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Practice Wireless, July 1976
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**FEATURES:** Complete pre-amplifier in single pack—Multi-function equalization—Low noise—Low distortion—High overload—Two tone simply for level.

**APPLICATIONS:** Hi-Fi Mixers—Disco—Guitar and Organ—Public address

**SPECIFICATIONS:**
- Input: Magnetic Pickup 3mV; Ceramic Pickup 30mV; Tuner 100mV; Microphone 10mV
- Auxiliary: 3-100mV; Input Impedance 4-7kOhm at 1kHz
- Output: Tape: Tone 500mV; Main output 5000mV R.M.S.
- Active Tone Controls. Treble ±12dB at 1kHz; Bass ±12dB at 1kHz
- Distortion: 0.1% at 1kHz
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- Overload: 3dB on Magnetic Pickup. Supply Voltage ±5-15V.
- Price £4.75 + £1.19 VAT P&P free.

**HY30**

15 Watts into 8Ω

- **HY30** is an existing New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up-to-date technology available.

**APPLICATIONS:** Complete Kit—Low Distortion—Short, Open and Thermal Protection—Easy to Build

**SPECIFICATIONS:**
- Output Power 15W R.M.S. into 8Ω
- Distortion 0.1% at 1-5W
- Input Sensitivity 500mV
- Frequency Response 10Hz-16kHz
- Supply Voltage ±15V
- Price £4.75 + £1.19 VAT P&P free.

**HY50**

25 Watts into 8Ω

- **HY50** leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust high Fidelity modules in the world.

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

**SPECIFICATIONS:**
- Output Power 25W R.M.S. into 8Ω
- Load Impedance 4-16Ω
- Distortion 0.1% at 25W
- Supply Voltage ±35V
- Signal/Noise Ratio 75dB
- Frequency Response 10Hz-45kHz
- Price £4.75 + £1.19 VAT P&P free.

**HY120**

60 Watts into 8Ω

- **HY120** is the baby of I.L.P.'s £15 series. Designed to meet the most exacting requirements including lead line and thermal protection this amplifier sets a new standard in modular design.

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

**SPECIFICATIONS:**
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**One flew over the Citizen's band**

There is a decidedly bad odour in the air. It is interpreted by some semi-knowing nostrils as "Citizen's Band" (CB) and it is growing markedly stronger in the UK. However, a little thought reveals that this evil aroma emanates not from the idea of a Citizen's Band, but from the approach being made in implementing it.

Let us be realistic; there will be a Citizen's Band in the UK. The problems include when, where and how? Which frequencies are to be involved, what power allowed, the cost, types of emission, what equipment? Interference considerations also give cause for concern. This has reached very serious proportions in both Germany and the USA.

What about overcrowding? If one takes a crude rule of thumb by comparing the USA with the UK, somewhat alarming figures result. In America there are approximately 10,000,000 (ten million) CB users and some 250,000 to 270,000 fully licensed Amateurs or Hams. Thus the ratio of CB users to Amateurs is 40:1. If that same ratio were projected for the UK, it would mean 800,000 CB users all packed into a 0·25MHz bandwidth. The situation would become a radio frequency madhouse—unless we act and plan now.

Other problems are even more serious and could affect British workers, people not even interested in CB.

Think; when a CB opens in the UK there will be a huge demand for low-priced walkie talkie type equipment. Imagine the sheer volume of sets required. Now think of all the individual components needed to manufacture those sets. Good, this means more work for Britain in producing the goods, more work more jobs, right?

Wrong! The Japanese for one have already proved themselves masters in the areas of marketing this type of equipment and the design and manufacture of it in large volume. Thus a CB in the UK could offer big business to overseas manufacturers, no increase in employment for Britain, but a big increase in our import bills.

Before you say it couldn't happen, consider the colour television tube dumping allegations made against the Japanese. If these do not convince you, go talk to the ex-workers who used to work in the Thorn factory which used to produce colour TV tubes, or people who used to work at the Pilkington factory which used to produce colour TV tubes.

Citizen's Band will come. Will we learn from the mistakes of other countries or will we, through lack of sensible preparation, blunder in and make exactly the same mistakes all over again?

The Government has lent weight to compulsory membership of a Trades Union so a principle has been established—we have a precedent as the legal profession would say. Why not compulsory membership of the Radio Society of Great Britain (RSGB) before any kind of licence is issued?

Why the RSGB? Because here, Government would have a fully organised, fully qualified, tailor made watch-dog and one which genuinely has the interests of both ether and Amateur at heart. It is the only organisation which is so admirably equipped to handle the situation.

Making would-be CB operators become members would at least ensure that they were under the guidance and influence of a responsible and experienced organisation. The Society could steer these operatives along the lines of sensible band usage and behaviour, perhaps through its literature, and by encouraging them to attend meetings of their local Amateur radio clubs where expert advice on virtually any radio/electrical/electronic subject or topic can invariably be found.

Let a proper committee be set up now which includes the RSGB. Priorities should be (a) the frequencies involved and (b) the minimal specifications for equipment.

There should also be very stiff penalties for pirate stations but, more importantly, there should be even stiffer penalties for any person or shop which sells CB transmission equipment to another party which does not produce a valid licence at the time of purchase (try getting a road fund disc without the necessary documentation).

Further, all equipment should, by law, have a unique letter/number combination so that it, like a car registration number and log book, can enable the owner/vendor to be found.

This leader article is not aimed at popularising the RSGB nor at "knocking" Government departments. It is aimed at putting a critical spotlight on a situation which could fester into bedlam, and it has made positive suggestions. Bureaucracy has no excuse, it is now well aware of the dangers.

Citizen's Band is coming. Let us make sound preparations now and let the Government of the day and its relative departments recognise that they have a clear duty to plan the event properly. Isn't that why we voted these people into Parliament—or have I got democracy all wrong?

LIONEL E. HOWES—Editor

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Practical Wireless, July 1976
Bi-Pak Competition

MR. M. S. BLUNT, 5 Woodbury Street, Tooting London SW17 9RP, accepts the 1st prize of a 22in colour television from Mr. Roger Powell of Bi-Pak Semiconductors.

Other winners in the competition held in Bi-Pak’s adverts were: 2nd Prize (Legionnaire Stereo Amplifier, Deck and E.M.I. Speakers): Mr. William J. A. Atrill, 97 Sandringham Road, Barking, Essex, IG11 9AF. 3rd Prize (Black and White Portable TV): Mr. I. A. Barton, 31 Linton Road, Loose, Maidstone, Kent, ME15 0AG. 4th Prize (Electronic Calculator): Mr. R. Attwood, Dept. Electrical Engineering, Imperial College, London, S.W.7.

Forty-nine consolation prizes of Electronic Slide Rules have also been sent and Bi-Pak Semiconductors wish to thank all participants. If you were unlucky this time, perhaps it will be your turn next year! Watch for the date.

A full list of winners is available on request from: Bi-Pak Semiconductors, P.O. Box 6, Ware.

Xciton Lightin’

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Practical Wireless, July 1976

Official recommendation for DECS

THE DEC solderless breadboards and Super Solder Boards have now been officially recommended for teaching electronics in Britain’s 5,000 schools. Designing and manufactured by P.B. Electronics (Scotland) Limited, the system facilitates the easy design, testing and production of prototype and custom PCBs without the use of chemicals.

Response to the official recommendation has been almost immediate. P.B. Electronics is currently marketing a complete CSE electronics educational system comprising all five text books, six S-DECs, six Super Solder Boards plus discrete components for only £25.

Peter Brownlie, managing director of P.B. Electronics said, ‘With 5,000 schools in the UK as potential buyers the growth for DECs and SSBs in this area is obvious but it doesn’t stop there. We are currently discussing similar acceptances and recommendation in other countries. The ultimate growth for these products in the education markets alone is enormous.”

Officially recommended for the CSE electronics course by the National Centre for Schools Technology, it is virtually certain that DEC/SSB approval will include it in the GCE electronics course slated for next year. Further information on DECs, etc., can be obtained from P.B. Electronics (Scotland) Limited, (Dept. P.W.), 57 High Street, Saffron Walden, Essex (s.a.e. appreciated).

Barclay Electronics

DUE to an error in the Barclay Electronics advert on page 255 of this issue, calculator prices were quoted wrongly. The Casio FX20 should be priced at £13·65 and the Rockwell 65R should be priced at £25·60. Further information may be obtained from Barclay Electronics (Dept PW) 1115 Finchley Road, Temple Fortune, London, N.W.1.

BBC Radio Bristol

SINCE Friday, 19 March, Radio Bristol’s mf service on 1546kHz (194 metres) has been transmitted from a new site at Mangotsfield and the old transmitter at Clevedon has closed down. The vhf service is not affected by this change.

Welsh Convention

THE 1976 Welsh Amateur Radio Convention will be held on Sunday, 26th September, 1976, at its usual venue, Oakdale Community College, Blackwood in Gwent, South Wales.

Last year’s attendance clearly established the Convention as the major amateur radio event in Wales. This year’s programme will enable visitors to attend both the technical lectures and film/slide shows. Further information from: R. B. Davies, GW3KYA, 16 Vanguard Drive, Penmaen, Blackwood, Gwent, NP2 0UQ.

Goldring move

GOLDRING announce the move of their Sales and Technical Service Department to new premises at: Anglian Lane, Derry St. Edmunds, Suffolk, IP32 6ES. Tel. (0284) 64011 (6 lines). Tel. GW3738.

