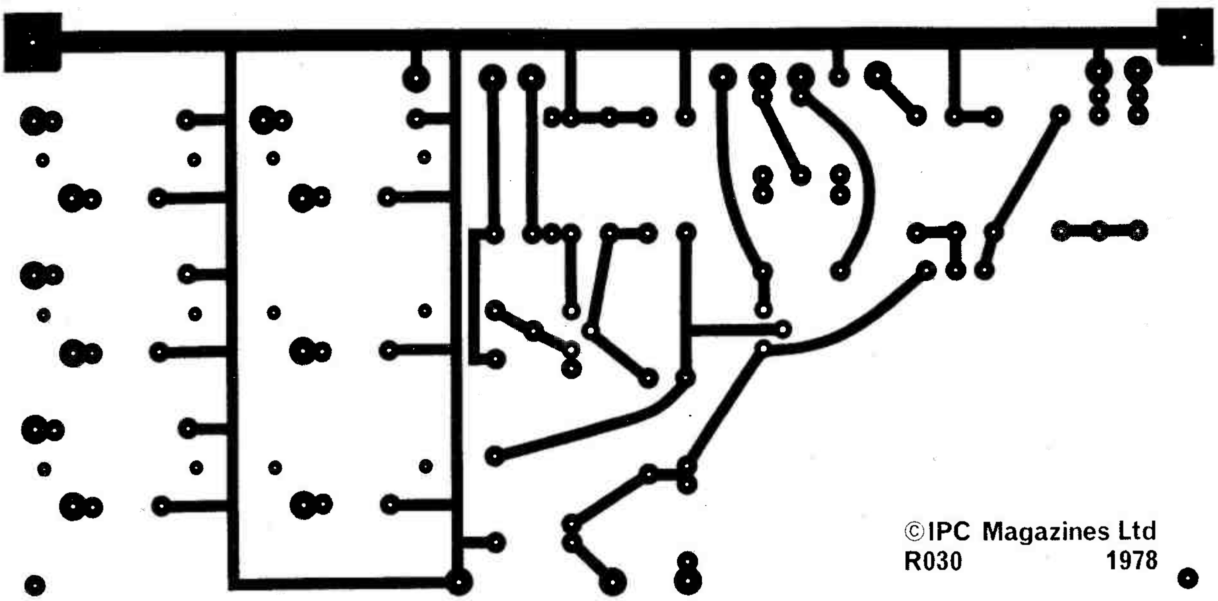


Fig. 5: Copper track layout of the printed circuit board, shown actual size

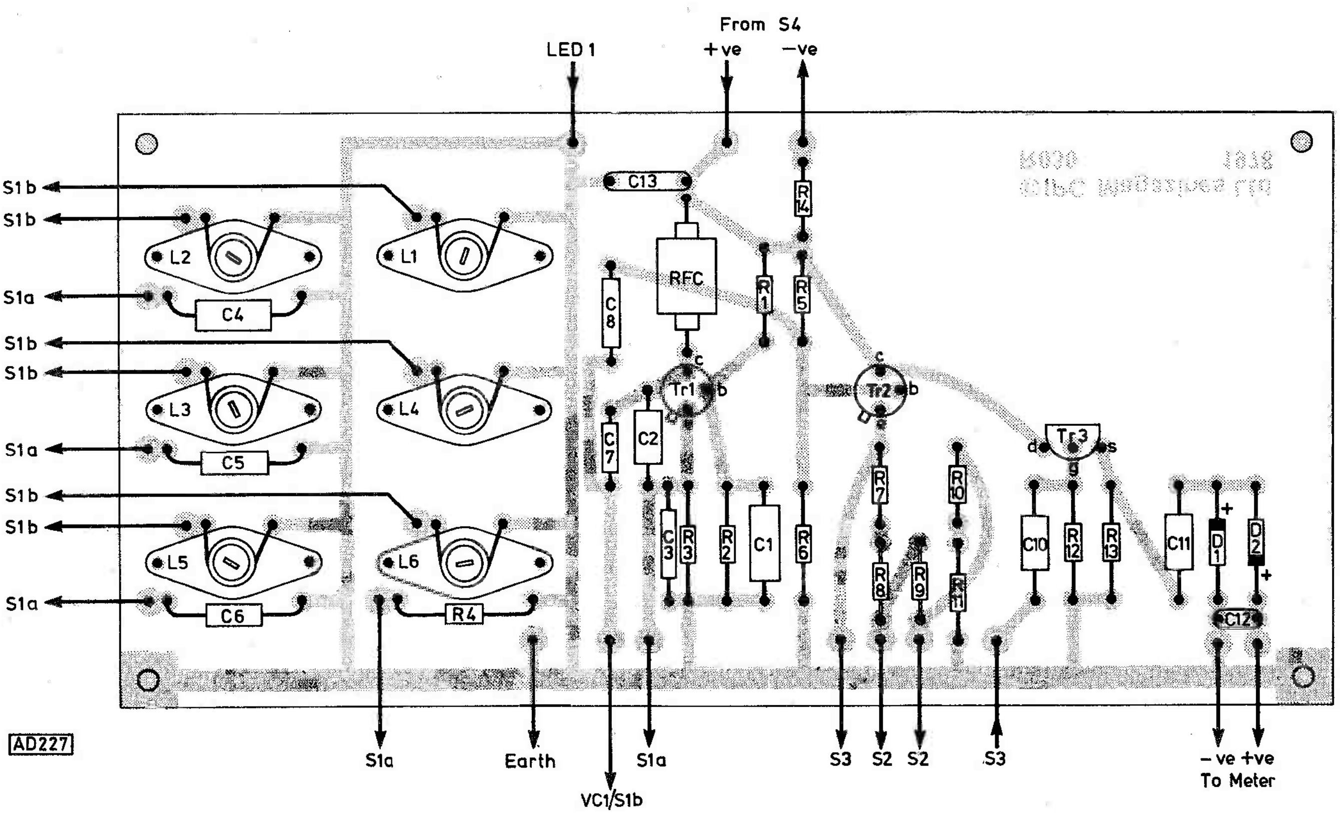
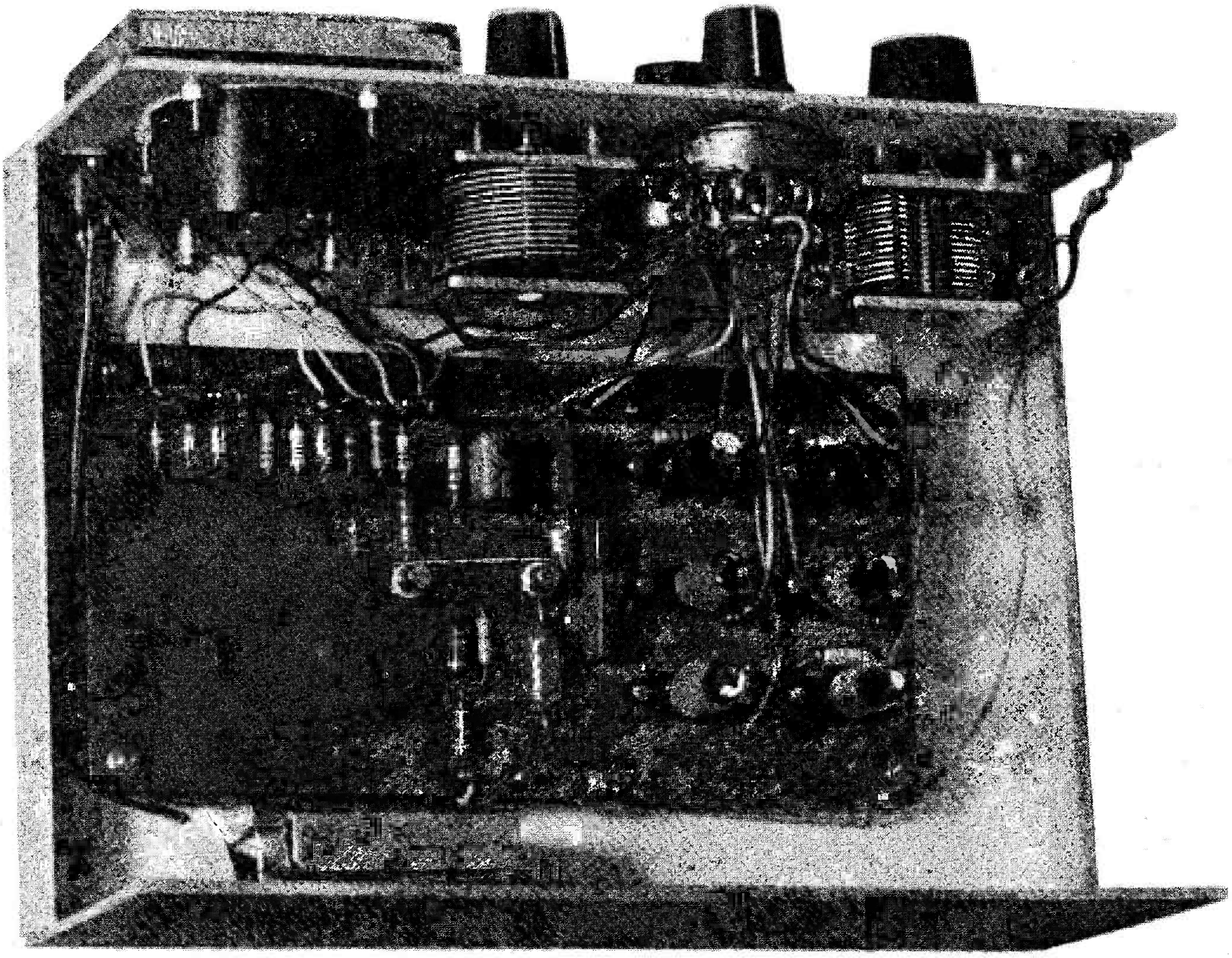


Fig. 6: Component placement and wiring of the printed circuit board



Internal view showing the front panel controls and the printed circuit board

Using the 'Q' Meter

The normal procedure for determining the resonant frequency and approximate 'Q' factor of a coil/capacitor combination is as follows. Connect the coil to the 'L' terminals and set the desired parallel capacitance value on VC2. If a value greater than 365pF is required, an extra capacitor may be connected to the 'C' terminals and its value is then added to the reading on VC2. If possible, estimate the approximate resonant frequency and set the 'Q' meter tuning to this value. If this is not possible, the 'Q' meter tuning will have to be swept across each band slowly whilst looking for a peak on the meter. A peak should be found with S2 in the '20' position, S3 in the 'Read Q' position and VR1 set to about mid-position. Very small peaks may occur at several frequencies lower than the correct resonant frequency. These are due to harmonics present in the signal waveform and they should be hardly noticeable compared with the peak at true resonance. After establishing that the correct peak has been obtained, S3 should be switched to 'set' and VR1 should be carefully adjusted for full-scale deflection (100) on the meter. The 'Q' factor can then be read, on a scale of 0 to 20 or 0 to 100 depending on the setting of S2, with S3 in the 'Read Q' position.

Other Measurements with the 'Q' Meter

1. Unknown Inductance

This method is satisfactory for inductors in the range 1μH to 250μH. The accuracy does not depend on the 'Q' factor of the coil but on the accuracy of calibration of the 'Q' meter frequency scale and on VC2. With VC2 set to 100pF, connect the unknown inductor to the 'L' terminals and vary the frequency of excitation until resonance is obtained. Note down the resonant frequency and then calculate the inductance from the approximate expression:

$$L = \frac{250}{f^2}$$

Where L is in μH and f is in MHz.
Example: If f=5MHz then L=250÷25=10μH.

2. Unknown Capacitance

This method is useful for values of capacitance in the range 20pF to 350pF. The accuracy of this method depends on the calibration scale of VC2. Connect an inductor, preferably one which will be resonant with 20pF between 3MHz and 8MHz, to the 'L' terminals and the unknown capacitor to the 'C' terminals. Set the internal capacitor at 20pF and vary the frequency

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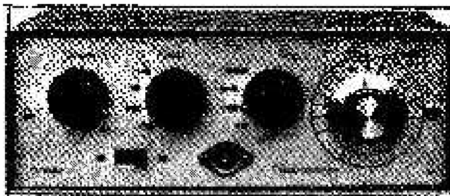

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20P1 0·40
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20P4 1·10
20P5 1·00
25L6GT 0·80
25Z4G 0·70
30C15 1·00
30C17 1·10
30C18 see PCF805
30F5 1·00
30F12 1·20
30FL12 1·20
30FL14 1·00
30L15 1·00
30L17 1·00
30P12 1·00
30PL1 1·00
30PL13 1·10
30PL14 1·10
35L6GT 0·80
35W4 0·60
35Z4GT 0·70
50C5 0·70
50CD6G 1·20
75 1·00
75C1 0·80
76 0·80
78 0·75
80 0·75
85A2 2·20
723A/B 11·00
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805 18·00
807 1·00
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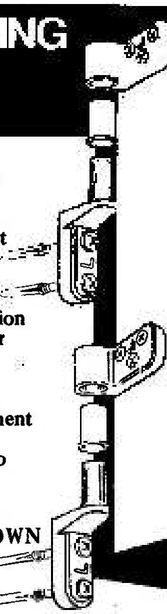

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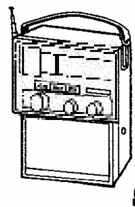

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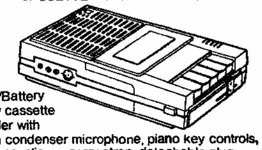

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The PR100, which measures approximately 160 × 78 × 32mm runs on internal Ni-cad batteries and comes complete with a protective carrying pouch, a.c. mains adaptor/charger and a comprehensive instruction and application manual. This contains twenty-one program examples plus instructions for writing your own programs. A one year guarantee for labour and parts is given by the manufacturers.

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Arithmetic:	+, −, ÷, x, M, MR, M+, M−, M÷, Mx, X⟷M, 9M, (,), constant.
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Hyperbolic:	sinh X, cosh X, tanh X, (inv).
Graphical:	R⟷P, c⟷s.
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Programming:	Back step, Single step, R/S, GOTO, Skip, Clr, Run, Load.

ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

The advent of TV may have been a boon to many people but it did nothing for the amateur radio movement. Unless one lives out in the country away from any neighbours, or stays up half the night when TV is QRT, it is now virtually impossible to construct and test a transmitter without causing QRM on nearby TV sets. The very wideband nature of the input circuits of colour TVs, in particular, has not helped.

Screening and filters are ineffective when one is experimenting with a transmitter. If power inputs are restricted to a few watts then one might get away with it, which may explain the increasing popularity of QRP operation. The use of a dummy load when testing does not help all that much especially if one's own TV is only the thickness of a wall away!

The result, of course, has been for the frustrated amateur to buy commercial equipment, generally imported, which is generally well screened and able to meet requirements in respect of harmonic radiation. In the process, however, the amateur has had to forgo the pleasure and satisfaction of making his own gear, thereby failing to learn anything on either the constructional or theoretical sides.

There are now thousands of licensed amateurs in this country who have never known the pleasure of building even the simplest of transmitters and getting it on the air. Believe me, even a few watts of home-produced c.w. is much more satisfying than 400W of s.s.b. from a commercial rig that one dares not touch inside.

The only hope is that the transmitting amateur or listener will at least try to construct his own aids such as frequency measuring equipment, audio filters, converters for v.h.f. and u.h.f., and perhaps gear for RTTY or SSTV operation.

Remember that the more commercial gear we buy and use the more we become "communicators" rather than experimenters, and the greater the possibility of losing amateur band frequencies to those whose job it is just to communicate: commercial and government interests.

General Notes

No newcomers to the column this month so straight on to the letters from regular writers. Following the request for a manual for his Skywood CX203 receiver **Paul Bown** of Theale, near Reading, is very pleased with the 'stat copy he was able to get from a reader. He hopes to have the set working properly on 10 and 15m before long. Paul wonders if a loop aerial of the classic *PW* medium wave type would be any good on the 80m band. Well, I'm afraid that it probably wouldn't help very much. Since most signals there arrive via sky wave there would be little directional effect. Some listeners on 160m have reported using loops to good effect especially in reducing local man-made interference.

Greg Duffy (East Kilbride, Glasgow) is getting down to the handbook stuff and playing around with aerials for his Yaesu FR50B and logging some interesting calls on 10 and 15m. **Ian Marquis** A9140 of Leigh-on-Sea, Essex, points out that the call of the schoolboy net on 3780kHz should have been GW4GIA and not GMA. Ian said he was "sprawled out in the garden on his back" while writing his letter. Funny, I must have missed the summer this year! But I'm off to SV land shortly so perhaps I can make up for it there!

On the Bands

J. Goodier, near Stockport, Cheshire, was surprised to find not one but two rare ones, from Western Samoa, 5W1AX and BN. Well, one can go for years and never hear 5W1 and then up they come. That was on 15m s.s.b. and they were indeed heard by several readers. J.S.G. was intrigued when TI2CF reduced power, at the request of a German station, from 1kW to, he said, 1 watt! when he was still just about copyable. There's a motto there somewhere!

Back to Ian Marquis who found such breathtaking stuff as 5W1, KH6, KG6, VR8, KX6 and the like on 15m s.s.b. not to mention TF6M on 20m from beneath a glacier at Kirkjubaejarklaustur! If I've got the spelling wrong, blame Ian.

Looks like we shall be losing **Dave Greenhalgh** (Poynton, Cheshire) to the opposition v.h.f. column before long. Dave is just getting a QM70 2m converter and about to knock up some kind of suitable aerial from an old Band I TV beam. However, BRS39965 admits to logging some good DX on bands from 10 to 40m including the aforementioned 5W1s.

Bernard Hughes BRS25901 of Worcester is now the proud owner of a Drake R4C receiver and his log bristles with rare stuff. Seems it is the set of his dreams, having tried just about everything else. So OM, what about getting down to it and getting on the air??

The offer of an R1155 receiver in the September issue produced several replies, all from young readers, all anxious to get going on the s.w. bands with something better than a domestic set. I wonder just how many more sets there are sitting around doing nothing that would give so much pleasure to young beginners? If any regular reader wants to give such a set he, or she, has only to give me brief details and I'll try to arrange for some suitable applicant to pick it up without any further bother. As one applicant said "Us schoolkids just can't afford to lash out on reasonable receivers".

Some late but excellent news from two of our regular contributors. **Martin Liezers** (Newport) has passed the May RAE and hopes to be on 2m very soon. Likewise **Simon Robinson** BRS40093 in Stocksfield, Northumberland, has done the trick with a distinction in each part and now goes on for the code test. In the meantime he will be on 2m with a Belcom FS1007P, a 16-channel scanning transceiver. Incidentally, Simon wants to swop a Shibaden SV700ED video recorder for something similar that uses 1in tape. Good luck to you both as you depart this column!

Clubs and Societies

The **Bury RS** continues to meet every Tuesday evening at Mosses Centre, Cecil Street, Bury, with the club station on the air and constructional projects under way, not to mention the odd "noggin and natter". October 10th sees the annual construction competition, with a surplus gear sale on November 14th. The new RAE course is already running at the Metropolitan College of Further Education, with G8NOF lecturing. Details from Eric Thirkell G4FQE, at the centre.

TARS Talk is a jolly good 10-pence worth from the **Torbay ARS,** with at least a couple of down-to-earth articles every month, conned from members' experiences. Write to F. J. E. Bolton, G3VTQ, 2 Lower Combe Road, Kingsteignton, Newton Abbot, Devon, for info on the club and magazine.

Don't forget the newly formed **Shirehampton ARC** meeting every Friday evening at Twyford House, High Street, Shirehampton. Club call is G4AHG and RAE courses are envisaged soon. Fortunately the club premises can be used for RAE exams which should help the more nervous candidates! Write to R. Ford G4GTD at 2 Jersey Avenue, St. Annes, Bristol.

Members of the East London **Silverthorn RC** are also lucky to have such a fine magazine as their *Spurious* newsletter. Five technical articles plus all the usual chatter can't be bad for an annual club fee. Don't forget Friday nights at Friday Hill House, Simmons Lane, Chingford, London E4, or details from C. J. Hoare at that QTH. *CARA News* of the **Cheltenham ARA** deserves an equal mention, likewise well-produced and a mine of info. Their previously mentioned TVI clinic quotes a member fixing TVI on a neighbour's hi-fi outfit "within the hour, before he had time to get uptight". That kind of action can only do good all round. Contact Garth Martin G3IER, 88 Tennyson Road, Cheltenham.

Reports by 15th of month please. Club meeting info at least **seven weeks** ahead!

Log Extracts

B. Hughes:— 20m A3BHF (Tonga) KC6BNQ YB3AE 5W1AT 8R1DT **15m** JD1AHS (Marcus Is.?) 5V1TA **10m** KC4QMN 5V1JH

D. Greenhalgh:— 40m EA8SS **20m** HK0EDF JX3P (Jan Mayen) VP2VBK TF6M 8R1R **15m** A2LAV C5EE HH2A YS1WP 5W1AX **10m** C31QR PY0RO

I. Marquis:— 80m HI8RPB VE3BWK/4X4 **40m** VP2MBB **20m** TF6M VR3AK **15m** F0CH/FC KX6MP VP5SI VR8O 5W1AX 9V1SR **10m** 8R1J

G. Duffy:— 20m VP2DAW HP1MU VP2MZZ YB0CR **15m** SV1JJ CX8CV 5W1BN

J. Goodier:— 20m HH2SD KZ5GE VP2MBB VP9L VE8RCS **15m** FY7OG HS1WR TU2GM WD9FCC/VQ9 ZF2AA 5W1BN 5W1AX

M. Liezers:— 80m OA3I VP1RDT VP2MBB 7X2GOK **40m** CO2KK HI8RDH LU3MCO ZP5EF **20m** C5ABK FM7AC FP0MG HR1JAG VP2EEN VP2KG VP2MZZ VP2SSA YK4ACW YK6JBK 4D6DO (Philippines) 5J4RCA 5V3YJ **15m** FH8CY HK4EU HM2JV

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy G8BUS

Following on from last month when a number of Asiatic and African stations operating in the gaps between Europeans were highlighted, it might now be useful to have a look at a few Europeans, mainly low power, which transmit on non-standard frequencies. Why they do so is not clear though it may be to avoid interference. One would expect these broadcasters to be moved onto official channels after the introduction of the new band plan that comes into operation on the 23rd November this year. If this happens then it will no longer be possible to eavesdrop into local broadcasting at the eastern end of the Mediterranean where currently some of these outlets are located.

Low Power Greek Stations

Broadcasting in Greece is carried out mainly by the state-owned ERT and by YENED which provides a service to the armed forces. There are also a few privately-owned locals, two of which operate just beyond the highest European channel. **Bob Bell** (Blyth Northumberland) reports hearing an unidentified Greek on approximately 1620kHz at 2350 using an FRG-7 receiver and a 20in mini-loop aerial. This is probably Radio Ierapetra, situated on the south coast of Crete, which operates on a nominal 1614kHz with a power of 500 watts. This station has been known to QSL and the address for reception reports is Radio Ierapetra, Anatolikis Kristis, Crete, Greece. Do not forget to enclose an International Reply Coupon. The other station in this part of the band is Radio Aegion on 1610kHz. Although inclined to wander off frequency these two locals are not too difficult to pick up in the UK.

THERMOSTATS

Refrigeration as illustrated with 36" capillary **£1·62.**
Limpet Stat must be mounted in close contact calibrated 90°-190°F 15 amp contacts **£1·62.**
Appliance Stat fix like a volume control—15 amp contact 30°-80°F **85p.**
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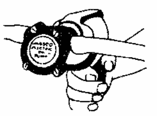

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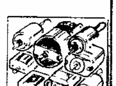
8 POWERFUL BATTERY MOTORS



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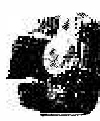
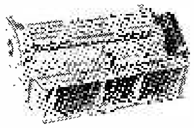


One illustrated is our reference MM11 made for ITT ¾ stack 1½ spindle **£2·25,** ¾ stack model **£1·75.** 1 stack **£2·75.** 1½ stack **£3·25.**

TANGENTIAL HEATER UNIT



A most efficient and quiet running blower-heater by Solatron—same type as is fitted to many famous name heaters—Comprises mains induction motor—long turbo fan—split 2 kw heating element and thermostatic safety trip—simply connect to the mains for immediate heat—mount in a simple wooden or metal case or mount direct onto base of say kitchen unit—price **£4·95** post **£1·50** control switch to give 2kw. 1kw, cold blow or off available **60p** extra.