All correspondence concerning Sales and Service of Goldring/Lenco Record Playing Equipment must now be made to the above address.
MOBILE and repeater station operation on the 2 metre (144-146MHz) and 70 centimetre (430-440MHz) bands has brought about increasing use of vertically polarised transmitting aerials with omnidirectional radiation at low angles. Such aerials range from simple quarter-wavelength pull-out rods used on hand-held portable transceivers to multiple half-wave element collinear systems which provide a worthwhile gain over a single half-wave dipole. Probably the most popular aerial in use is the so-called “5/8 wavelength” vertical and for fixed station operation this usually consists of the aerial mounted above a system of metal radials which form an “artificial earth” or “ground plane”. This aerial is also used extensively for mobile operation in which case it is mounted on the roof, or some part of the car body, which acts as the ground plane.

![Fig. 1: Theoretical radiation pattern in the vertical plane for a quarter-wave vertical aerial near to earth.](image)

The quarter-wave vertical

A vertical aerial, a quarter-wavelength long, has a relatively low impedance feed point at the end nearest earth. Such an aerial radiates equally well in all horizontal directions and, assuming a perfectly conducting earth, the vertical radiation angle is quite low, as in Fig. 1. However, at VHF such an aerial would be at a considerable disadvantage because at ground level and even with perfectly conducting earth beneath it, the radiated signal would be quickly absorbed by surrounding structures, buildings and walls, etc. In any case real earth is far from being a perfect conductor so a considerable loss in radiated power would also occur. The only answer is to provide an artificial earth of high conductivity material beneath the aerial, to reduce otherwise high ground losses. This still permits the aerial to radiate at a low vertical angle when the whole system can be elevated. Attenuation by surrounding structures is largely overcome and the horizon raised and the useful working distance increased.

![Fig. 2: Basic configuration of a vertical aerial five-eighths of wavelength long.](image)

Much the same reasoning applies to the $\frac{3}{2}\lambda$ aerial. It has a relatively low impedance feed point at its centre and when operated vertically at ground level, the radiation is also at a low angle, assuming perfectly conducting earth. The problem of high attenuation of the radiated signal, due to surrounding structures and ground losses, still remains. However, if this aerial is elevated to several wavelengths above ground it behaves as a “free space” aerial. Ground losses are eliminated, attenuation due to nearby buildings, etc., is reduced and, again, the higher the aerial the greater the working range.

These two useful basic aerials are capable of providing the all-important low-angle radiation equally in all directions. The simple quarter-wave ground plane can, however, be modified to provide increased radiation whilst the effectively “free space” dipole can be used in a configuration popularly known as a “collinear” aerial to provide a worthwhile degree of gain over a single element.
The "\( \frac{5}{8} \lambda \)" ground plane

Called a "\( \frac{5}{8} \lambda \)" wavelength aerial because this is approximately its physical length, electrically it is \( \frac{5}{8} \lambda \) but as the current and voltage distribution along the aerial shows, Fig. 2, the first section is electrically a \( \frac{1}{4} \lambda \) because of the loading coil. The aerial requires a ground plane for efficient operation and the feed point impedance is about 50Ω. Construction is not difficult and both the aerial and its radial section can be made from thin copper or aluminium tubing, or stiff wire such as welding rod, or even from wire coat hangers straightened out. The rib frame of an old umbrella also makes a very efficient folding ground plane as will be shown later! The loading coil consists of 4 turns of 16 SWG wire 19mm (0.75in) diameter on a paxolin or PTFE former. The top portion of the aerial is made adjustable to achieve resonance. An outline of the construction is given in Fig. 3.

There should be absolutely no need to trim the 50Ω feed line, however long this might be as with the radiator properly adjusted for resonance the standing wave ratio (SWR) should be not more than 1 to 1.1 or 1.2. With 10W going into the aerial it should be possible to light fully a 6W fluorescent tube (240V) as used for cabinet lights, etc., at the voltage points marked "X" in Fig. 3.

A method of constructing the loading coil is given in Fig. 4. The radials should be not less than about 510mm (20in) long and whilst four are essential, six should be used for preference. The base mounting plate may be copper, brass or tinplate, thick enough to support the radials which are bolted or soldered to it. Do not bend the radials down to achieve low SWR. If this cannot be obtained by adjusting the radiator to resonance, as described, there may be another reason such as wrong feeder impedance or a mismatch at the transmitter end, etc. Adjustment for resonance can be carried out with the aerial at a low height but clear of other conductors. If it is to be used outdoors make sure that water cannot enter the open end of the coaxial feeder where it joins the coil and where the screening braid ends. Seal with Sealastic or similar non-conducting sealer. The coil can be covered with PVC tape and the whole aerial, including the taped coil, may be given a coat of polyurethane varnish for protection against the weather.

This aerial is also suitable for mobile operation using the car body as the ground plane. Centre rofftop mounting is best and the loading coil is insulated from the car metal work as with the ground plane version. The coaxial feed is the same except that the screening braid is connected to the car metal work as close to the loading coil as possible.

Colinear aerial

This aerial is also omnidirectional, can be made to provide a useful degree of gain over a dipole and is not too difficult to construct. There is now a number of commercially made colinears available for 2 metre operation but the claims made for gain should be viewed with some suspicion. Specifications often quote "10dB gain" which is meaningless unless a reference level is given but which may be related, as are other seemingly high gain figures, to that obtained from a quarter-wave aerial, the efficiency of which is much lower than that of a dipole. The standard 0dB reference aerial for gain measurements is the dipole in free space.

A simple colinear array consists of two (half-wave) dipoles made to radiate in 'phase' so the total radiated power is about 1.5 times that of a single dipole, i.e., the power gain is about 2dB, Fig. 5. More elements can be used to achieve higher

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Insulating material may be PVC wastepipe which is very strong and best for heavy tubular elements. Paxolin or PTFE tubing can be used for light-weight elements or a “plumbing” job with copper water pipe for the elements and stubs using appropriate fittings to join them together. The writer has built quite a number of colinears using all the materials mentioned but successful construction depends largely on the ingenious use of readily available materials.

**Construction**

The whole aerial must be well insulated from the mast or other support, because the ends of the elements are at high RF potential which means that insulation between elements must also be good. The elements and matching stubs can be made from large diameter copper wire but this would require extra insulating support. Copper, brass or aluminium tubing is better and more or less self-supporting.
Feeding and matching

The radiating elements are "in phase", connected by means of quarter-wave stubs and the whole system can be fed at a suitable point on one of the stubs. Coaxial cable provides an unbalanced feed but by using a balun as shown in Fig. 7 an impedance step-up of about 4 to 1 can be obtained to about 200 ohms, as well as a balanced connection. Providing the elements are resonant and the stubs properly constructed, good matching and low SWR can be obtained by finding the right tapping points along the stub for the feeder/baluin connection. The configurations for two, three and four element colinears are shown in Fig. 8.

Practical colinears

One colinear used by the writer is shown in Fig. 9 and is a "plumbing" job as the elements and stubs are made from copper water pipe joined with appropriate fittings. Note that a blow-lamp is needed to soft-solder the fittings. The aerial is self-supporting and can be mounted on the top of a metal mast as shown by means of a "T" junction let into the lower leg of the stub and coupled to a section of PVC waste pipe. Suitable couplers for this can be obtained from builders merchants.

![Image of a colinear system]

Fig. 9: Use of copper water pipe and fittings in constructing a colinear aerial.

All dimensions are given in Fig. 9 and details for the balun feed will be found in Fig. 7. Adjust the tapping points (X) for maximum radiation (field strength meter, power meter, neon or fluorescent tube at voltage points, etc.) and low SWR which should not be greater than 1 to 1.2. Adjustment can also be made on a steady signal by adjusting for maximum signal meter reading.

The colinear shown in Fig. 10 is a four-element version, also in use, made from copper tubing, sections of waste pipe and stiff wire for the stubs. The feeder line may require some support to prevent drag on the stub and the upper and lower stubs can be coiled up to about 150mm (6in) diameter to reduce windage. All the elements are 1m (39-5in) long. Again the only adjustment is for maximum radiation and low SWR by finding the correct tapping points (X) for the balun feed.

The umbrella ground plane

As mentioned earlier, an old umbrella frame, shorn of its cover, makes an excellent 2 metre ground plane. The ribs will need to be soldered together (old coaxial outer braid), as electrical contact between them is rather poor. Using the $\frac{3}{8}$ radiator and loading coil as described in Figs. 3 and 4, the umbrella ground plane makes a useful portable aerial particularly if the radiator is made detachable when the ground plane can be folded up. For portable use, all that is required is a light sectional mast. The arrangement used by the writer is shown in Fig. 11 and with a 4m (12ft) mast in clear surroundings quite long distances have been covered including continental DX with tropospheric lift.

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Conclusion

The aerials described can be adapted for the 70cm band with proportional dimensions but, as with all aerials at UHF/VHF, siting is important. They should be well clear of other metal structures such as water pipes, guttering, metal roofs, etc. and mounted as high as possible. When using a new aerial don’t rely on the report of the first contact made as one may get an S9+ or an S1 depending upon the path over which the signal travels. Make lots of contacts and plot the signal reports on a map with distance circles from your QTH drawn in. The signal path can introduce some peculiar effects on transmission and reception and even a small change in operating conditions can bring an S9+ signal down to zero, or vice versa.

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SOLAR CELL COSTS

Japanese interest and capability in electronics is now well known. A quick look at what these Easterners are up to proves very interesting. Toshiba, for example, has issued a statement which is truly staggering; they intend to cut the cost of solar cells by 99 (ninety nine) per cent! The company has discovered a new method of producing the silicon cells. Instead of making each one separately, the silicon material is pulled in a long strip from a melt. Aptly described as the Sunshine Project it appears to be showing great promise as a method of fabrication. To date, ribbons of solar cell have been pulled which are about 300 µm thick and some 30mm wide. The longest "pull" so far is 800mm.

ELECTRONIC ENGRAVING

Elsewhere in Japan the mighty Matsushita has been concentrating its efforts in another direction: electronic engraving. One application is in identity cards or credit cards, etc. The image is picked up by a vidicon camera and then fed into a memory. This can then be held and/or fed to an engraving head. This takes the form of a stylus which cuts into the "card". The latter is a black (or dark) surfaced plastic which has a lighter color immediately beneath it. The stylus pricks into the surface of the card exposing the lighter areas. The greater the signal from the memory the further the stylus bites into the plastic and so the whiter that part of the image becomes. Some 32 degrees of tone are possible and the engraver operates at a resolution of 5 lines/millimetres.

Securitywise it appears very useful since the photograph cannot be removed nor another inserted in its place. Also, since the plastic isn't laminated, it isn't possible for would-be baddies to erase magnetic stripes by heating the cards until the temperature is above the cure point of the material. Already two chains of petrol stations are using the system.

32" COLOUR TELLY

Our last port of call in Japan is the Sony Corporation which just launched a 32in. colour television set. Neck of the tube is 36.5mm in diameter and it has a deflection angle of 114°. Perhaps big is beautiful?

SPECIAL TUBE

Speaking of displays reminds me of the new high-resolution CRT unit which has a spot diameter of one fifth of a millimetre. Resolution is 193,354 separate picture elements on its 8 x 10cm screen face and it is aimed at rather specialised markets such as nuclear and X-ray scanning, etc.

SUN POWER

Earlier I talked about Toshiba making solar cells in ribbon form. In the United States an American company has opted for a different idea. It intends to market a handheld unit which will collect and convert solar energy. One market option is to use the units to power calculators and portable radio receivers. A special technique is employed which enables the company to claim that it's units only need 30% of the number of silicon cells required by more conventional approaches. Not available here and no further information as yet, but it looks promising.

GOT IT TAPEd?

Know what happens when you speed up a tape recorder? The voice goes higher and higher as the speed increases and, of course, more words per minute are transmitted. One enterprising company has launched what it calls a "Pitch Control microcomputer". Using this device enables the speed of speech to be altered without altering it's pitch. Using a digital technique it samples the speech from a tape running at normal speed but it does this sampling at a rate of 16kHz. The tape speed is controlled by the user who can slow it down or speed it up. But as it slows (or speeds up) so the sampling rate slows or increases accordingly in step with the tape.

In many analog methods of attempting to do this a problem is encountered; the splice noises and other pops are noticeable. In this digital approach a special intelligent splicing algorithm is employed. The voice input is sampled and digitized, and this data is then stored in a RAM (random access memory). The data entering the memory is, of course, always a function of the tape speed but when it comes out of the RAM it always does so at the basic centre frequency of 16kHz which thus ensures that the pitch remains unchanged.

C.B. FOR U.K.?

Shortwave listeners and others who have tuned into the American 27MHz Citizens Band will know that it makes for hours of fascinating listening although sometimes it can be baffling. A storm is brewing in the US over this band and it will be interesting to see just how it is all resolved. To operate on the Citizens Band in the US is comparatively simple and it has an avid collection of users. It has been estimated that in the US alone there are some 10 million Citizen Band enthusiasts—all transmitting at one time or another. Now this does tend to make the band just a tiny bit crowded and, as some tyros point out, ten million Citizen Band users are packed into 250kHz, while only 250,000 Hams are allowed to use some 42MHz of r.f. space all the way up to 450MHz. The problem is compounded because many feel that expansion around 27MHz is not the answer and are eagerly looking to other frequencies. Trouble is that there just isn't any area in the r.f.

CONTINUED ON NEXT PAGE

www.americanradiohistory.com
A 'HOLY' BUSINESS

Just to keep a sense of proportion when you think of small things, how about an American company which "drills" a 0-0001in. hole in a metal cap. The hole is then electro-polished to smooth out irregularities around it's diameter. Then, it is electroplated with gold to prevent corrosion closing it up. The plating reduces the size of the hole to something like 0-00001in., in diameter. The object of the exercise is to test hermetically sealed packages for leakage and with the hole and pressures involved, the leakage rate is something of the order of 10⁻⁸ atmosphere cubic centimeters/second. I understand that the method works very well on the whole.

MINI RELAY

For the builder of miniature things, a tiny relay from the US will doubtless be of interest. Measuring only 0.56in² by 0.41in deep, its contacts are capable of switching 2A at 28V d.c. Contact resistance is given as less than 50 milliohms and the 2 pole double throw unit I saw was rated to keep going for over 100,000 operations.

CHIP 'C's'

The last item is really a kind of rehash. Chip capacitors called Vee Cals were launched and were novel in that along their sides they had a series of adjustment points. By rubbing a pencil and forming a conducting bridge between two of these points, the capacitance of the otherwise "fixed" capacitor could be altered. The company has now altered the range of values and also brought out the adjustment points so that they lie on the top face of the chip thus permitting easier adjustment. Nominal capacitance values range from 1 to 55pF and the capacitors measure only 0.12 x 0.1 x 0.03in.

LAST MONTH

In the item 1k CQ's the final paragraph should have been included under "Creditable".

GInsberg

Mail Order Protection Scheme

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(Block caps please)
Following the publication of the PW Stereo Disco System in the December 1975 and January/February 1976 issues of PW some correspondence was received commenting on the lack of bass when using some of the recommended ceramic pick-up cartridges. It was therefore decided to design a simple stereo equalisation preamplifier to cater for two turntables.

Since the amplifier response is linear, within the usual audio limits, and most disc recordings follow the standard Radio Industries Association of America (RIAA) curve, it follows that if a pick-up cartridge is used which has an output that is proportional to the velocity of the recording then the result will be attenuated low frequencies and accentuated high frequencies.

In the case of magnetic pick-up cartridges the RIAA correction is usually incorporated in the preamplifier circuitry. In the case of the PW Disco System any such correction would be most undesirable as it would affect all the mixer inputs. The use of a magnetic pick-up cartridge would also bring hum problems.

**THE CIRCUIT**

The matching unit comprises four separate preamplifiers, one of which is shown in Fig. 1, and calls for an equalising circuit which has a frequency response that takes into consideration the disc recording characteristic, the deficiencies of the pick-up cartridge used, and the amplifier loading. Resistor R1 and capacitor C1 provide correction but since the value of these components will vary with the make of cartridge a table is given for the more popular types of cartridge in use. Where no information is available experiments with values of R1 and C1 should provide satisfactory results.

As well as correcting the loss incurred by the matching procedure the preamplifiers will provide some extra gain for the low output type of cartridge, such as the Sonotone 9TAHC.

![Diagram](image)

*See table

**Components list**

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<th>Resistors</th>
<th>R1-4 1MΩ</th>
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<td>R9-12 68kΩ</td>
<td>R21-84 270Ω</td>
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<td>All 1W 5% carbon film</td>
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<th>Capacitors</th>
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<th>C13-16 10µF</th>
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<td>C9-12 10µF</td>
<td>WV minimum</td>
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<tr>
<td>C10-16 10µF</td>
<td>30V</td>
<td></td>
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<tr>
<td>Miscellaneous</td>
<td>Tr 1-4, BC184 or similar low-noise NPN. Printed circuit board (Reader's PCB Service, see ad). Screened connecting wire.</td>
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The component list above is for all four preamplifiers. If any other form of BC184 is used check leadout connections against those shown.

**CONSTRUCTION**

The printed circuit board is shown full size in Fig. 2 together with the layout of the components on the board. The prototype board is mounted on the rear right of the Disco control panel, next to the pick-up inputs. The turntable screened leads

**Table**

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<tr>
<th>CARTRIDGE</th>
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<td>Discog CS99</td>
<td>100Ω</td>
<td>680pF</td>
</tr>
<tr>
<td>Acc ceramic</td>
<td>150Ω</td>
<td>1mΩ</td>
</tr>
<tr>
<td>SSR ceramic</td>
<td>12mΩ</td>
<td>None</td>
</tr>
</tbody>
</table>
are disconnected from the mixer inputs and connected to the corresponding inputs on the matching unit. The screen of each pick-up lead is connected to the respective centre pin of each input, as indicated on the PCB.

The output of each preamplifier is connected to the respective mixer input in a similar manner, using short lengths of screened lead ensuring that the screens of these are connected to BOTH the matching unit and the mixer's copper plane. This also provides the negative side of the supply voltage. The supply for the unit is obtained from the 30V positive stabilised supply which feeds the main preamplifier board in the Disco.

**MONO OPERATION**

The matching unit may also be used for a mono pick-up but it must be appreciated that a stereo cartridge connected for mono will require slightly different values for the resistor R1 and capacitor C1, which will have to be found by trial and error. On mono only two of the matching amplifiers need be wired up on the printed circuit board.

**TECHNICROSS**

No. 14

**ACROSS**

1. Signal success with this cleaner type? (3-4, 6)
2. Lace used in 14 Down? (7)
3. Oscillator badly installed? (3)
4. Little senior citizen starts O.A. Peru (3)
5. Onions and rice but no liam in it (7)
6. Sooth media about one subject (6)
7. His receiver is in the loft (5)
8. He arranges aerial exhibitions (7)
9. Army power unit on 2 Down? (3)
10. Drop of spirit around tone-nut? (3)
11. A case of over-charging? (7)
12. Hear them as substitutes for letters (8, 5)

**DOWN**

1. Undistorted in real modulation? (6)
2. Radio sisters at the spa? (6)
3. Power unit with split infusion (4)
4. There’s no interfering with this! (8)
5. Do tire of adapting such valves... (6)
6. ... and smoothing over such voltage problems? (6)
7. Thousands of burn-outs! (9)
8. It’s opened up at full power (8)
9. Addiction to the relay system? (4-2)
10. It gets woolly reception from Spain (6)
11. Linked with the 007 programme? (6)
12. Fiddlers in the radio business? (6)
13. Handler: A replacement is a record? (4)

*FOR AMUSEMENT ONLY
ANSWERS NEXT MONTH*
Dear Sir,

letters

Unjust comment?