3KW MODEL
£5·95
+ £1·50 P & P

2 k.w. model made in metal case with control switch **£12·00**

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VOLTAGE	CURRENT	REF.	PRICE
1v	2 amp	TM1	£1·94
2·4v	5 amp	TM2	£1·62
4v	7 amp	TM32	£2·70
6v	¾ amp	TM3	85p
6·5v	¾ amp	TM37	85p
6·5v	200 mA	TM21	£1·62
6·5v 0-0·5v	100 mA	TM21	£1·62
6·5v 0-6·5v	750 mA	TM7	£2·16
6·3v 0-6·3v	100 mA	TM33	£1·62
6·3v	2 amp	TM4	£1·89
8·5v	1 amp	TM12	£1·62
8·5v + 8·5 sep winding	½ amp	TM12	£1·62
9v	1 amp	TM5	£1·62
9v	1 amp 'c' core		£1·80
9v	3½ amp	TM11	£2·70
9v	5 amp	TM38	£3·24
10v	25 amp	TM15	£4·86
10v 0·10v	12½ amp	TM15	£4·86
12v	½ amp	TM9	£1·05
13v	¾ amp	TM7	£2·16
12v	1 amp	TM10	£1·89
12v-0·12v	50 mA	TM19	£1·62
12v-0·12v	1 amp	TM41	£3·24
15v tapped 9v	2 amp	TM11	£2·70
17v	½ amp	TM12	£1·62
18v	¾ amp	TM13	£1·90
20v	½ amp	TM14	£1·62
20v	5 amp	TM27	£4·32
20v	12½ amp	TM15	£4·86
20v-0·20v	6 amp	TM15	£4·86
13v	100 mA	TM21	£1·62
24v	1½ amp	TM16	£2·12
24v	2 amp	TM17	£2·70
24v + 2v 7 amp	2 amp	TM39	£2·97
24v	4 amp	TM40	£3·78
25v	1½ amp	TM18	£2·43
26v	2 amp	TM39	£2·98
30v	8 amps	TM15	£4·86
37v	37 amps	TM34	£31·86
40v tapped @ 30v, 20v & 10v	6 amp	TM15	£4·86
50v-2 amp with 6·3v shrouded		TM22	£4·86
50v	8 amp	TM29	£11·65
60v	5 amp	TM24	£7·02
75v-3 amp with 6·3v shrouded		TM23	£8·10
75v	4½ amp	TM24	£7·02
70v tapped 60v & 75v	4 amp	TM24	£7·02
100v	1 amp	TM25	£7·02
100v-0·100v	½ amp	TM25	£7·02
130v tapped 120v	½ amp	TM28	£3·78
200v	½ amp	TM25	£7·02
250v-0·250v with 6·3v 2A	50 mA	TM36	£3·78
250v	100 mA	TM36	£3·78
500v	50 mA	TM36	£3·78

Quantity Prices available. Please, unless you are calling add 25% to your order to cover cost of carriage.

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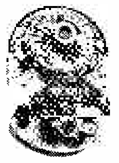
A mains operated 4+4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone in easy-to-assemble modular form and complete with a pair of Plessey speakers this should sell at about £30—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only **£15** including VAT and postage.



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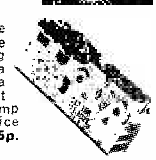
SOUND TO LIGHT UNIT

Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450W). Unit in box all ready to work. **£9·95.**

HUMIDITY SWITCH



American made by Ranco, their type No. J11. The action of this device depends upon the dampness causing a membrane to stretch and trigger a sensitive microswitch adjustable by a screw, quite sensitive—breathing on it for instance will switch it on. Micro 3 amp at 250v AC. Overall size of the device approx. 3¾" long, 1" wide and 1¾" deep. **75p.**

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REMEMBER THIS IS YOUR CHANCE!

RELAYS

12 volt two 10 amp changeover plug in **95p.** 12v three 10 amp changeover plug in **£1·28.** 12v two changeover miniature wire ended **95p.** 12 volt open single screw fixing two 10 amp changeovers **85p.** 12 volt open three 10 amp change overs **£1·25.** Latching relay mains operated 2 c/o contacts **£2·11.** Mains operated three 10 amp changeovers open type one screw fixing **£1·25.** Many other types with different coil voltages and contact arrangements are in stock, enquiries invited.

SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 29, 31 metre bands. Kit contains chassis front panel and all the parts **£1·94**—crystal earphone **55p** including VAT and postage.

XMAS PRESENTS

Table radio as illustrated—mains MW	£6·50
Cassette Recorder and player—LM & FM Radio	£42·50
Stereo Record player with pair of speakers	£33·50

BURGLAR ALARM ITEMS

(Circuit free on application)

Trigger mats 24" × 18"	£2·45
13" × 10"	£1·95
Relay 24 volt	95p
9-12 volt	95p
Alarm Bell 24 volt	£7·50
9-12 volt	£2·25
Mains	on application
Reset, Switch, ordinary	45p
Secret type with key	95p
Wire—100 metres	£1·50
24v Power unit mains operated	£5·35

Terms: Prices include Post & VAT. But orders under £6·00 please add 50p to offset packing. Bulk enquiries—Please Phone for Generous Discounts 688 1833.

J. BULL (ELECTRICAL) LTD

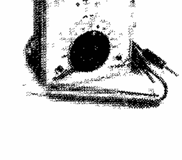
(Dept. P. W.), 103 TAMWORTH RD., CROYDON CR8 1SG

IT'S FREE!

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

FM Tuner and decoder, 2 very well made, (Japan) units, nice clear dial, excellent reproduction. **£11·20** the pair.
12 Volt Heavy Duty Relay, plug in tape has three pairs of 10 amp changeover contacts. A transparent dust cover, price **£1·08** suitable 11 oin base 45.
4 Changeover Relay, upright mounting 4 sets of 10 amps changeover contacts, mains voltage coil **£1·72.**
12 Volt Pump. Designed we believe as a bilge pump, this is 12 volt AC/DC motor coupled by a long enclosed shaft to a submersible pump. Suitable for water or most any fluids. Price **£12·50.**
High Load 24 Hour Clock Switch, made by the famous Smiths Company for normal mains but with clockwork reserve has load capacity of 80 amps at 240V 50HZ. Therefore suitable for dealing with large loads of say shop lighting, water heating, storage heaters, etc., etc. Has triggers for on and off once per 24 hours but extra triggers will be available. Price **£1·50** per pair., totally encased, Price **£9·50.**
Enclosed 24 Hour Clock with contacts for breaking 10-12 amps at 240 volts. This one has two sets of on/off per 24 hours, price **£7·00.**
Light Dimmer, our timer module with small mods makes an excellent light dimmer. Contains a 4 amp 400V SCR so it should be suitable for loads approaching 1KW. Price of module and instructions **£2·25.**
Push Pull Solenoids, mains operated solenoids which will push as well as or instead of pull. Very heavy duty, estimate this at 20lbs push or pull 1¾" × 3⅛" × 4" made Magnetic Devices Co. **£7·50.**
Flashing Lights, chasing lights, random flashes, strobe effects etc., etc., can easily be achieved using our disco switches. These switches are ex-equipment but guaranteed perfect and supplied suitable for mains working. To get some idea of the loading number, each switch is 10 amp. For the light pipe or Catherine Wheel effect order the 12 switch model with light pipe data model, interconnecting the switches to give fastest speed. 6 Switch model **£5.** 9 Switch model **£9·75** 12 Switch model **£6·20.**
Reed Switches, standard 60 watt glass type. Normal open contacts glass lengths 2" diameter 3/16", 10 for **£1,** 100 for **£8,** 1000 for **£70.**
Flat Reed Switches, for stacking, greater quantity in confined space. Price **50p.**
Ceramic Magnets, suitable for operating Reed switches, central fixing hole, 10 for **£1.**
Music Centre Transformer 12-0-12 at 1 amp and 9 volt at ½ amp. Normal primary, uprighting, impregnated and varnished for quiet operation. Price **£3·50.**
'W' Shaped Fluorescent Tubes for porch light, box signs or where you want light evenly spaced over a confined area of approx. 10" × 10", 30 watts made by Philips, price **£2·24.**
Extension Speakers, 8 ohm 4-5 watts handling power. We have 5 or 6 different models in stock. cheapest being the Partytime at **£3·95** each, again only really a bargain for callers as postage is £1·50 per speaker.
Auto Transformers for working American tools and equipment, completely enclosed in sheet metal case with American type flat output socket made for computer so obviously first class 500 watts. With cang handle, offered at about half price only **£15.** These may be a bit soiled but are fully guaranteed. Similar but 1000 watt £29·50.
Car Starter Charger Kit. New version. We supply two 10 amp rectifiers. 250v transformer and the start change switch with instructions. price **£9·75.** This is probably one of the most useful pieces of equipment you can have in your garage. Sooner or later you or someone will leave something on and you will have a flat battery, this starter will get you away usually in less than 5 minutes.
Resetter Counter, by Veedroot Company, 230/240V mains operated, intended for surface mounting has a fixing flange at the bottom. Price **£2·16.**
12V Drip proof Relay. Specially designed for going under the bonnet of a car, made by one of our big manufacturers, this really has a removable semi-hard rubber cover. Contacts look suitable for up to 10 amps so this could be the right one if you are thinking about making an anti-thief device. Price **£1**+8p.
High Speed Uniselector. As many customers know, we have a very comprehensive stock of uniselectors as used in automatic telephone exchanges. light flashing device etc., etc. Just arrived however is a high speed model made by famous Plessey, this is 2 pole 32 way with make before break wipers, overall size approx. 4" × 3" × 2½", price **£3·50** + 28p.
Pneumatic Ram for lifting, thrusting, pulling etc., etc., has 2¾" travel, looks large enough to open doors, lift, staircase, ventilators, etc. Price **£7·00.**
Solder Gun Bargain. The ETP, this is 100 watt solder gun a very well made tool with lamp to illuminate work, has double insulated mains transformer and is built into the shock proof thermoplastic case. Comes complete with spare tips. Mains operated of course. Price **£4·50.**
Interested in Tape Control. American made tape punches really beautiful units made of sophisticated parts, designed we believe to automatically operate typewriters and they can of course be used to operate other punch tape controlled machines. Reference number is NCR Class 461-2 reference 205 H8 R56. We believe these are 8 bit paper tape punches, powered from 115V 50HZ in very good condition with tape **£16·00,** carriage is £3·20.

MINI-MULTI TESTER



Mazing deluxe pocket size precision moving coil instrument — jewelled bearings — 1000 opv — mirrored scale.
11 instant ranges measures—
DC volts 10, 50, 250, 1000
AC volts 10, 50, 150, 1000
DC amps 0-1mA and 0·100 mA.
Continuity and resistance 0·150K ohms.
Complete with insulated probes, leads, battery, circuit diagrams and instructions.
Unbelievable value only **£6·50.**

ELECTROVALUE Buying Guide

Section 2

If you have bought from Electrovalue, you will know just how large and varied our stocks are. For those who have yet to know, we are publishing a series of five ads. month by month to give up-to-date information and prices on the most important items we carry. These ads. now appear in stepped rotation in five journals—Pr. Wireless, Pr. Electronics, Everyday Electronics, Electronics Today Intntnl. and Elektor so that the complete series will be available each month. In this way, no matter which journals you read, BY DETACHING AND SAVING THESE PAGES, YOU WILL HAVE A VALUABLE AND COMPREHENSIVE MONEY SAVING CATALOGUE. ALL MERCHANDISE IS BRAND NEW AND GUARANTEED.

Meet us at BREADBOARD 78 Stand B8

Capacitors

Quantity prices available except for MDC.

CERAMIC DISC ●

500V: 1, 2, 5nF	3p
50V: 0.02µF	3p

CERAMIC FLAT TUBULAR B37448 ●
(2.5mm)

0.01µF 63V	4p
0.022µF 40V #	3p
0.022µF 63V	5p
0.033µF 63V	5p
0.047µF 63V	5p
0.068µF 63V	6p

CERAMIC FLAT TUBULAR B37449 ●
(5mm)

0.047µF 63V	5p
0.068µF 63V	5p
0.1µF 63V	6p
0.22µF 63V	11p

CERAMIC PLATE
(Mullard C333) ●
E12 values

1.8pF – 18pF	4p

CERAMIC PLATE ●

E12 values	
22 – 33pF	3p
39 – 68pF	3p
82 – 220pF	3p
270 – 1000pF	3p
E6 values	
1500 – 4700pF	3p
6800pF	3p

CERAMIC FEED THROUGH ●

1000pF 350V	6p

ELECTROLYTIC, REVERSIBLE ●
EX50 series, 50V.