I have just bought a Sinclair Oxford 300 calculator, and consider your comments in the “Special Product Report” on this calculator, completely unjustified.

First, I would not describe the case as “dull” but rather plain; it is functional rather than “flashy”, and the on/off switch is, contrary to your opinion, perfectly acceptable. I find it exceptionally good for hand-held operation, and no worse than most, for desk-top use.

I would therefore like to congratulate Sinclair for producing an extremely able calculator at a very modest price, and in my opinion stands up very well when compared with more expensive models.—Sean Kelly (Nottingham)

Speedy valve

After fruitless weeks searching my local dealers in Eastbourne for a 6BR7 valve, and obtaining comments like “No sir, never heard of that before”, or “you won’t get one of those these days”, I wrote to RST Valve Co.

I posted the order on the 15th March and got my valve on the 17th March. As you can imagine I was amazed at this type of service. Thank you RST and PW.—Brian Ward (Eastbourne)

Save it!

When using the PW Tuner Cassette in a tape machine with a remote control facility, it is possible to save on batteries by simply plugging in the microphone and moving the mic. switch to OFF. This switch is usually wired as a pause control, and turns off the power to the motor only, leaving the electronics supplied with power. This is for setting-up purposes, such as obtaining a correct recording level.

An alternative to this, if the microphone has no ON/OFF switch, or to obviate the need for carrying the microphone, is to insert a suitably wired spare plug in the ‘remote’ or possibly the ‘mic’ socket depending upon the type of connection used. The problem of dents in the pinch wheel, is eliminated by a small stiff strip in the tuner cassette, which occupies the same position as the tape would in a normal cassette. This prevents the capstan coming into contact with the wheel whilst not running.—Peter Rostgaard (Broxbourn)

Good work, Robin!

The Geography teacher at Codswall Comprehensive School wanted to build the PW Music Box electronic organ for his children and, knowing my enthusiasm for electronics, asked me to help him, although I am at another school. We only worked for about an hour a week but managed to finish it and to tune it with the aid of a piano. Another teacher, Mr. Simkin has a commercial version of the organ but prefers ours to his own! The Headmaster Mr. Bates, and teachers Messrs Price, Mincher and Mansell were all impressed with a demonstration so all I can say is that it is a very good design.

I hope that you can publish my letter.—Robin Bayley (Kingswood School, Allbrighton, near Wolverhampton)

What? No rumba

The Rhythm Generator project featured in May ’76 PW undoubtedly created great interest among constructors who are musically inclined and tribute must be paid to the skill of SGS-ATES in designing the M252 device which is the basis of the project. Musical readers may at the same time share my curiosity why given a capability of 15 rhythms, SGS-ATES elected to include the rarely used Jazz Waltz and Shuffle at the expense of the much more common Rumba.

This is perhaps even more puzzling when one observes that the companion device M253 (which provides for 12 rhythms) actually includes the Rumba but excludes not only the Jazz Waltz, Mambo and Bajon—but also the ubiquitous Fox trot.

Unless there is an electronic explanation—and I can think of none—one is tempted to conclude that SGS-ATES know a great deal more about IC technology than they do about contemporary dance rhythms! D G Daverson (Brentwood)

Wake-up PW

I understand from your company that you have cancelled your subscription service. Could this possibly be true? If so, this must surely mean one more nail in the proverbial coffin of yet another well established, and, I gather, profitable magazine.

I know many people, including myself, who took PW by subscription, who will now think twice about taking PW on a regular basis, especially as recent price increases have pushed the price out of all proportion. True, its a good magazine, but when you have to go out of your way to obtain a copy, its logical that you'll only do it if there is something published that really captures the imagination.

This action possibly affects your foreign readers even more so than your UK readers. They have no way of obtaining a copy, except by subscription.

How many readers can you afford to lose by such moves? Another point that I would like to grouch about is the subject of back editions of PW. Many times since taking PW, I have been told of an interesting project that was published in months gone by. I would gladly pay the cover price plus a little extra to get my hands on that particular issue. But can I—not on your life!

So come on PW, wake-up, and lets have a bit of good old-fashioned service for your faithful readers.—T. McCahill (Barrow-in-Furness).
**ANTEX ALARMS**

Antex (the soldering iron people) have launched what is believed to be the first D.I.Y. burglar alarm kit which complies with the BS 4737 Standards.

The picture shows the control box of the battery-operated version (model A1 B). The kit comprises the control box with instructions, 6in. (15cm) alarm bell, heat sensor, exit/entry switch, 6 magnetic contacts, 30 metres twin and 15 metres 4-core cable, 100 cable clips, screws, rawplugs, terminal block. Price is £50 plus 25% VAT and batteries.

**TRIMMING POTS**

Lemo (UK) have announced a range of miniliner and exponential trimming potentiometers: the Siegert cermet TPO C range. Measuring 4 by 5 by 2-6mm, they are ideal for p.c.b. and hybrid circuit work. Values offered are from 47Ω to 1MΩ (exponential), or 100Ω to 1MΩ (linear), at a power rating of 150mW at 70°C.

The exponential effect is achieved by joining two tracks of differing characteristics, at a point between 125° and 165° of function angle. Total angle of travel is about 260°. Resistance tolerance is ± 30%. Siegert say that the potentiometers comply with DIN 41 450 when used as trimmer resistors.

Applications suggested for these micro potentiometers include car and pocket radios, paging devices, computers, hearing aids, calculators, electronic watches and defence circuitry. Further gen from: Lemo (UK) Ltd., (Dept. P.W.) 6 South Street, Worthing, Sussex BN11 3AE. Telephone: 0903 204637.

A mains/battery version is also available for £74.

The control box is a strong steel box of pleasing appearance. It houses the electronic circuit necessary to ensure reliable operation and to reduce the chances of false alarms to a minimum. Magnetically operated switches are fitted to doors and windows where an intruder is likely to attempt gaining access to the property. These switches are connected to the control box by "double pole wire". The control box is fitted with a key-operated ON/OFF switch. When the key switch is set to the ON position, any door or window switches being opened will cause the alarm to sound. Closing the door or window again will not stop the alarm sounding. Cutting either or both of the double pole wires or shorting them together will also cause the alarm to sound. The only way to stop the bell ringing under any of these conditions is to turn the ON/OFF key switch on the control box to the OFF position.


**CABLE METER**

Electronic Services & Products Limited announce a new instrument for accurately determining the length of coaxial cables and the location of open faults.

Its circuit incorporates ICs; it is completely portable and its small size makes it an ideal piece of test equipment for Service Engineers, TV Servicing Departments and Engineers concerned with the location of open faults.

Measurement is made by connecting the cable to the instrument and reading the length directly in metres. Lengths of coax from less than 10cm up to 100metres of either 50Ω or 75Ω cable can be accurately measured simply by selecting one of the four ranges.

Power is provided by a 9V PP3 battery or similar type and a LED battery monitor is incorporated which does not light when the battery voltage drops below a certain value thus preventing a false reading being made.

Price of the instrument is £45.00 inclusive of batteries. For further details contact: E & L (Dept. P.W.) Cross Lane, Braunston, Nr. Daventry, Northants. Telephone Rugby 890672.

**TRANSFORMERS GALORE**

S. G. Wright Ltd. of Burnley inform us that as transformer suppliers their boast is that they have a transformer for almost every application required in P.W. projects. In fact, they have their own winding equipment and will wind to readers' specs. at very keen prices.

If you send them a stamped, addressed envelope, they will be pleased to forward a free copy of their catalogue/price list. S. G. Wright's Ltd., (Dept. P.W.) Bishop House Works, Rylands Street, Burnley, Lancs. Tel.: 26934.

Practical Wireless, July 1976
TAPE-SLIDE SYNCHRONISER
Square M Electronix inform us that they market a "Mark III" tape-slide synchroniser for £20 plus 90p for postage and packing.

It is designed for use with automatic slide projectors and reel-to-reel or cassette stereo tape recorders. The 1kHz pulse signal duration is pre-timed to make it suitable for use with any automatic projector. Connecting leads are suitably terminated to suit standard DIN configurations.

In order to achieve the maximum economic use of a cassette tape, the recording of the pulse is on the left-hand channel and the commentary or music on the right-hand channel. This facility enables the use of cassettes in both directions (side 1 and side 2). This selection of tracks offers greater flexibility with commercially available cassette recorders. At the same time, however, the possibility of the recorded 1kHz pulse interaction between channels is minimised. Due to the track allocation for cassettes, the LH channels are well separated when the recording is made on side 1 and side 2.

Although the selection of tracks is not compatible with the Philips system, which restricts the cassette to unidirectional use requiring a special record-replay tapehead, the Square M Electronix method offers bidirectional use of either cassette or reel-to-reel recording and reproduction facilities of any commercial unit. By special request, the wiring of the pulse record and replay DIN socket can be made in accordance with CET'S, USPEC 2 or IEC proposals for international pulse standardisation.

Further information on this very interesting piece of equipment may be obtained by sending a stamped, addressed envelope to Square M Electronix (Dept. P.W.), 34 Rippleside, Portishead, Bristol, BS20 9NB. Telephone: 0272 844595.

PYE PORTABLE
Pye Ltd. have launched a new portable receiver called the 1650. It has a power output in excess of 1 watt, has four wavebands, long, medium, VHF and a 49 metres shortwave band. There is also a push-button wave change together with a slider volume control.

An internal ferrite rod aerial is provided for long and medium wavebands, while for shortwave or VHF listening there is an external hinged telescopic aerial.

The 1650 can be mains or battery operated, each set being supplied with a detachable mains lead. Should battery operation be preferred the power source is four standard 1·5 volt batteries. There is a separate on/off switch which allows controls to be pre-set and a two position tone control—high and low. Should the use of an earphone be required there is an earpiece socket suitable for 3mm plug.

Housed in a scratch resistant black Abshtene cabinet with silver carrying handle, the 1650 is equally suitable in the home or in a 'knock about' situation. It measures 267mm x 153mm x 60mm, and the recommended retail price is £37·50.

BURGESS SOLDERING IRON

Burgess Power Tools Limited have introduced a new Soldering Iron and a complete soldering kit. Both are available through tool stores and DIY shops.

The Model 25 Powerline 25 watt Electric Soldering Iron is balanced to allow it to be laid on the bench or worktable without the soldering tip resting on the working surface. It has a long-life copper/cobalt tip which is easily exchangeable, 6ft. (1·9m) of cable, and is guaranteed for twelve months. Recommended retail price is £3·25 plus 8½ VAT.

The Powerline soldering iron is also contained in the Model 25K kit which also includes a supply of resin-coated solder, a heat dissipator, a locating and positioning probe, tweezers, and an interchangeable 2-30mm (8/32in) cobalt/copper tip for intricate work. This kit is also guarannteed for twelve months and full working instructions are included with both models. The cost of the Model 25K is £4·50 (r.r.p.) + 8½ VAT. Burgess Power Tools Limited, (Dept. PW), Sapcote, Leics. LE9 6JW. Tel: 045.527.2292.

Practical Wireless, July 1976

The diagram above shows how the synchroniser is connected to an automatic projector and stereo recorder. The photograph shows the unit together with a typical recorder and projector.
Dynatron info.

This month, I wonder if readers could help me a little. I am searching for information on the Dynatron company together with photographs of some of their earlier receivers. I hope to compile a “Going Back” on this firm some time in the future and any help would be mightily appreciated!

Vintage meeting

Remember from time to time we mention Tudor Reeves’ vintage wireless emporium? Well, if any readers are interested, Tudor is holding a meeting on July 4th at 64 Broad Street, Staple Hill, Bristol BS16 5NL. Anyone interested in vintage radio is cordially invited to attend and take along a piece of vintage gear or a component to show around and have a general chinwag about the “good old days”. I’m afraid it’s rather short notice but Tudor’s on the phone if anyone wants to get in touch (Bristol 565472). Should be well-worth attending! Whilst on the point, Tudor tells me that his 1976 full catalogue is ready. Apart from equipment for sale, the catalogue includes some photographs of early gear, period adverts (my favourite) and technical tips. Price is 50p post paid or for our colleagues across the pond, $2 airmail, post paid.

Sir William Preece

Sir William Preece, F.R.S. was without doubt one of the country’s most outstanding engineers at the end of the Victorian era. He influenced the course of Victorian telecommuni-
write your own messages on the tv screen!

nov 'Easybuild'

VIDEO-WRITER

The Video-Writer resembles a typewriter but it displays the text directly on the screen of a domestic TV set or a video monitor. A page of text, which is alphanumeric with a wide range of punctuation, comprises 16 lines of 32 characters. Hold one page in memory while composing the second!

USE IT for DISPLAYING INFORMATION—ADVERTISING—SCORING for darts, bowls etc. —silent PAGING in hotels, clubs, libraries — electronic SCRABBLE.

BOAT OWNERS!
DON'T BE A SLAVE TO YOUR ECHO SOUNDER
FIT THIS SIMPLE

AUDIO DEPTH ALARM

& Cassette POWER SUPPLY for Cars

ON SALE IN JULY

Practical Wireless, July 1976
A very useful adjunct to any electronic laboratory, home or professional, is a versatile transistor tester, especially if it will also test diodes, zeners, FETs, light-emitting diodes etc. In the nature of things, a transistor tester comes in for intermittent use, rather than the longer periods of use typical for signal generators, level meters and test instruments generally. Thus, if power transistors are excluded, a transistor tester can be conveniently designed to run from internal batteries. The freedom from a mains lead greatly enhances...
A very useful adjunct to any electronic laboratory, home or professional, is a versatile transistor tester, especially if it will also test diodes, zeners, FETs, light-emitting diodes etc. In the nature of things, a transistor tester comes in for intermittent use, rather than the longer periods of use typical for signal generators, level meters and test instruments generally. Thus, if power transistors are excluded, a transistor tester can be conveniently designed to run from internal batteries. The freedom from a mains lead greatly enhances the instrument’s utility and the maximum current of 30mA does, in fact, allow transistors to be tested satisfactorily, as explained later. At the other end of the instrument allows transistors to be tested at collector currents down to a microamp, whilst leakage currents of a few nanoamps are indicated on the 500μA FSD meter.

When an earlier version of this tester was designed, the provision of direct reading

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**Parameters**

- **hFE** Direct Current Gain
- **hFe** Dynamic Current Gain
- **ICes** Collector Current Flowing With Base Short Circuit To Emitter
- **ICEO** Collector Current Flowing With Base Open Circuit
- **rDOn** Drain/Source Slope Resistance At Zero Gate Voltage
- **VG** Gate Voltage Of FET’s
- **IDSS** Drain Saturation Of FET’s
the instrument's utility and the maximum collector current of 30mA does, in fact, allow most power transistors to be tested satisfactorily, as will be explained later. At the other end of the range, the instrument allows transistors to be tested for $h_{FE}$ at collector currents down to a micro-amp or less, whilst leakage currents of a few nanoamps are indicated on the 500µA FSD meter.

When an earlier version of this transistor tester was designed, the provision of direct reading scales for $h_{FE}$ at given collector currents was considered and rejected, as it was felt that defined values of base current in conjunction with a meter scaled in collector current were more convenient (the method of use is dealt with later) and the arrangement has been retained in the present design. However, the design still permits the measurement of $h_{fe}$ since circuits depending on a transistor having a particular value of this parameter should be avoided wherever possible.

The result is a notably simple design, without the plethora of switching usually employed to cope with measurements on both NPN and PNP types, and which also tests FETS, MOS FETS (enhancement and depletion types), diodes and zeners etc.

CIRCUIT DETAILS

As mentioned above, to measure the $h_{FE}$ of a transistor the instrument injects a defined base current and displays the collector current. Referring to Fig. 1, assume that the NPN/PNP selector switch S4 has been set to NPN and an NPN transistor has been connected to the correct "transistor under test" TUT terminals. In this position, transistors Tr2, Tr5 and Tr6 are not used and the emitter of Tr1 is at a voltage with respect to the lower end of R5, determined by the setting of VR1. When the latter is set to the scale indication denoting $h_{FE} \times 1$, this is 10-5V. The odd 0-5V is a compromise allowance for the $V_{be}$ of the transistor under test, be it silicon or germanium, and hence there is 10-0V across the base current resistor chain. The resistance in circuit, selected by the BASE CURRENT switch S1, may be set at 3-2K (R1+R2) in position 11 to 100МΩ in position 2. Thus the base current can be set in 10 steps from 3-16mA down to 0-1µA. At the lower currents, the $V_{be}$ of Tr1 tends to fall some-

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Fig. 1. Circuit diagram including inter-component wiring on the P.C.B. For clarity most of the functions performed by switches and variable resistors have not been shown. Note, suitable cut-outs for the meter scale and the D.U.T./T.U.T. panel are incorporated in the heading.
### Components List

<table>
<thead>
<tr>
<th>Resistors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>2 kΩ ±1%</td>
</tr>
<tr>
<td>R2</td>
<td>1 kΩ ±1%</td>
</tr>
<tr>
<td>R3</td>
<td>10 kΩ ±1%</td>
</tr>
<tr>
<td>R4</td>
<td>8.8 kΩ ±1%</td>
</tr>
<tr>
<td>R5</td>
<td>22 kΩ ±1%</td>
</tr>
<tr>
<td>R6</td>
<td>68 kΩ ±1%</td>
</tr>
<tr>
<td>R7</td>
<td>220 kΩ ±1%</td>
</tr>
<tr>
<td>R8</td>
<td>680 kΩ ±1%</td>
</tr>
<tr>
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<td>68 MΩ</td>
</tr>
<tr>
<td>R11</td>
<td>22 MΩ</td>
</tr>
<tr>
<td>R12</td>
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</tr>
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<td>22kΩ</td>
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<tr>
<td>VR1</td>
<td>10kΩ</td>
</tr>
<tr>
<td>VR2</td>
<td>10kΩ</td>
</tr>
<tr>
<td>VR3</td>
<td>10kΩ</td>
</tr>
<tr>
<td>VR4</td>
<td>2.2kΩ</td>
</tr>
</tbody>
</table>

### Variable Resistors

- VR1: 10kΩ Panel Mounting
- VR2: 100kΩ Skeleton Vertical
- VR3: 10kΩ Panel Mounting
- VR4: 2.2kΩ Skeleton Vertical

### Semiconductors

- T1: BC108
- T2: BC123
- T3: BF245
- T4: BF244
- T5: BF243
- T6: BF407
- T7: BF407
- T8: BF239
- T9: BF238
- T10: BC108
- T11: OC140
- I1: CA3190

### Capacitors

- C1: 0.047μF Ceramic
- C2: 0.047μF Ceramic
- C3: 10μF 15V min
- C4: 0.047μF Ceramic
- C5: 10μF 25V min
- C6: 15opF
- C7: 0.022μF Ceramic

### Switches

- S1: 1 Pole, 12 Way, Rotary
- S2: 2 Pole, 2 Way, Biased Toggle, Miniature
- S3: 1 Pole, 12 Way, Rotary
- S4: 4 Pole, 3 Way, Rotary

### Miscellaneous

- Meter: 300mA FSD Watford Electronics, type T23
- Batteries: 2 off type PP7, 1 off type PP3
- Connectors: 10pcs suit Case: 10½" x 7½" x 3½" Watford Electronics type W,E,1
- Knobs: 4 off to suit switches and variable resistors
- P.C.B.: Readers PCB Services Ltd.
- Ferrite beads: 2 off 3/16" x 1" dia. Veroboard: 2" x 1" approx., 0-15 Matrix

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What, resulting in more than 10V being applied across the S1 resistor chain. By drawing a 1mA standing current, R3 reduces this effect.