2µF	25p
4uF	27p
6, 8, 10, 16uF	30p
25µF	35p
40, 60µF	56p
100µF	65p

ELECTROLYTIC, CANS ●
Siemens B41070, *unsleeved*

1000µF 40V	.99p
1000µF 63V	1.07
1000µF 100V	1.50
2200µF 25V	1.08
2200µF 40V	1.21
2200µF 63V	1.50
4700µF 25V	1.46
4700µF 40V	1.50
4700µF 63V	2.04

ELECTROLYTIC, CANS ●
Daly, *sleeved*

1000/25	46p
2200/50	94p
5000/25	98p
4700/100	3.61

ELECTROLYTIC, axial lead ●
Siemens B41313/B41283/B41010

µF	volts	
0.47	63	21p
0.47	100	12p
1.0	40	21p
1.0	100	12p
2.2	25	12p
2.2	63	12p
2.2	100	12p
4.7	16	21p
4.7	40	12p
4.7	63	12p
4.7	100	14p
10	6.3	21p
10	25	12p
10	40	12p
10	63	14p
10	100	15p
22	10	12p
22	25	12p
22	40	13p
22	63	15p
22	100	16p
47	3	12p
47	10	12p
47	25	14p
47	40	15p
47	63	16p
47	100	19p
100	3	12p
100	10	14p
100	16	15p
100	25	16p
100	40	16p
100	63	22p
100	100	28p
220	3	13p
220	6.3	15p
220	10	15p
220	16	17p
220	25	20p
220	40	24p
220	63	30p
220	100	47p
470	10	19p
470	16	24p
470	25	22p
470	40	31p
470	63	49p
470	100	74p
1000	3	18p
1000	6.3	22p
1000	10	21p
1000	16	30p
1000	25	40p
1000	40	45p
1000	63	76p
2200	3	23p
2200	10	30p
2200	16	45p
2200	25	70p
2200	40	77p
4700	16	85p
4700	25	96p
10,000	3	40p

ELECTROLYTIC, PLUGGABLE ●
Siemens B41316 series

µF	volts	
1.0	63	13p
2.2	63	13p
4.7	63	13p
10	63	13p
22	40	13p
22	63	14p
47	16	13p
47	40	14p
47	63	18p
100	6.3	14p
100	16	14p
100	25	15p
100	40	18p
100	63	24p
220	3	8p
220	10	16p
220	16	18p
220	25	19p
220	40	23p
470	6.3	16p
470	10	19p
470	25	25p
470	40	29p
1000	16	26p

ELECTROLYTIC, TANTALUM BEAD
Siemens B45134 series

µF	volts		
0.1	35	●	14p
0.15	35	●	12p
0.22	35	●	14p
0.47	35	●	14p
0.68	35	●	14p
1.0	35	●	14p
2.2	16	●	14p
2.2	35	●	14p
3.3	16	●	14p
4.7	16	●	16p
4.7	35	●	18p
6.8	25	●	18p
10	6.3	●	16p
10	16	●	18p
10	25	●	20p
15	25		31p
22	6.3	●	18p
22	16		22p
22	25		45p
33	10		22p
47	6.3		22p
47	16		35p
100	3	●	22p
100	6.3		45p
100	10		67p

ELECTROLYTIC, TANTALUM, AXIAL
Siemens series D.

0.1/35, 0.47/35, 1/35	35p
2.2/20, 4.7/10	35p
2.2/35, 4.7/35	37p
10/20, 22/15	37p
47/10	66p

LACQUER FILM
(non-polarised)
Siemens B32110 series 20% tol.

µF	volts	
0.1	100	76p
0.15	63	62p
0.22	63	65p
0.33	63	70p
0.47	63	78p
0.68	63	84p
1.0	63	91p
1.0	100	1.45
1.0	250	2.01
1.5	63	93p
2.2	63	1.60
3.3	63	1.82
4.7	63	2.07
6.8	63	2.59
10	63	3.00
10	100	5.06

SILVERED MICA, 350V
1% (or ½pF) ●

R611, 12.7 x 8mm. All in pF.	
2.2, 3.3, 5	11p
6.8, 10, 15	11p
18, 20, 22, 25	11p
27, 30, 33	11p
39, 47, 50	11p
56, 68	11p
100	12p
150	14p
220	17p
330	20p
R1015, 16.5 x 11.4mm	
82, 100	11p
120, 150	11p
180, 200, 220	12p
250, 270, 300	12p
330	15p
470	16p
1000	20p
R1524, 28.0 x 17.8mm	
330	18p
390, 470, 500	18p
560, 680	18p
820 1000	22p
2200	24p
3300	36p
4700	46p
R2032, 35.6 x 23.0mm	
1500, 1800	18p
2200, 2700	24p
3600, 3900	29p
4700, 5000	33p
6800	41p
8200, 10,000	56p

MIXED DIELECTRIC.
M.D.C.
600V
0.1 **28p**; 0.47 **77p**;
1.0uF **84p**
1000V
0.001, 0.0022, 0.0047 **20p**;
0.01 **22p**; 0.022 **23p**;
0.1 **32p**; 0.22 **57p**;
0.47 **81p**; 0.047 **32p**

POLYESTER,
Mullard C280. PC mtg.

0.01, 0.015	●	6p
0.022	●	6p
0.033, 0.047	●	6p
0.068	●	7p
0.1	●	7p
0.15	●	8p
0.22	●	9p
0.33	●	13p
0.47	●	15p
0.68, 1.0		24p
1.5, 2.2		42p

POLYESTER,
PC mounting
Mullard 344- or Siemens B32234- series as available

100v		
0.047	●	9p
0.068	●	9p
0.1	●	10p
0.15	●	11p
0.22	●	12p
0.33	●	16p
0.47	●	18p
0.68		22p
1.0		27p
2.2		46p
4.7		79p
6.8		1.08
250V		
0.01	●	6p
0.015	●	6p
0.022	●	8p
0.033	●	8p
0.047	●	8p
0.1	●	11p
0.68		24p
0.82		24p
1.0		27p
2.2		48p
400V		
0.01	●	7p
0.015	●	7p

POLYESTER, Axial lead
Siemens B32231 series

µF	volts		
0.01	630		13p
0.015	630		13p
0.022	630		13p
0.033	400	●	13p
0.047	250	●	13p
0.047	400	●	14p
0.047	630		16p
0.068	250	●	14p
0.1	250	●	14p
0.1	400	●	15p
0.1	630		25p
0.12	250	●	13p
0.15	250	●	14p
0.22	250	●	15p
0.33	250	●	18p
0.47	250	●	21p
0.68	250		27p
1.0	250		31p
1.0	400		46p
2.2	250		51p
4.7	250		1.04
10	250		1.81

POLYESTER,
B32560 PCM 7.5mm

µF	volts		
0.001	250	●	6p
0.0015	250	●	6p
0.0022	250	●	6p
0.0033	250	●	6p
0.0047	250	●	6p
0.0068	250	●	6p
0.0082	250	●	7p
0.01	250	●	6p
0.012	250	●	7p
0.015	250	●	6p
0.018	250	●	8p
0.022	250	●	7p
0.027	250	●	8p
0.033	250	●	7p
0.039	250	●	8p
0.047	250	●	7p
0.056	250	●	9p
0.068	250	●	8p
0.082	250	●	11p
0.1	250	●	9p
0.1	100	●	9p
0.12	100	●	12p
0.15	100	●	10p
0.18	100	●	14p
0.22	100	●	12p
0.27	100	●	19p
0.33	100	●	16p
0.39	100	●	23p
0.47	100	●	20p
0.56	100		30p
0.68	100		25p

POLYESTER,
B32561 PCM

0.01	250	●	5p
0.022	250	●	6p
0.047	250	●	7p
0.1	250	●	9p
0.22	100	●	11p
0.47	100	●	17p
1.0	100		28p

POLYESTER,
B32562 PCM

0.47	100	●	17p
1.0	100		30p
2.2	100		48p

POLYESTER,
B32563 PCM

1.0	400	72p

(Good pulse discharge ratings)

POLYPROPYLENE,
B33063, 160V ●

100, 470, 680pF	4p
2200, 4700, 5600pF	6p
5100pf	4p
6800, 10,000pF	6p

POLYSTYRENE,
B31110, 160V

5, 7, 10, 12pF	6p
15, 22, 27, 33pF	6p
39pF	6p
47, 56, 68, 82pF	5p
100, 120, 150pF	5p
160, 180, 220pF	5p
270, 330, 390pF	5p
470, 560pF	5p

POLYSTYRENE,
B31310 160V

560, 680, 820pF	5p
1000, 1500	5p
2200, 3300pF	5p
1200, 1800, 2700	8p
3900, 4700	8p
5600, 6800, 8200	8p
10000pF	8p
12000, 15000	12p
18000, 22000	13p

TRIMMER CAPACITORS ●
Polypropylene, 100V, 0.1" matrix

2-10pF	23p
5.5-65pF	34p
2-22pF	27p

VARIABLE CAPACITORS
Jackson 'Dilicon' solid dielec.

100pF	**1.70**	200pF	**1.82**
300pF	**1.96**	500pF	**2.20**

Jackson C804,
air dielectric.

5pF	**1.39**	60pF	**1.66**
20pF	**1.48**	150pF	**1.89**
50pF	**1.48**	15pF	**1.39**
100pF	**1.71**	30pF	**1.66**
10pF	**1.39**	75pF	**1.66**
25pF	**1.39**		

Jackson Ball Drives, 6 1

4511BD	**1.38**
4511DA	**1.38**
4489 with calibrated dial	**4.88**

CAPACITOR CLIPS

HORIZONTAL

25mm	**8p**	35mm	**10p**
44mm	**11p**		

VERTICAL

25mm	**8p**	30mm	**14p**
35mm	**8p**	41mm	**8p**
44mm	**10p**	51mm	**14p**
64mm	**14p**		

We are National Distributors for

NASCOM 1
MICROCOMPUTER KITS

for delivery from stock. Net from **£197·50** + **V.A.T.**

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MICROPROCESSOR EVALUATION KIT
£175·87 Net + V.A.T.

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- TOP QUALITY MERCHANDISE – ALL GUARANTEED.
- V.A.T. – add 8% to value of order. For items marked ● add 12½%.
- For ACCESS or BARCLAYCARD orders, just phone or write your number.
- No discounts allowable on prices marked NET or N
- **TEAR OUT AND TAKE GOOD CARE OF THIS PAGE AND REMEMBER TO LOOK OUT FOR NEXT MONTH'S TO ADD TO IT.**
- **OUR COMPUTER-AIDED SERVICE TAKES GOOD CARE OF *YOUR* ORDER NO MATTER HOW LARGE OR SMALL.**
- **COMPREHENSIVE PRICE LIST FREE ON REQUEST.**

Reply please to Dept P.W.11.

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Telephone Egham 3603 Telex 264475
Northern Branch - 680, BURNAGE LANE, BURNAGE, MANCHESTER M19 1NA (061) 432 4945

Crystal calibrators are available commercially either as completed units or in kit form. Kits are available from two advertisers in *PW*. Rocquaine Electronics, Aldebaran, Le Coudre, St Peters, Guernsey, C.I. offer their RQ-1 which has outputs of 1MHz, 100kHz and 10kHz with optional c.w. or modulated outputs, while Cambridge Kits have a calibrator with outputs of 1MHz, 100kHz and 25kHz which provides markers up to v.h.f.

DX Clubs

The World DX Club has recently released the 3rd edition of its QSL Statistics which contains details of 16576 QSLs received by members from 1969 to 1976. Copies can be obtained from the WDXC, 17 Motspur Drive, Northampton, NN2 6ZY for 50p (UK) or 5 IRCs seamail and 7 IRCs airmail. The WDXC can also supply copies of two new publications issued by the European DX Council. The first is the Reporting Guide which contains advice, vocabularies and report models for reporting in English, French, Spanish and Portuguese. The other is the EDXC Landlist which lists 274 radio countries and contains an ITU zone map. The EDXC publications can be obtained by UK and Irish DXers from 39 Sollershott Hall, Letchworth, Herts for 80p each.