Alternatively, the base of the TUT can be earthed (via S2a and position 1 of S1) to measure the short circuit collector current $I_{CER}$ or left open circuit (position 12 of S1) to measure the open circuit collector current $I_{CEO}$.

The base stopper resistor R15 and the antiparasitic ferrite beads on the base and collector leads ensure that when the TUT is a very high frequency type it does not oscillate.

The collector current passes through a current shunt selected by the COLLECTOR CURRENT RANGE switch S3. The voltage drop across the shunt is always 100mV at full scale, thus a 3-20Ω shunt is used for the 30mA range (position 1 of S3) and 1MΩ (total) for the 100mA range (position 12 of S3). As resistors are only readily available down to 4-7Ω, the p.c. layout allows for three resistors in parallel, see Fig. 5. Two resistors of 6-8Ω and one of 47Ω provide the right value.

Note that the meter is so scaled that 1mA (FSD) on the 0-1mA range corresponds to 3-15mA on the “0-3mA” range, which is actually calibrated up to 3-2mA. This is important as will appear in the section on using the instrument.

The drop across the selected part of the collector current shunt, applied to the operational amplifier I1 via the remaining shunts plus R2B, is equivalent to a voltage source applied through a 1-2MΩ total. Since R2B is also 1-2MΩ the amplifier produces 100mV at the junction of R2B and R30 at FSD. Thus R30 defines the current through the meter. After passing through the current shunt the collector current is absorbed by the augmented emitter follower Tr4 and Tr3. This stage sets the collector voltage of the TUT, as determined by the setting of the COLLECTOR VOLTAGE control VR3.

When testing a PNP transistor, S4b and S4c invert the polarity applied to the TUT and also to VR1 and VR3. Thus the base current and collector voltage are now provided by Tr2, Tr5 and Tr6, but the scale calibration of the hFE MULTIPLIER control VR1 and COLLECTOR VOLTAGE control VR3 still apply. The direction of collector current flow through the current shunt is reversed but this is of no consequence as the meter is in a bridge rectifier circuit. This arrangement results in less wiring and a neater layout compared to reversing the meter with extra poles on S4 and also simplifies testing of diodes for both forward and reverse current.

The meter amplifier is powered by a single 9V battery type PP3 and a stabiliser is not provided. The offset voltage of IC1 is adjusted by VR2 and, after initial setting to give zero reading on the meter, no further adjustment is required over a long period. An offset of either polarity will, of course, cause the meter to read due to the bridge rectifier action. To ensure meter protection the maximum overload current is limited to about four times full scale by R31 and the rds of the output stage of IC1.

The TUT circuit is powered by 2 PP7 batteries, via a current limited stabiliser. This is so arranged that a 12V output can be obtained with only a few hundred millivolts drop across the regulator transistor Tr9, permitting the batteries to be used almost down to 1V per cell. On an intermittent use basis, the batteries would therefore provide many hours' use at 50mA drain and, of course, even longer.
in practice, as not all transistors will be tested at this current.

In addition to the negative feedback loop Tr7, Tr8 and Tr9 comprising the voltage stabiliser, a second loop consisting of Tr10, Tr8 and Tr9 limits the short circuit output current to approximately 60mA. Provided extended short circuits are avoided (and these are expensive in terms of batteries anyway) heatsinks are not necessary on Tr9, Tr3 or Tr6. The change-over from constant voltage to constant current mode is quite sharp, and no sagging of the stabiliser output voltage occurs up to the 30mA FSD of the highest TUT collector current range.

Light emitting diode D5 provides an indication of excessive current drawn by the TUT, for example if 3mA base current is applied to a high gain transistor or if a transistor is wrongly connected etc.

The accuracy of the instrument is controlled to a large extent by the tolerance of the resistors associated with S1 and S3. Over the range of resistance for which they are available, Electroslit Tr5 2% metal oxide resistors may be used. Over 90% of these resistors are, in practice, within 1% of their marked value.

CONSTRUCTION

Except for resistors R4-R12, mounted on S1, R16-R26, mounted on S3, R13, mounted between VR1 and S2a, R14, R15 and capacitor C7, mounted on the DUT/TUT panel, all components were mounted on a printed circuit board.

The instrument was constructed in a case with a sloping front panel, type WE1, obtainable from Watford Electronics. This is 10\%in wide × 7\%in deep × 3\%in high, but any case of similar size would be suitable. Fig. 3 shows the front panel drillings for the above case. The compartment for the two PP7 batteries was made by Araldite wood blocks inside the case, as shown in the photograph. To achieve a “Professional” finish the box and front panel were spray painted after drilling.

Hollow pins from an old multiway socket were used to form the connector panel, which is shown in Fig. 2. The diode connector pins were veed slotted to grip a D07 or similar miniature package. The printed circuit panel was mounted on the terminals of the meter and a 16SWG support of tinned copper wire was soldered on the opposite end of the board and to the body of S4. The meter is a 500mA movement, type T23 from Watford Electronics.

Fig. 4 shows the printed circuit layout, viewed from the copper side. It can be transferred to the
board blank by placing it over the board with a piece of carbon paper in between and then going over the p.c. tracks firmly with an HB pencil. Provided the copper has been well cleaned beforehand, the carbon paper will mark the copper clearly enough to be easily visible in an oblique light. For cleaning the copper, a piece of well-used “Scotch” green kitchen scouring cloth, used wet, is ideal. (When new it is a little too scratchy!) The tracks should next be marked in with a suitable ferric chloride resist using one of the fibre pens available for this purpose. The author used a brushing cellulose as sold for touching-up car paintwork. The p.c. pads were all marked in first, by applying a blob of the paint with a fine brush. Practice on an odd piece of copper clad board soon shows the right amount to apply; the paint will then spread out into a neat circle. Finally the shaded areas were filled in, using a paint brush. These areas not only reduce the supply rail impedance, they save a fair amount of ferric chloride!

After etching, which takes about half an hour, wash the board well. If cellulose paint has been used, it can be removed with “Polystrippa” paint

Fig. 4. Printed wiring pattern designed for minimum etch. This pattern is full size and may be traced directly onto single sided clad board.

Photo of reverse of front panel, with P.C.B. removed, showing main component positions.
stripper. Wash the board well again and dry. It is best to drill the board and assemble all the components and pins straight away. The track side of the board can then be lightly varnished to prevent the copper tarnishing—a purely aesthetic point this. If available, “Letracote” spray is suitable, hair spray might even do at a pinch!

Having completed the p.c. board, assemble the controls, the meter and the test socket to the drilled front panel. Wire up as per the circuit diagram, noting that in Fig. 1 the arrows on the switch wipers indicate clockwise direction of rotation viewed from the front. The holder for the 9V PP3 battery powering the meter circuit is simply a strip of tinplate cut to size and stuck to the front panel with Araldite. Assemble the p.c. board to the meter and connect the pins to the front panel controls and battery leads as appropriate.

Part 2, to be published in our August issue, will describe the calibration and operation of the equipment.

Photo of the author’s board. (Compare with Fig. 5). Note the short component leads.

Fig. 5. Component side of the board with component locations identified. The track pattern is shown to eliminate the possibility of wrong insertion.
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The availability of modern integrated circuits specifically designed for radio applications has enormously simplified the design of modern receivers. Nevertheless, we are still some way from the time at which a radio receiver can be made by connecting an IC to a tuning control, a volume control and a loudspeaker without the use of any other components. However, the recent release of the National Semiconductor LM1808 device has moved us a step nearer to this ideal, since it contains an IF amplifier/limiter, FM detector, electronic volume control and a 2W audio power amplifier in a single package.

Although the LM1808 has been primarily developed as a television sound system the IF amplifier circuit is very similar to that of the LM3065 device (equivalent to the RCA CA3065 and the Fairchild 3065) which is intended for television sound IF use. These devices are rather similar to the 3075 types intended for FM IF radio applications. The LM1808 has a better volume control circuit than the 3065.

In addition, the LM1808 contains an audio power amplifier similar to the well-known LM380N. This power amplifier can be used with simpler circuitry than is possible with many other types and it is fully protected against shorting of the output and against thermal overloads.

Circuit

The LM1808 is a dual-in-line device with 18 pins; this unusual number of connections makes it rather difficult to obtain a ready made socket for the device. The connections are shown in Fig. 1 together with the internal circuitry in block form.

A typical circuit for the use of the LM1808 is shown in Fig. 2. The IF input is fed to pin 13 via C5. Pin 12 is the other input of the differential amplifier; it is necessary to keep pins 12 and 13 at almost the same steady potential by means of a resistor R2. The input impedance is about 17kΩ, whilst an input of about 200mV is required to cause limiting of the input amplifier. The output of the amplifier is fed to the demodulator circuit, the tuned circuit connected to pins 9 and 10 forming part of the demodulator. The Toko tuned circuit type KAC5-K-596HM has been found very suitable for use as a 10-7MHz tuned circuit in this application; it is available from Ambit International, 25 High St., Brentwood, Essex, CM14 4RH. The Toko type 94AES 3046SN should also be suitable.

The detector output is fed to the volume control circuit. Variation of VR1 of Fig. 2 will provide a linear variation of the output over a very wide range, typically 75dB. When pin 7 is earthed, the residual feed-through signal at pin 1 does not exceed 15mV RMS. The connection to pin 7 controls the volume by its steady DC potential; no signal voltages are present across VR1. A long unscreened lead can therefore normally be used to connect VR1 to the LM1808, since any hum or noise picked up by this lead can be bypassed and will not appear at the output. The rejection of amplitude modulated signals, including car ignition noise, is over 40dB for inputs of 1mV to 100mV RMS.

Power Stage

The audio output from pin 8 is fed via C7 to the input of the power amplifier at pin 16 where the input impedance is typically 200kΩ. C6 is an optional capacitor which will provide about 38dB rejection of any hum on the power supply line; a smaller value of this capacitor will also provide a useful amount of hum rejection.

Fig. 1: Top view of the pin connections for the LM1808 with the internal stages shown in block form.
The components R3 and C9 across the loudspeaker are used to prevent a 5 to 10MHz oscillation from occurring; this oscillation can appear during the negative swing into a load which takes a fairly high current if these two components are omitted. The distortion at the output is of the order of 1-2 percent at 2W output power. The voltage gain of the output stage is fixed at 50 times (34dB); this enables the simplest possible circuits to be used.

POWER SUPPLY

The power supply voltage is connected directly to the power amplifier at pin 2; if the capacitor C8 is further than about 8cm from pin 2, an additional 0-1µF capacitor should be connected from pin 2 to earth to provide good decoupling at radio frequencies. The power supply to the IF section of the IC flows through R1 to pin 6; the internal regulator circuit in the LM1808 adjusts the pin 6 voltage to between 10-5 and 12-5V.

A 24V supply is shown in Fig. 2 (as suggested in the device data sheet), but a somewhat lower supply voltage may be used if R1 is reduced to keep the current to pin 6 to a suitable value. However, the supply voltage must be considerably greater than the maximum value of the stabilised voltage at pin 6 or the stabiliser circuit will not be able to function correctly. The absolute maximum permissible supply voltage is 30V. The current to pin 6 is 7 to 15mA, whilst the quiescent current to pin 1 is 2 to 20mA; obviously this latter current increases greatly when the device delivers power into a load.

The input to the circuit of Fig. 2 may be conveniently obtained by using a commercially manufactured front-end unit and feeding the output through a 10-7MHz ceramic filter to a Fairchild A753 amplifier, as described in Practical Wireless, October 1974. The output from the A753 can be fed directly to C5 of Fig. 2 or through a second ceramic filter to C5. However, any 10-7MHz input which is at a level greater than about 200µV may be fed to C5.

In conclusion, it may be mentioned that the writer has also used the LM1808 to amplify the signal from an ultrasonic transducer; the power amplifier in the LM1808 was used to close a large relay when the ultrasonic waves fell on the transducer. However, this is another story!

This device is now available from: D.T.V. Group Ltd., 126 Hamilton Road, West Norwood, London, S.E.27. at £1-86 inc VAT, post and packing.

EQUIPMENT WANTED

- Active filter unit Sinclair Project 60—R. W. Sheppard, 48 Grindstone Crescent, Knaphill, Woking, Surrey.
- Stereo tuner (250mV output) for use with PW (Jan/Feb 1973) 10W + 10W amplifier.—F. Southworth, 58 Sheep Hill Lane, New Longton, Preston, PR4 4YN.
- Perdio transistor receiver 'Caralux' or 'Town & Country' for spares.—W. Pearce, 32 Wathen Road, Dorking, Surrey.
- FL50B transmitter in good condition. All offers acknowledged.—R. J. Wallace, 26 Broadheath Drive, Chislehurst, Kent.

ISSUES FOR DISPOSAL

- Volumes PW/TV issues (bound) to be disposed of in 1 lot. SAE for details.—N. Stevens, 48 Eversley Avenue, Barnehurst, Kent.
- Practical Electronics Aug 1970 to Jan 1975.—M. V. Pedersen, 19 Belgrave Street, Brighton, BN2 2NS.

Practical Wireless, July 1976
A fair amount to pay for a book of this size, but worth every penny or 'P'. Audio on Wheels covers all aspects of 'in-car entertainment', detailing how to choose and install mobile audio equipment. Basic principles of radio and tape recording are given and the book also explains how to set-up complete systems. Many types of radio, cassette and cartridge players are discussed—including of course, stereo and 4-channel systems.

The book caters for the radio engineer, motor mechanic and DIY man. For readers with little or no knowledge of audio, Part 1 outlines the basic principles of receivers and sound recording. Part 2 deals with practical applications and covers such things as: power supplies, speakers, car aerials, car radios, stereo and multi speaker systems, cassette players, cartridge players, motor control circuits, disc systems, installation, interference suppression, mobile public address, setting up a workshop and repairs and maintenance.

Since this book was first published in 1936, over ½ million copies have been sold. This new edition, like the previous ones, covers the whole basic theory starting with a sound exposition of the elementary principles needed in all branches of radio and electronics. No previous technical knowledge is assumed and the author has only used maths where he deems it absolutely essential. The first chapters are not greatly changed from previous editions but those that follow, on applications, were almost completely re-written in the 8th edition to take in more general on semiconductors. In this 9th edition, more attention has been given to ICs and printed circuits and information on ceramic filters, SSB radio and photoelectric devices is included.


U SEFUL hints that one acquires through experience of handling components are provided and the book sets out to tell the reader—in somewhat verbose terms—what components look like, what they do and where they could be employed.


The book guides the reader through the stages of translating circuit diagrams into PCB layouts. Image transference, etching, milling, and trimming methods are described.

Transistor ELECTRONIC ORGANS FOR THE AMATEUR (3rd Revised Edition) by Alan Douglas and S. Astley Published by Pitman Publishing Limited, 39 Parker Street, London WC2B 5PB. 119 pages 14.5cms × 22.5cms Price £4.25

The construction of inexpensive compact electronic organs is now well within the capabilities of the home constructor as our readers will know. ICs are used in some of the designs in this book but readily-available transistors are employed in the majority of circuits.

A point of interest is that a design for a Leslie-type rotating curtain speaker is included—a useful design and one for which we on P.W. often have enquiries. Once again, this is an expensive book but one which will appeal to the home-constructors' organ enthusiast for it contains some useful little circuits for experimentation.


This book describes in detail the electronic content of photographic equipment. It sets out to serve all those interested in electronics or camera mechanisms. Using a minimum of technical jargon, the text sets out precisely all the areas of photography where electricity is used. Its explanation of electronic fundamentals forms the basis from which non-technical readers can approach subsequent chapters. The discussion is extended to include separate exposure meters and their calculators. In the area of lighting, the author covers the functioning of electronic flash-guns and 'computerised' flash units. Photographic processing is covered and the book describes automatic timing, darkroom equipment, print exposure and process control systems (B & W and colour). The author finishes the book by looking into the "future", and covers automatic focusing, and micro-circuit technology which can compress the works of a camera 'computer' into a pin-head sized chip of silicon.

Practical Wireless, July 1976
The function of S5 is not so obvious and can be explained as follows: When S5b is in the position shown, the store pulse is allowed to pass through. When the switch is put in the opposite position, the condition presented to the inverters is logic '1', the store pulse thus effectively cut off. This means the actual condition presented to the stores is again '1'. The stores thus follow the data at their inputs. This is useful when in the time mode, since the counting may actually be seen. The second part of the switch S5a applies a logic '0' to the reset lines, thus preventing the counters from being reset, and forming a useful hold facility. The second function of the switch is to produce a low-to-high transition which is used to reset the counter when first switched on and when in the time mode. This is achieved by placing the switch in one position and then the other, fairly rapidly.

**COUNTER/STORE/DECODER/DISPLAY**

The four counters IC11 to IC14, Fig. 8, receive the incoming signal from the Gate, IC10. The reset terminals of each IC are connected together and
Fig. 8: Diagram of the remainder of the circuit. This should be used in conjunction with Fig. 7 part 1. IC's 11 to 22 are all housed on the filament tube PCB's.
taken to the collector of Tr6. Four four-bit latches are used as the store, these are IC's 15 to 18. The store command signal comes from Tr4 in the pulse generator, via S5b and the inverters in IC8. The inverters are required to present a pulse of correct positive going shape to enable the stores. One inverter per IC is used, so as not to load the pulse generator too greatly.

Four decoders IC19 to IC22 type 7447's are used in the present design, since the displays chosen require these types. Alternatively, the 74141 IC may be used to drive cold cathode tubes although since a vast amount of modification is required to the circuit and PCB's this was not considered a viable proposition. (There is no reason however, why the type of display could not be changed. For example LED's may be used with no change in the circuit. However, an alternative method of mounting the LED's must be found.) The displays used in this design, are the Doram 7 segment indicators. These are incandescent types, working off a supply of 5V, and are ideally suited to the present application.

**CONTROL LOGIC**

As was explained earlier the signal needs to be applied to the counter for a certain gate time, this is achieved by using the gate IC10. It is possible to apply the gate times direct to the gate, but unreliable operation would result. Instead the gate is controlled by a signal from FF2 IC9, this has the advantage of isolating the signal and the gate times (this may also be referred to, as the Clock pulse).

It is obvious that if the counters are not reset after each count, the frequency being measured will add to itself each time and cause an incorrect count. There are various methods of achieving this reset condition, and luckily the counters require a positive going pulse at either of their reset terminals. One method is to use a free running multivibrator to produce such a pulse, at the same time it may be used to display the count for a certain time, thus having a certain display time. Also in this design, a complication is added with the inclusion of the 7475 stores in order to achieve a stable display.

We now have to produce two separate pulses, one to reset the counters, and the other to enable the stores. The second pulse is needed to allow data at the 'D' inputs to be transferred to the 'Q' outputs of IC15 to IC18, this is accomplished when the Clock is high (7475 operation condition). It follows then, that if the clock inputs are low then no further data can arrive at the decoders to be displayed, thus for a steady signal the numbers displayed would be the same.