The inaugural meeting of the North England Radio Club took place in Birkenhead on July 29, the new club being formed out of the old Merseyside DX club. A sample copy of the club bulletin *Radio Spectrum* is available for two 9p stamps (UK) or for two IRCs (abroad) from the secretary who is Norman Monti, 66 Chesnut Grove, Birkenhead, Merseyside, L42 0MZ.

DX

Radio Japan has been picked up on 21535kHz in the 13m band by **Charles Kaberry** (Fleetwood) who heard the English programme at 0800 with his FRG-7 and Joystick antenna. **Bill Stevenson** (Swinton) also heard this transmission with his Vega 206 plus 40ft loft aerial and he received a QSL card within 3 weeks. **Bob Bell** (Blyth) logged Radio Colombia on 5985 at 0335 and ORF (Austria) on 15410 and 15440 at 0830 using his FRG-7 and long wire. **Davis Stevenson** (Thurso) has an Astrad 17 and 100ft long wire with which he picked up Radio Australia on 6035 at 2100, 15410 at 2240, 11880 at 1900, 17825 at 0140 and 17725 at 0200, none of which are beamed to the UK. The address for reception reports is Box 428G, Melbourne, Australia 3001.

Harmonics are reported by **P. R. Sixe** (Cambourne) on 23670 (2×11835) and 23940 (2×11970) both being from Radio Free Europe and on 23660 (2×11830) this time from Radio Moscow. DX heard on 60m included Lagos 4990 at 0430, Radio Colosal Colombia 4945 at 0445, Radio Reloj Costa Rica on 4832 also at 0445 and a station mentioning Paramaribo Surinam on approx 4850 at 0425 (nothing listed here). **Roy Patrick** (Derby) has also been active on 60m with his Trio 9R59D and he pulled in ELWA Monrovia on 4770 at 2215 and a Chinese station on 5020 at 2200. **Jim Edward** (Wigan) has an FRG-7 and a 60ft loft aerial plus a.t.u. DX heard included Radio Nacional Colombia on 15335 at 0200 and Uganda on 15325 at 0400, the latter being a test transmission with a request for reception reports.

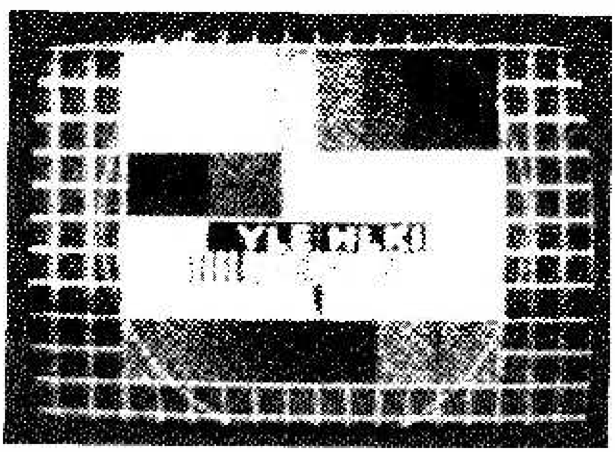
by Ron Ham BRS15744

Guy Stanburys letter to the Editor in our August issue about interest in Band II has certainly prompted comments from my readers and I know that Guy is delighted with the response he has already received. **John Branegan**, GM8OXQ, Saline, Fife, says "I wonder if many of the youngsters realise what a good band for DX Band II is, with my ordinary commercial stereo and a simple 3-element beam, fixed on Kirk of Shotts, i.e. 215°, I still get plenty of Polish, Slav and French stations on f.m. whenever the barometer is up".

Mike Gaskin, a new reader from Croydon, Surrey, uses a Trio KT600S on Band II with a dipole at 30ft and says that Hilversum 1 was audible for 4 days from July 13th to 18th and **Ian Rennison**, Horsham, Sussex, writes "The MUF increased to 100MHz for about 15 minutes at 1805 on July 27th allowing a number of Spanish stations to be heard in Band II". Between 1200 and 2200 on July 12th, **Frank Luman**, Glasgow, heard several Norwegian stations between 89 and 97MHz and recommends that DXers should use some form of r.f. pre-amplification as well as a good aerial on Band II.

Sporadic-E

Both Ian Rennison and myself frequently received strong television pictures, identified by their test cards, from stations in eastern Europe, Russia, Spain and Scandinavia during the sporadic-E disturbances which occurred for some period on 21 of the 30 days between July 19th and August 18th. Signals from Norwegian television were often very strong and test cards labelled Norge, Gulen and Steigen were seen on Ch.E2 and Gamlem and Hermnes on Ch.E3. Mike Gaskin uses a JVC 3050, 625-line TV receiver for DXing on Bands I, III and V and around 1830 on July 15th he saw, as I did, a caption which read "Granada Television International", we think on Ch.E2. Any gen about this will be welcome.



A picture received in Sussex by sporadic-E from Finland. The JVC 3060 receiver was fed by a simple dipole aerial

Throughout each event, a large number of strong signals were received from east-European broadcast stations between 65 and 73HMz, a variety of Continental radiotelephone signals between 40 and 50MHz and often signals from the German 10m beacon, DL0IGI.

Solar Activity

Although very little solar noise was recorded at 136MHz between July 19th and August 18th, **Cmdr Henry Hatfield**, Sevenoaks, Kent, has observed several very dense prominences and filaments with his spectrohelioscope. Henry is building a 23cm radio telescope and intends to find out if there is any positive relationship between solar noise at 1296MHz and 136MHz when sunspots are present.

The 10 Metre Band

John Branegan also noticed the lack of solar activity and writes, "This is a very sudden change from a month ago, 10m is dead, 15m poor, OSCAR-8A superb into USA with 4-minute QSOs right down to the horizon with no trace of fading, so the ionosphere is very quiet". **Mr M. Mrzyglod**, Wallingford, Oxford, has been DXing on the m.w. band for about two years, and, after reading about the International Beacon Project stations, in this column, and hearing distant amateurs on 10m, he is going to give this band a try.

Sporadic-E was very prominent on July 27th and **Harold Goble**, G4FDQ, Lancing, worked OD5ID, a French Embassy station in Beirut, who was using 10 watts and 7X2BIC, Algeria, who was only using 2 watts. **Harold Brodribb**, St Leonards-on-Sea, now using an AR88LF receiver, heard DM5TML calling CQ and LV9DM calling SM. Both Harolds have heard Rhodesian and South African stations on 10m during sporadic-E disturbances. On August 8th stations were again heard calling CQ sporadic-E on 10m and at 1832 on the 10th and 0913 on the 18th, the Cyprus beacon, 5B4CY was heard.

Microwaves

Both **Ern Hoare**, G8BDJ, Southwick, Sussex, and **Ern Downer**, G8GKV, Worthing, worked **Don Hayter**, G3JHM/P, from Chanctonbury Ring, near Worthing, during a recent RSGB Microwave Cumulative contest. However, during the evening of August 11th Don, holidaying near Parfleur, used his 3cm gear with the callsign, F0AKD/P and, at a distance of 155km he had 59 plus QSOs with both G8BDJ/P and G8GKV/P on Mill Hill, some 400ft above Shoreham, Sussex, which means that Ern Downer now qualifies for the RSGB's award, for a contact on 3cm above 150km. Further congratulations go to Ern who has completed 3cm contacts with stations in 5 QRA Locator Squares and qualifies for another Society award. He may well be the first UK amateur to hold both microwave awards.

Readers' Special Events

On July 22/23rd, members of the Chichester Radio Club established a station, G8NMF/P at the Goodwood Show, in aid of charity, along with military displays and vintage vehicles. During the event, club chairman **Mike Rowe**, G8JVE/M, was a passenger in a TR7 with a 2200G between his knees, and a whip aerial inside the car being driven around the famous Goodwood motor circuit by a chief racing driving instructor. At 100m.p.h., Mike worked their exhibition station and his signals were also heard by a listener, in nearby Chichester, who reported hearing the squeal of tyres via Mike's microphone.

Early in July, **Jack Brooker**, G3JMB, Hassocks, Sussex, had a camping holiday in Orkney and Scotland and managed a few f.m. contacts on 2m. Jack did very little mobile operating in the three days he took to travel 770 miles to Scrabster, Caithness, "Mainly", says Jack, "because in the head winds my 5/8 magnetic mount would not stay on the roof of the car". During his holiday he worked numerous GMs, G, ON, and LA via the Aberdeen repeater GB3GM, R7, and while parked on the old Flintstown to Kirkwall road he heard the Stavanger repeater, LA5VR, competing with GB3GM on R7 and used it to work LA2FV in Stavanger.

Ian Rennison has produced some fine transparencies of the sporadic-E television signals he received from Austria, DDR, Italy, Iceland, Spain and Russia. His brother David, in the same QTH, has a special interest in 2m DX using a NR56 in his car with a 5/8 whip aerial and a Microwave Modules converter into a Trio 9R59-DS in his shack. David built a 3-element beam for s.s.b. DXing and uses a 5/8 ground plane for the repeater network.

Alan Baker, G4GNX, Newhaven, worked W8FUP on 20m who told him that there are over 100 repeaters on 2m within a 50 mile radius of Cincinnati, Ohio, and some of them are over 800ft a.s.l.

Tropospheric

Between 2000 and midnight on July 27th a tropospheric disturbance followed the sporadic-E and Mike Rowe worked 3 Fs, 3 HB9s, and 1 ON on 2m s.s.b. During the early evening of July 22nd, **Roy Bannister**, G4GPX, heard PA0s and ONs on 2m s.s.b. and Alan Baker had 2m c.w. contacts with F6DOP in Paris and F9LT in Versailles. A brief lift occurred around 2000 on August 8th when I heard G3GDW in Northampton contact Constance Hall, G8LY, Hampshire, through our local repeater, GB3SN, R5, and at 2010 Ian Rennison watched a news programme, with a YL announcer on Ch.E6, 182MHz.

At 1600 on August 14th, G4GPX heard repeaters FZ2THF, FZ3THF, GB3BC, and GB3PO, and at 2146, G4GNX worked F1ENH, Boulogne, and ON6FI and ON5AN in Ghent. Conditions were good for v.h.f. during the spell of fine weather on August 17th, 18th, and 19th, when many repeater signals were heard well above their normal range. At 0722 on the 19th I heard G8DD in Nottingham and G8MLC on the Isle of Wight have a QSO through the Bristol Channel repeater, GB3BC.

OSCAR

John Branegan has now worked transatlantic s.s.b. on both satellites, on all four modes, 7A, 7B, 8A and 8J. "On my first test transmission up to OSCAR-7B", writes John, "I called CQ test and DB5KF/P came straight back" and later he worked a K4 in West Virginia.

What do the VHFs have to offer? . . . . Part 2

Apart from the general enjoyment of operating on the v.h.f. bands, the scientific aspect of hearing or working DX is exciting, especially when a given region of the earth's atmosphere is well and truly disturbed. Although a great deal is already known about the strange behaviour of v.h.f signals under abnormal conditions, we still have a lot to learn and the observations which we make during each new event will be of value to the scientists of the future.

Owing to the limited range of v.h.f. signals and the careful planning by both national and international bodies, the hundreds of transmitters required to meet the needs of a thickly populated area like Europe, must share the same or similar frequencies, within a particlar band. This arrangement works well until a natural disturbance occurs and increases the normal range of signals from about 100 to more than 1,000 miles. Remember the old saying "One man's meat is another's poison" well, this is very true in the world of v.h.f., because, when we radio enthusiasts are enjoying that super DX on 2m and 70cm, the Band III and Band V televiewers are pestered with interference on their sound and pictures from the unwanted signals, of the distant stations, which are sharing the same channel.

Solar Noise

Radio waves from a solar event are most likely to be heard between 100 and 200MHz and will sound like a massive increase in the receiver background noise. whoooooosh, and covering several megahertz These waves, which originate on the sun 8·3 minutes before they are heard on earth, tell us that a solar event, like a flare, has taken place and that particles from the sun may reach us within the following 50 hours.

Because the earth's atmosphere is so very complex it is worth taking a look at the different regions and their effect upon v.h.f. signals.

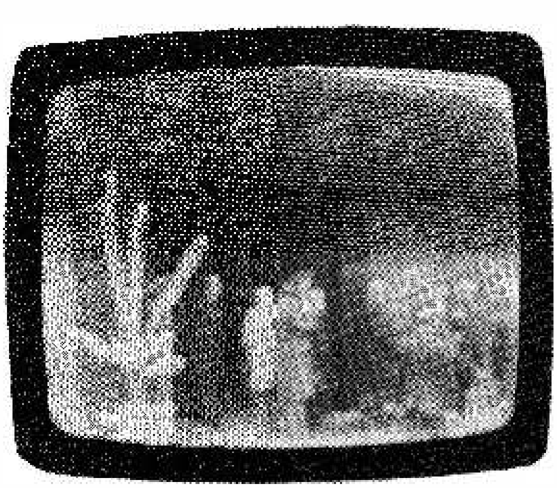
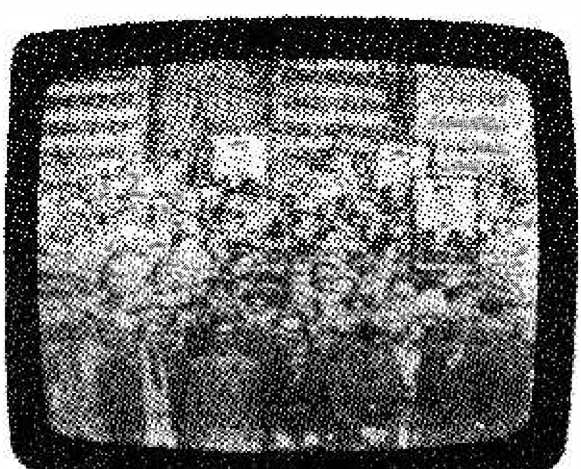
Aurora Borealis

Briefly, if a stream of particles from a solar flare enter the earth's polar atmosphere they are likely to randomly ionise the surrounding gases for several hours. This phenomenon, called aurora, has a strange effect on radio signals, for instance, the letter X in Morse code normally sounds like dah-dit-dit-dah, but when reflected from an aurora it will sound raspy, ror-rit-rit-ror and likewise, an s.s.b. signal is like a ghostly whisper and no amount of b.f.o. will improve it. Another point to remember is, that whatever the geographical location of the transmitter from which the auroral reflected signals originated, your receiving aerial beam **must** point toward the north. By careful tuning it is possible to detect signals from stations some 2,000 miles away. For our readers in the southern hemisphere, a similar effect—Aurora Australis—occurs at the South Pole.

Sporadic-E

The E region, or, as in early technical literature, the Kennelly-Heaviside layer, of the ionosphere, forms some 60 miles up at sunrise and disperses at sunset. But, during the months of April to August this region will suddenly break up into clouds of densely ionised gas and deflect radio signals within the range 30-80MHz more than 1,000 miles off their intended course. Because of this extended range, UK televiewers, still using Band I, 40-67MHz for BBC, will receive a wide variety of continental radiotelephone, RTTY, and beacon signals on top of their pictures. While those viewers gnash their teeth, the TV DXers among us look in Band I for pictures from stations in Europe, the Mediterranean area, Russia, and parts of South Africa.

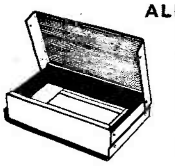
Most sporadic-E events last for only a few hours, during which time the 4m amateur band may be blotted out by strong f.m. signals from broadcast stations in Poland, while broadcast signals from several other east-European countries, using the range 65-73MHz, pound into the UK and interfere with Private Mobile Radio transmissions in "low band". Readers like Anthony Mann in Australia, keep us informed about the sporadic-E disturbances which affect other parts of the world at different times of the year.

Two further examples of sporadic-E TV reception. Pictures from Moscow on Ch.R1 (49·75MHz) of a funeral taking place on July 19th. The receiving set-up is the same as that for the picture from Finland

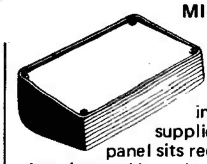
YOUR COMPLETE RANGE OF ELECTRONIC HARDWARE....

BIMENCLOSURES



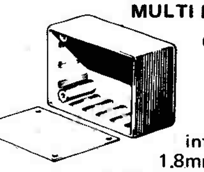
ALL METAL BIMCASES

Red, Grey or Orange 14swg Aluminium removable top and bottom covers. 18 swg black mild steel chassis with fixing support brackets.
BIM 3000
(250x167.5x68.5mm)
£14.58



MINI DESK BIMCONSOLES

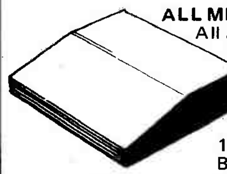
Orange, Blue, Black or Grey ABS body incorporates 1.8mm pcb guides, stand-off bosses in base with 4 BIMFEET supplied. 1mm Grey Aluminium panel sits recessed with fixing screws into integral brass bushes.
BIM 1005 (161 x 96 x 58mm) £2.18
BIM 1006 (215 x 130 x 75mm) £3.05

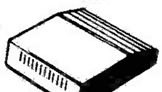


MULTI PURPOSE BIMBOXES

Orange, Blue, Black or Grey ABS with 1mm Grey Aluminium recessed front cover held by screws into integral brass bushes. 1.8mm pcb guides incorporated and 4 BIMFEET supplied.

BIM 4003 (85x56x28.5mm) £1.18
BIM 4004 (111x71x41.5mm) £1.62
BIM 4005 (161x96x52.5mm) £2.19



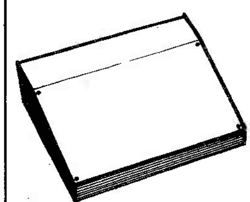


ALL METAL BIMCONSOLES

All aluminium, 2 piece desk consoles with either 15° or 30° sloping fronts, sit on 4 self-adhesive non-slip rubber feet. Ventilation slots in base and rear panel for excellent cooling.

Colour Code	Top Panel	Base
A	Off White	Blue
B	Sand	Green
C	Satin Black	Gold

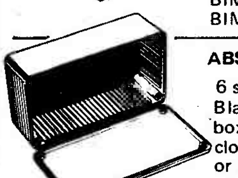
15° Sloping Panel	30° Sloping Panel	
BIM7151 (102x140x51[28] mm)	BIM7301 (102x140x76[28] mm)	£ 9.87
BIM7152 (165x140x51[28] mm)	BIM7302 (165x140x76[28] mm)	£10.86
BIM7153 (165x216x51[28] mm)	BIM7303 (165x183x102[28] mm)	£11.96
BIM7154 (165x211x76[33] mm)	BIM7304 (254x140x76[28] mm)	£12.93
BIM7155 (254x211x76[33] mm)	BIM7305 (254x183x102[28] mm)	£14.47
BIM7156 (254x287x76[33] mm)	BIM7306 (254x259x102[28] mm)	£15.46
BIM7157 (356x211x76[33] mm)	BIM7307 (356x183x102[28] mm)	£16.55
BIM7158 (356x287x76[33] mm)	BIM7308 (356x259x102[28] mm)	£17.43



LOW PROFILE BIMCONSOLES

Orange, Blue, Black or Grey ABS body has ventilation slots as well as 1.8mm pcb guides and stand-off bosses in base. Double angle recessed front panel with 4 fixing screws into integral brass bushes. 4 BIMFEET supplied.

BIM 6005 (143 x 105 x 55.5 [31.5] mm) £2.37
BIM 6006 (143 x 170 x 55.5 [31.5] mm) £3.08
BIM 6007 (214 x 170 x 82.0 [31.5] mm) £4.12

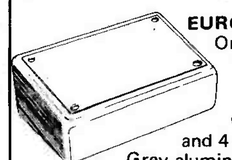


ABS & DIECAST BIMBOXES

6 sizes in ABS or Diecast Aluminium. ABS moulded in Orange, Blue, Black or Grey. Diecast Aluminium in Grey Hammertone or Natural. All boxes incorporate 1.8mm pcb guides, stand-off supports in base and have close fitting flanged lids held by screws into integral brass bushes (ABS) or tapped holes (Diecast).

	ABS		Diecast	Hammertone	Natural
(50x60x31mm)	N/A		BIM5001/11	TBA	TBA
(100x50x25mm)	BIM2002/12	£0.96	BIM5002/12	£1.46	£1.19
(112x62x31mm)	BIM2003/13	£1.13	BIM5003/13	£1.78	£1.46
(120x65x40mm)	BIM2004/14	£1.35	BIM5004/14	£2.24	£1.82
(150x80x50mm)	BIM2005/15	£1.52	BIM5005/15	£2.84	£2.28
(190x110x60mm)	BIM2006/16	£2.37	BIM5006/16	£3.94	£3.33

Also available in Grey Polystyrene with no slots and self-tapping screws
BIM 2007/17 (112x61x31mm) £1.00

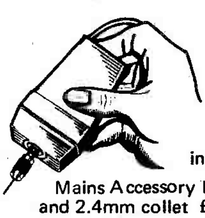


EUROCARD BIMCONSOLES

Orange, Blue, Black or Grey ABS body accepts full or ½ size Eurocards, with bosses in the base for direct fixing. 1.8mm wide pcb guides incorporated and 4 BIMFEET supplied. 1mm Grey aluminium lid sits flush with body top and held by 4 screws into integral brass bushes.

BIM 8005 (169x127x70[45] mm) £4.12
BIM 8007 (to be announced shortly)

BIMTOOLS



MAINS BIMDRILLS

Small, powerful 240V hand drill complete with 2 metres of cable and 2 pin DIN plug. Accepts all tools with 1mm, 2mm or .125" dia. shanks. Drills brass, steel, aluminium and pcb's. Under 250g, off load speed 7500 rpm. Orange ABS, high impact, fully insulated body with spring return on/off switch £10.53

Mains Accessory Kit 1 includes 1mm, 2mm, .125" twist drills, 5 burrs and 2.4mm collet £2.48

Mains Kit 2 includes Mains BIMDRILL as above, 20 assorted drills, mops, burrs, grinding wheels and mounted points, 1mm, 2mm, 2.4mm and .125" collets. Complete in transparent case measuring 230x130x58mm £22.14

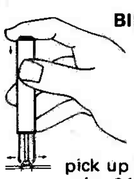
12 VOLT BIMDRILLS

2 small, powerful drills easily hand held or used with lathe/stand adaptor. Integral on/off switch and 1 metre cable.

Mini BIMDRILL with 3 collets up to 2.4mm dia £ 8.10
Major BIMDRILL with 4 collets up to 3mm dia £13.60

Accessory Kits 1 have appropriate drills and collets as above plus 20 assorted tools. Mini Kit 1 – £15.12, Major Kit 1 – £19.44.
Accessory Kits 2 have appropriate drills, collets plus 40 tools and mains 12V dc adaptor. Mini Kit 2 – £34.02, Major Kit 2 – £39.42.

Accessory Kits 3 as appropriate Kits 2 plus stand/lathe unit. Mini Kit 3 – £45.36, Major Kit 3 – £50.76.



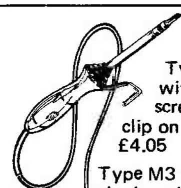
BIMDIPS

Rapidly inserts and withdraws any 4-18 pin, .3" pitch DIL package without beding the legs. Adjustable metal jaws for MOS type devices grip the bottom of the leg for minimum strain. Will pick up IC's from a bench, a carrier or a pcb. £13.77.

BIMSNIPS

Precision made side cutters, spring action, ground steel fine pointed blades for intricate work.

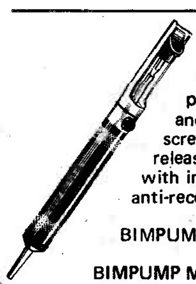
5¼" long £3.34



BIMIRONS

Type 30 General Purpose 27 watt iron with long life, rapid change element, screw on tip, stainless steel shaft and clip on hook. Styled handle with neon. £4.05

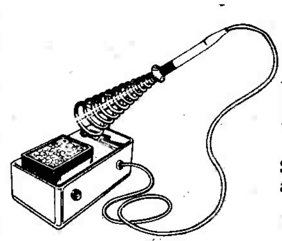
Type M3 Precision 17 watt iron, quick change tip, long life element, styled handle with clip on hook £4.43



BIMPUMPS

2 all metal desoldering tools provide high suction power and have easily replaceable screw in Teflon tips. Primed and released by thumb operation with in-built safety guard and anti-recoil system.

BIMPUMP Major (180mm long) £7.99
BIMPUMP Minor (150mm long) £6.80



BIMSTATION

Type PSU6 Soldering Iron Station complete with 6V, 6 Watt miniature iron having stainless steel shaft, quick change slide on tip and long life element.

Station contains 240V/6V transformer, neon, coiled iron support and sponge iron tip cleaning pad.

New product available shortly

What did Fleming say to Edison about antennas in 1912?

We're not sure, but we *can* be sure that they couldn't have been discussing the merits of the Joystick VFA (Variable Frequency Antenna, ·5-30 Mhz). That had to come later.... so that now, you can have a versatile antenna system that acts as a ground plane right through the six lower amateur bands and on all frequencies in between. Short wave listener and transmitting amateur alike will benefit from a VFA—if you can't hear 'em, you can't work 'em.

SYSTEM "A" £41·00

250 w. p.e.p. **OR** for the SWL.

SYSTEM "J" £47·95

500 w. p.e.p. (improved 'Q' on receive).

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Featuring the World Record Joystick Aerial (System 'A'), 8ft, feeder, all necessary cables, matching communication headphones. Deliv. Securicor our risk. **ASSEMBLED IN SECONDS! BIG CASH SAVINGS!**

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As above with R.300 RX. SAVE £14·15!

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Is offered with the FRG7 RX. SAVE £14·15!

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Here is a lower-price, high-quality package featuring the LOWE SRX30., with all the Partridge extras. SAVE £14·15!

RECEIVERS ONLY, inclusive delivery, etc.

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Transistors		*BF 197	11	**DIODES**		7425	25
ACY 20	34	*BF 198	17	*AA 119	6	7427	27
ASY 66	90	BF 200	26	*BY 127	10	7430	15
BC 107	8	BF 257	26	1N 4001/2	4	7440	15
BC 108	8	BF 258/9	24	1N 4004/5	5	7445	80
*BC 147/A	8	BF 324	28	1N 4006/7	6	7472	25
*BC 148	8	*BF 336	28	*1s 44	4	7473	30
*BC 149/C	8	*BF 337	30	*1s 940	4	74L73	49
*BC 158	9	*BFR 80	25	*1s 941	4	7474	27
*BC 171A	10	BFY 50	1	**LINEAR IC's**		74L74	43
*BC 207	11	BSX 19/20	16	741 8P	19	7476	30
*BC 207B	10	BT 106	130	555 8P	25	7480	45
BC 348	11	*BU 205	150	**Regulators**		7482	69
BC 351	12	*BU 208	160	7812	60	7483	72
BCY 70	14	*BU 208A	175	7815	60	7486	30
BCY 71	14	MJE 340	43	**TTL**		7490	33
BCY 72	14	MJE 520	43	7400	13	7491	75
BD 115	43	OC 201	70	74L00	24	74L91	145
BD 131	33	TIP 31A	38	7401	13	7493	32
BD 135	34	TIP 42A	62	7404	14	7495	60
BD 139	33	*ZTX 212/B	16	74LO4	27	7496	57
BD 695A	65	*ZTX 302	11	7405	14	74100	95
BD 696A	65	*ZTX 502	12	7408	17	74107	29
BF 115	18	2N 930	16	7409	17	74121	25
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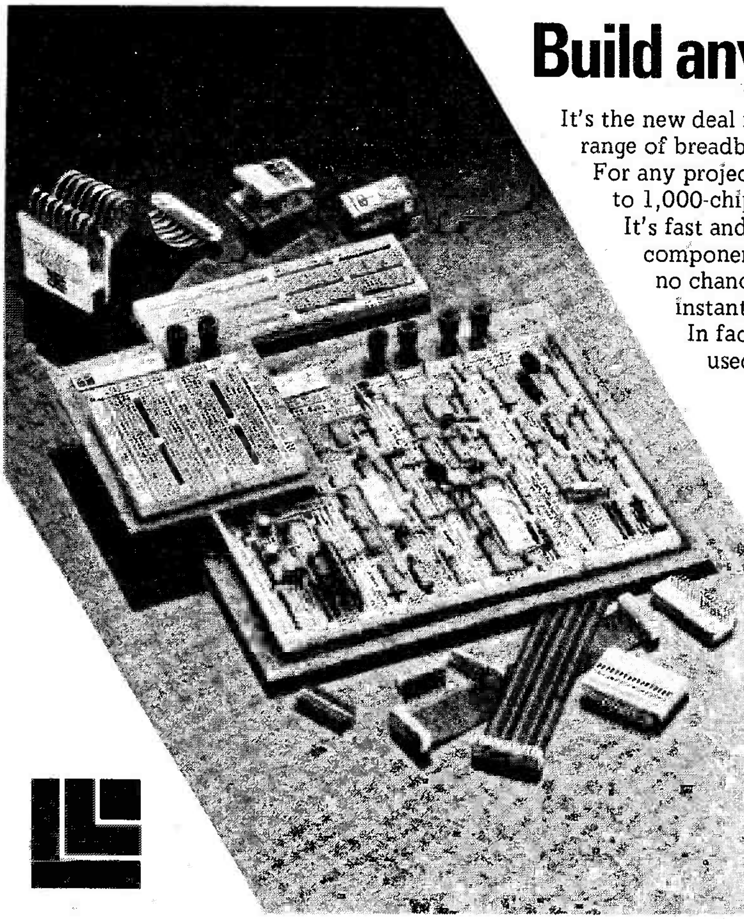

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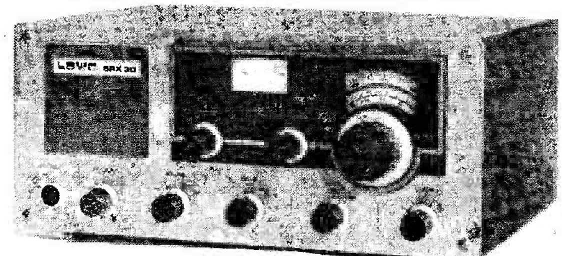

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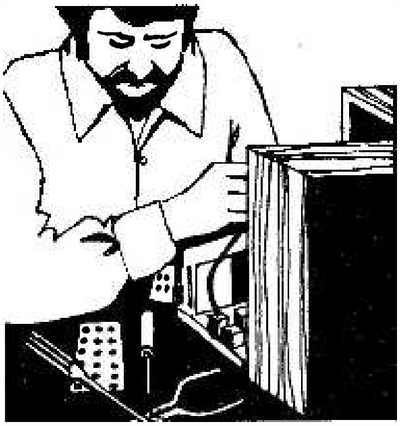

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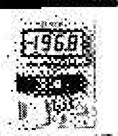

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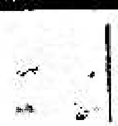

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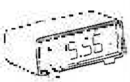

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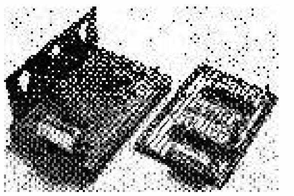

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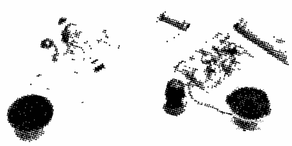

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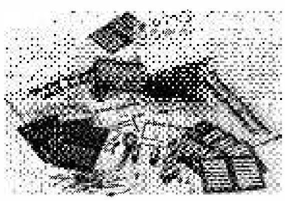

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6-0-6V 100mA; 9-0-9V 75mA; 12-0-12V 100mA **95p.**
8VA type: 6V-·5A 6V-·5A; 9V-·4A 9V-·4A; 12V-·3A 12V-·3A; 15V ·25A 15V-·25A **195p.**
12VA; 4·5V-1·3A 4·5V-1·3A; 6V-12A 6V-1·2A 12V-·5A 12V-·5A; 15V- ·4A 15V-·4A 20V- ·3A 20V-·3A (20p p&p) **220p**
24VA: 6V-1·5A 6V-1·5A; 9V-1·2A 9V-1·2A; 12V-1A 12V-1A; 15V-·4A 15V-·4A; 20V-·3A 20V-·3A (45p p&p) **290p**
50VA: 6V-4A 6V-4A; 9V-2·5A 9V-2·5A; 12V-2A 12V-2A; 15V-1·5A 15V-1·5A; 20V-1·2A 20V-1·2A; 25V-1A 25V-1A; 30V-·8A 30V-·8A (50p p&p) **350p.**
100VA: 12V-4A 12V-4A; 15V-3A 15V-3A; 20V-2·5A 20V-2·5A; 30V-1·5A 30V-1·5A; 40V-1·25A 40V-1·25A; 50V-1A 50V-1A (60p p&p) **650p**
(N.B. P&P charge to be added above our normal postal charge.)

DENCO COILS
Dual Purpose 'DP' VALVE TYPE
Range 1-5 B,Y,R,W **86p**
6-7 B,Y, R, **75p**
1-5 Green **92p**
'T' Type (Trns. tuning)
Rng. 1-5 B, Y, R, W, **92p**

B9A Valve Base **25p**
RDT2 **92p**
RFC 5 chokes **91p**
RFC 7(19mH) **96p**
1FT 13/14/15/16 17 **85p**
1FT 18/1·6 or 465 **99p**
TOC1 **86p**
MW 5FR **82p**
MW/LW 5FR **103p**

TRANSISTORS

	p
AC107*	23
AC117*	35
AC125*	20
AC126*	20
AC127*	20
AC128*	20
AC141*	24
AC141K*	38
AC142*	24
AC142K*	38
AC176*	18
AC187*	20
AC188*	20
ACY17	35
ACY18	40
ACY19	40
ACY20	40
ACY21	35
ACY22	40
ACY28	40
ACY39	78
AD149*	70
AD161*	42
AD162*	42
AF106	70
AF114*	25
AF115*	25
AF116*	25
AF117*	25
AF118*	55
AF121*	48
AF124*	55
AF125*	35
AF126	55
AF127*	35
AF139*	35
AF178*	70
AF180*	70
AF239*	42
AFZ12	126
ASY26*	40
ASY27*	45
ASY50*	95
ASY76*	95
BC107*	9
BC107B*	10
BC108*	9
BC108B*	12
BC108C*	12
BC109	9
BC109B*	12
BC109C*	12
BC113	17
BC114	19
BC115	19
BC116	19
BC117	15
BC118	19
BC119*	26
BC134	19
BC135	20
BC136	18
BC137	20
BC140*	28
BC142*	25
BC143*	25
BC147	7
BC147B	10
BC148	7
BC148B	10
BC148C	10
BC149	8
BC149C	10
BC153	14
BC154	14
BC157	10
BC158	11
BC159	11
BC160*	27
BC167A	11
BC168C	12
BC169C	10

	p
BC170	17
BC171	11
BC172	10
BC173	12
BC177*	17
BC178*	17
BC179*	17
BC182	9
BC183	9
BC184	9
BC182L	10
BC183L	10
BC184L	10
BC186	21
BC187*	28
BC212	9
BC212L	10
BC213	9
BC213L	11
BC214	9
BC214K	14
BC214L	10
BC307B	14
BC308	13
BC327	15
BC328	13
BC338	12
BC441*	30
BC461*	30
BC477*	25
BC547	11
BC548	11
BC549C	11
BC557	13
BC558	12
BC559	18
BCY30*	97
BCY34*	75
BCY39*	80
BCY40*	78
BCY42	48
BCY43	75
BCY58	22
BCY59*	22
BCY70*	15
BCY71*	17
BCY72*	17
BCY78*	20
BCZ10	145
BCZ11	145
BD112	95
BD115*	62
BD121	95
BD123	98
BD124*	115
BD131*	38
BD132*	38
BD133*	43
BD135*	36
BD136*	37
BD137*	36
BD138*	36
BD139*	36
BD140*	36
BD142*	59
BD144*	198
BD145*	198
BD181*	85
BD205*	110
BD222	60
BD378*	65
BD434	42
BD517*	65
BD695A*	75
BD696A*	75
BDY11	220
BDY17*	195
BDY56*	156
BDY60*	110
BDY61*	165
BF115*	22
BF154*	23
BF158	29
BF160	30
BF161	60

	p
BF167	25
BF173*	25
BF177*	24
BF178*	25
BF179*	30
BF180*	20
BF181*	30
BF182*	30
BF183*	30
BF184*	30
BF194	10
BF195	10
BF196	10
BF197	10
BF198	18
BF199	18
BF200*	28
BF224A	18
BF244	24
BF244B	30
BF256*	50
BF257*	26
BF258*	26
BF259*	30
BF336	30
BF394	22
BF594	40
BF595	38
BFR39	25
BFR40	25
BFR41	28
BFR79	28
BFR80	28
BFR81	28
BFR98	105
BFX29*	26
BFX84*	24
BFX85*	24
BFX86*	28
BFX87*	23
BFX88*	24
BFY18*	50
BFY50*	20
BFY51*	20
BFY52*	20
BFY53*	28
BFY55*	45
BFY64*	40
BFY71*	20
BLY83*	649
BSX20*	18
BSX26*	75
BSX29*	45
BSX78*	55
BSY95A	25
BU105*	140
BU205	190
BU208	228
E421	96
MD8001	158
ME1120	25
ME4102	10
ME6002	14
MJ400*	90
MJ491*	160
MJ2955*	95
MJE340*	50
MJE370*	55
MJE371*	60
MJE520*	45
MJE521*	65
MJE2955*	99
MJE3055*	70
MPF102	30
MPF103	36
MPF104	36
MPF105	36
MPF106	50
MPF107	50
MPS3904	40
MPSA05	24
MPSA06	24
MPSA12	40

	p
MPSA55	24
MPSA56	24
MPSA70	34
MPSU02	58
MPSU05	48
MPSU06	54
MPSU52	65
MPSU55	53
MPSU56	56
MPU131*	39
OC23*	150
OC25*	120
OC26*	150
OC28*	99
OC29*	160
OC35*	80
OC36*	99
OC41*	48
OC42*	32
OC43*	55
OC44*	31
OC45*	20
OC46*	28
OC70*	19
OC71*	25
OC72*	30
OC74*	45
OC75*	45
OC76*	36
OC77*	76
OC79*	76
OC81D*	28
OC82D*	48
OC83*	48
OC84*	44
OC122*	48
OC123*	48
OC139*	85
OC140*	85
OC141*	85
OC170*	40
OC171*	40
OC200*	48
OC201*	75
OC202	85
OC203*	85
OC204*	85
SJE5039*	95
TIP29	43
TIP29A	44
TIP29B	56
TIP29C	60
TIP30	47
TIP30A	47
TIP30B	64
TIP30C	65
TIP31*	40
TIP31A*	40
TIP31B*	40
TIP31C*	65
TIP32*	45
TIP32A*	49
TIP32B*	70
TIP32C*	70
TIP33*	80
TIP33A*	80
TIP33B*	100
TIP33C*	105
TIP34*	85
TIP34A*	85
TIP34B*	110
TIP34C*	110
TIP35*	219
TIP35A*	225
TIP35B*	240
TIP35C*	270
TIP36*	280
TIP36A*	265
TIP36B*	300
TIP36C*	325
TIP41A*	63
TIP41B*	73
TIP42A*	64
TIP42B*	82
TIP2955*	63

	p
TIP3055*	60
TIS43	36
TIS44	45
TIS45	45
TIS46	45
TIS47	50
TIS48	50
TIS49	50
TIS50	47
TIS60	45
TIS62	45
TIS74	47
TIS90	18
TIS91	22
ZTX107	11
ZTX108	11
ZTX109	11
ZTX212	28
ZTX300	13
ZTX301	16
ZTX302	18
ZTX303	21
ZTX304	24
ZTX311	17
ZTX314	24
ZTX320	30
ZTX326	40
ZTX341	20
ZTX500	13
ZTX501	14
ZTX502	19
ZTX503	15
ZTX504	25
ZTX531	25
ZTX550	25
40250*	85
40251*	97
40311*	50
40313*	125
40315*	55
40316*	85
40317*	52
40319*	71
40320*	56
40323*	60
40324*	85
40326*	52
40327*	62
40347*	80
40348*	101
40360*	43
40361*	45
40362*	48
40406*	45
40407*	50
40408*	75
40411*	285
40412*	63
40467*	95
40594*	80
40595*	90
40603*	58
40636*	125
40673*	68
2N697*	21
2N698*	39
2N699*	39
2N706A*	19
2N707*	50
2N708*	19
2N914*	32
2N916*	27
2N918*	30
2N920*	51
2N1131*	22
2N1132*	22
2N1303*	50
2N1304*	50
2N1305*	28
2N1306*	35
2N1307*	50
2N1308*	46
2N1613*	23
2N1670*	150
2N1671B*	195

	p
2N2160*	105
2N2217*	48
2N2218A*	31
2N2219A*	22
2N2220A*	26
2N2221A	23
2N2222A*	20
2N2303*	45
2N2368*	21
2N2369A*	15
2N2483*	28
2N2484*	30
2N2646*	48
2N2784	55
2N2904*	22
2N2905A*	20
2N2906*	18
2N2907*	20
2N2907A*	22
2N2926G	10
2N3011*	24
2N3053*	20
2N3054*	49
2N3055*	55
2N3108	39
2N3442*	131
2N3563	20
2N3614*	169
2N3615*	135
2N3663*	24
2N3702	10
2N3703	11
2N3704	10
2N3705	11
2N3706	10
2N3707	10
2N3708	10
2N3709	10
2N3710	16
2N3711	10
2N3772*	170
2N3773*	288
2N3819	22
2N3820	32
2N3823*	65
2N3824*	70
2N3866*	90
2N3903	18
2N3904	18
2N3905	18
2N3906	17
2N4037*	52
2N4041*	80
2N4058*	17
2N4061	17
2N4062	13
2N4064*	120
2N4069	45
2N4236	145
2N4286	20
2N4289	20
2N4427*	75
2N4859	65
2N4922*	55
2N5135	42
2N5136	42
2N5138	20
2N5172	24
2N5179	60
2N5180	60
2N5191	65
2N5305	24
2N5457	32
2N5458	32
2N5459	32
2N5485	32
2N5642*	750
2N5777	56
2N6027	40
2N6109	45
3N128	85
3N140	85

Matched Pair 10p extra

LINEAR IC'S

702	75
709C 8 pin	35
723* 14 pin	45
741* 8 pin	22
747C 14 pin	70
748C 8 pin	36
753 8 pin	150
810	159
AY-1-0212	580
AY-1-1313A	660
AY-1-1320	305
AY-1-5050	180
AY-1-5051	145
AY-1-6721/6	195
AY-3-8500*	390
AY-3-8710*	750
AY-5-1224A*	260
AY-5-1230*	450
AY-5-1315	560
AY-5-1317A	630
AY-5-3500*	510
AY-5-3507*	415
AY-5-4007	650
AY-5-8100*	735
CA3011*	82
CA3014*	137
CA3018*	68
CA3020	170
CA3023	170
CA3028A*	80
CA3035	240
CA3036	110
CA3043	190
CA3045	140
CA3046	70
CA3048	200
CA3075	175
CA3080E*	70
CA3081	190
CA3089E	210
CA3090AQ	375
CA3123	200
CA3130*	85
CA3140	70
ICL7106*	910
ICL7107*	975
ICL8038CC*	335
ICM7205*	1150

LM300H	170
LM301A	30
LM304	240
LM308T	110
LM311H*	120
LM318H	205
LM318S	195
LM324A	79
LM339	80
LM348	95
LM349*	
LM379	375
LM380	95
LM381N	145
LM381AN	248
LM382	125
LM3900*	60
LM3909N*	70
LM3911*	125
LM732	125
M252AA*	750
M253AA*	795
MC1303	88
MC1304P	260
MC1310P	149
MC1312PQ	195
MC1458P*	50
MC1488*	95
MC1489*	95
MC1495	395
MC1496L	92
MC3340P	150
MC3360P	120
MC3401	70
MEM780	205
MFC4000B	85
MFC6040*	97
MK50362*	650
MK50398*	635
MM57160*	620
NE543K	210
NE544	185
NE555*	29
NE556DB*	60
NE560*	325
NE561*	395
NE562B*	410
NE564*	
NE565A*	120

NE566*	160
NE567V*	155
NE571	420
RAM2102-2*	170
RC4136D	120
ROM2513*	700
SG3402*	295
SL437A	560
SN72710*	43
SN72733*	99
SN76003N	175
SN76013N	140
SN76013ND	120
SN70018*	
SN76023N	140
SN76023ND	111
SN76033N	175
SN76115N	215
SN76131*	
SN76227N	115
SN76477*	225
TAA621AX1	228
TAA661A	155
TAA960	300
TAD100	150
TAD110	170
TBA120S	70
TBA540	215
TBA550Q	330
TBA641-A12/	
TCA965*	120
BX1 or BX11	250
TBA651	180
TBA800	90
TBA810S	99
TBA820	70
TBA920Q	260
TDA1022	595
TDA2020	320
TLO81CP*	52
TLO82CP*	96
TLO84CP*	130
UAA170	198
ZN414	90
ZN424E	130
ZN425E*	375

TTL 74* (TEXAS)

7400	13
7401	13
7402	14
7403	14
7404	14
7405	18
7406	38
7407	38
7408	17
7409	17
7410	15
7411	20
7412	17
7413	30
7414	51
7416	30
7417	30
7420	16
7421	29
7422	24
7423	27
7425	27
7426	36
7427	27
7428	35
7430	17
7432	25
7433	40
7437	30
7438	33
7440	17
7441	74
7442	68
7443	115
7444	112
7445	94
7446	94
7447	82
7448	56
7450	17
7451	17
7453	17
7454	17
7460	17
7470	28
7472	25
7473	32

7474	27
7475	38
7476	36
7480	48
7481	86
7482	69
7483	72
7484	95
7485	106
7486	31
7489	210
7490	33
7491	75
7492	38
7493	32
7494	78
7495	65
7496	57
7497	189
74100	119
74104	62
74105	62
74107	29
74109	64
74110	54
74111	68
74112	88
74116	198
74118	83
74119	119
74120	115
74121	25
74122	46
74123	48
74125	38
74126	57
74128	74
74132	73
74141	56
74142	269
74143	314
74144	314
74145	65
74147	175
74148	109
74150	99
74151	64

74153	64
74154	96
74155	53
74156	80
74157	67
74159	210
74160	82
74161	92
74162	92
74163	92
74164	105
74165	105
74166	161
74167	198
74170	230
74172	625
74173	170
74174	87
74175	87
74176	75
74177	78
74180	85
74181	165
74182	90
74184	135
74185	135
74188	275
74190	115
74191	105
74192	105
74193	105
74194	105
74195	95
74196	99
74197	85
74198	150

74LS*

74LS00	18
01	18
02	20
04	20
10	20
13	38
14	75
27	28
42	98
74LS47	90
73	96
74	41
75	49
83	115
90	60
96	116
107	44
132	95
139	85
151	96
153	76
155	96
156	96
157	76
158	96
160	128
161	98
162	138
163	113
164	114
174	106
175	110
181	318
190	140
191	140
192	130
193	130
196	100
221	98
241	236
298	185
386	86

Complete LS range available

CMOS*

4000	15
4001	17
4002	17
4006	105
4007	18
4008	87
4009	50
4010	50
4011	18

4012	18
4013	42
4014	86
4015	89
4016	45
4017	89
4018	89
4019	48
4020	99
4021	91
4022	88
4023	20
4024	66
4025	19
4026	180
4027	45
4028	81
4029	99
4030	58
4031	205
4032	100
4033	145
4034	196
4035	111
4036	325
4037	100
4038	108
4039	320
4040	105
4041	80
4042	75
4043	94
4044	88
4045	145
4046	128
4047	87
4048	58
4049	48
4050	48
4051	72
4052	73
4053	72
4054	110
4055	128
4057	2570
4059	480
4060	99
4063	110

4066	58
4067	380
4068	22
4069	20
4070	32
4071	21
4072	21
4073	21
4075	23
4076	85
4077	40
4078	21
4081	20
4082	21
4085	74
4086	73
4089	150
4093	85
4094	190
4096	105
4097	372
4098	110
4099	145
4160	109
4161	109
4162	109
4163	109
4174	110
4175	99
4194	108
4408	720
4409	720
4410	720
4411	1040
4412V	1380
4415F	795
4415V	795
4419	280
4422	545
4433	1099
4435	825
4440	1275
4450	295
4451	295
4452	
4490F	695
4490V	525
4501	99

4502	120
4503	69
4506	51
4507	55
4508	298
4510	99
4511	150
4512	98
4513	206
4514	265
4515	299
4516	125
4517	382
4518	102
4519	55
4520	108
4521	268
4522	199
4527	152
4528	99
4529	165
4530	85
4531	165
4532	127
4534	788
4536	380
4538	160
4539	110
4541	150
4543	175
4549	396
4553	449
4554	152
4556	78
4557	451
4558	117
4559	388
4560	208
4561	65
4562	533
4566	159
4568	299
4569	359
4572	25
4580	604
4581	409
4585	101