**PULSE GENERATOR**

The important point to notice, is that the stores must be enabled before the counters are reset, since if the counters are reset first, the stores will pass this data to the decoders, and the resultant display would
be zero. We now need to produce two positive going pulses, in sequence, after the clock pulse has finished. The actual circuit for performing this function comprises Tr3 to Tr6, Fig. 8. This circuit configuration is that of differentiators, the action of which is basically as follows: Normally, the input to the junction of R12 & C16 is high, therefore the capacitor is fully charged. When this goes low the base of Tr5 is taken negative by the charge on the capacitor, thereby switching Tr5 off. The capacitor now discharges through R13 at a time approximately equal to 0.7CR at which time Tr3 will switch on, causing a similar action to take place at Tr4. This in turn will be followed by Tr5 and Tr6. Four differentiators are used, instead of the more obvious two, in order that the circuits have time to 'settle down' before the next pulse.

The pulse generated by Tr4 is used to enable the stores and is applied to pin 11 IC6e. The output of this is then routed to pins 1, 5, 9, IC6, and then to their respective stores IC15 to IC18. The pulse from Tr6 is connected to the counter reset terminals, and to the clock input of FF1 (IC9).

**INHIBIT AND RESET**

The two flip flops FF1 and FF2 in IC9, Fig. 8, complete the remainder of the control logic and operate as follows:

With the J & K inputs of FF1 at '1' & '0' respectively, the outputs, are Q Low and Q High. This sets FF2 with Q Low and Q High, thus the gate IC10 is closed, preventing the signal reaching the counters.

When the reset pulse from Tr6 arrives at the clock input of FF1, the Q and Q outputs change state, ie to '1' & '0'. This presets FF2 to also change it's outputs state on the next clock pulse. When the clock pulse does arrive at the input of FF2, the outputs Q & Q change state to '1' & '0' respectively. The Q output thus opens the gate, and the signal is allowed through to the counters. At the end of the clock pulse the outputs of FF2 revert back to their original state, due to the connection between the Q output of FF2 and the clear of FF1. The transition from '1' to '0' of the Q output of FF2 starts the pulse generator as described.

It may be seen that the capacitor C16 in the pulse generator is being charged up while counting, and commences to discharge at the end. In fact, the reset/store sequence is almost instantaneous, after the end of the clock pulse. This means that the reset/store sequence is completed before the arrival of the next clock pulse, and is thus ready to count once again. It may also be shown that, there is no display time as such, since the Stores provide a continuous display. There is however a sampling time which is directly related to the interval between clock pulses. In practice this works out to a sampling time of 1 second when used with a 1 second gate time. Thus for successive shorter gate times the sampling time also decreases.

**CONSTRUCTION**

The case for the counter is made from 6mm plywood and measures 255x205x117mm, covering is with Fablon or similar material and varnished to give a shine to the instrument. Cabinet dimensions, together with instructions for front panel drilling are shown in Fig. 9. The lettering may be applied using Letraset or similar and, as in the case of the prototype covered with transparent Fablon. The layout of the components in the case is shown, in Fig. 10.

Construction of the various boards should not be
Fig. 11: Main veroboard shown actual size, containing IC's for crystal clock, dividers, timer, pulse generator, gate and inverter. The width of this board should be 95mm and not 90mm as printed in the component list. Additional decoupling may be required for the regulated supply at IC10, in which case connect a 10nF capacitor (C20) across the 5V supply.

Fig. 12: Power supply veroboard on 0.1in matrix showing layout of rectifiers and smoothing components.
a problem, if the layouts shown in Figs. 11 and 12 are followed. Construction of the display boards are simplified by the use of ready made PCB's. The display boards should be joined together using lengths of 6BA studding, as shown in Fig. 13.

The mounting bracket for the regulator and fuse holder is made from aluminium, and shown in Fig. 14.

![Diagram of display boards and mounting bracket](image)

**Fig. 13:** Connect all four display boards together with a length of 6BA studding. Don’t forget to remove any copper track that might short to the studding.

**Fig. 14:** Aluminium bracket for mounting the voltage regulator and fuse holder. The fuse was omitted in Fig. 6 and should be connected between mains live and 31.

### TESTING

It is preferable that the power supply be tested first, since the remaining circuits require to be set up using the power supply. Testing of the power supply should present no problems, since all that is required, is to ensure the correct voltages are obtained.

The display boards should be tested in turn by connecting each to the power supply, and connecting the reset line to 0V. The store line shouldn’t be connected, and a 1Hz square wave of approx 5V should be applied to the input. The display should advance one digit per second. This should be done to each display, any faults being cleared before construction commences.

It may at this point be worth trying to find the board with the highest operating frequency, and using this in the first position. This may be done by applying a continually higher frequency to all the boards (all the boards must be connected in series) and noting when the display ceases. Using this method the fastest display board can be used thus extending the operating frequency of the counter. This is because the first board must operate at the maximum frequency of 50MHz. Thus the first board divides by 10 presenting a frequency of 3MHz to the second, well within the capability of the IC’s.

The input stage is the next to be tested and involves applying a variety of frequencies and amplitudes to ensure that ICl converts the waveform into a good square wave. The effectiveness of the input protection may also be tested, but be careful!

The crystal clock and dividers can now be tested, it is advisable to check each divider IC before inserting it into the circuit since a ‘dud’ can upset the entire clock generator. It will be noticed that no adjustment is provided for the crystal oscillator, since the crystal itself is very accurate. The timer control is tested to ensure that only a single pulse is generated when the input is earthed. It is recommended that a micro-switch be used to eliminate the contact bounce associated with normal press type switches. The remainder of the circuit, ie the control logic can only be tested when the other units are fully connected.

After construction is completed a final check should be made in the case of any shorts etc, and power applied. If all is well, the instrument can then be tested to ensure correct operation, after which the counter is ready for use.

### FAULT FINDING

With a complicated circuit such as this, the possibility of a ‘dud’ IC is not uncommon, it is therefore important that the IC be eliminated as faulty, as far as possible. The removal of an IC from a circuit board, can, more often than not, cause other damage. The use of IC sockets can eliminate this, but due to the expense, were not used in the prototype.

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**Kindly Note!**

Rhythm Generator, June 1976

It has been brought to our attention that pins one and two of IC5 (PCB3, Fig. 11) were connected together. This is incorrect, pin one should be bent clear and not soldered.
A fit of nostalgia was sparked off by a find whilst browsing through secondhand books one Sunday afternoon in a market town in rural Hampshire. Rural Hampshire being peopled by honest folk, there are racks of books outside the shop under a covered forecourt, even a notice saying "OAP's Take One Free". There I came across a copy, in excellent condition, of "A Manual of Modern Radio", by J. Scott-Taggart. As Point Contact is not yet quite old enough to benefit from that notice, I duly put the price marked inside the front cover—30p—through the slot by the door and that evening walked through the covers of the book into a long-lost Arcadia, full of differential reaction condensers (reduces the effect of hand capacity), basket weave coils and of course egg-shaped insulators.

But don't get the idea that Point Contact is a boring old man who lives entirely in the past. As a practising chartered engineer I am also involved with the latest techniques of information transmission, both line and wireless (sorry, radio!). And like any good engineer, I like to know what is going on in other fields of engineering. Some of the developments are fascinating—take Optical Computing, for instance, I had always assumed that if a photograph was taken out of focus, the fine detail was irrevocably lost; certainly putting the negative in the enlarger equally out of focus in the other direction won't help! Nevertheless, the way the blurring on the negative takes place is uniquely determined by the lens and the degree of out-of-focus. Imagine the blurred negative from an out of focus picture of a point of light on a black background. If we could process the information on the negative through a system with a transfer function equivalent to the inverse of the "point spreading function" of the out of focus lens, the negative could be made to yield a print showing the original point.

Exactly this has in fact been done, using holographic techniques, for real photographs full of detail. A minor snag is that certain "spatial frequencies" (number of lines-per-mm on the negative) depending on the original lens and degree of out of focus are missing from the "sharpened" picture. On normal subjects this is not noticeable any more than a narrow bandstop filter causing a 'hole' in the audio spectrum, on ordinary programme material like a full orchestra. There are numerous other applications of the technique, which is called "optical computing" because the holographic system is in fact processing vast amounts of information in parallel in real time.

Of course, not everyone is interested in science and technology; take Mrs. Point Contact for example—although I was surprised to find that even she can (usually) tell the difference between a resistor and a capacitor. And the little Point Contacts don't really show any interest in electronics at all, perhaps because they have been threatened with dire consequences if they grumble anything in my "laboratory". I am fortunate enough to have a corner of the spare bedroom for my work bench; well,

**Practical Wireless, July 1976**

Clearing up when we have visitors.

most of the spare room, actually, so a certain amount of clearing up is called for when we have visitors. How much depends on the visitor.

In the 20's, for most people, components were very expensive, but ready-made sets just prohibitive. Later on, as volume production of all-mains sets got under way, prices came down considerably and just before the war I bought a Cossor 365 Superheterodyne Receiver for the princely sum of £7.19.6. Of course, in real terms, that was equivalent to the present day price of a good television set, and as a receiver it had a remarkably good performance. "Excellent bass radiation and good crisp treble" was the verdict of the Wireless & Electrical Trader. In practice this meant 6dB per octave top cut from about middle C upwards, aided beyond a Kc or two by heavy RF filtering at the detector and 'High Q' IF transformers. Nevertheless, it did have a tuned RF stage and Long, Medium and Short Wave-bands and with a long aerial and a following wind would pick up plenty of American and the odd Australian station. Years later, when servicing it, I found out the hard way that whilst the top cap of the RF pentode was grid 1, that on the pentode in the IF stage was anode!
EDITORIAL ANNOUNCEMENT

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HARROW: LONDON W1: Henry's

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+50p p&p.
by Eric Dowdeswell G4AR

I have had an interesting letter from J. Watson of Bolton in which he says he has written to the RSGB to propose that they run a course for beginners in Radio Communication, which would complement the Guide to Amateur Radio and the Radio Amateur’s Examination Manual. Personally speaking I would have thought that the Guide would have been enough but, as JW says, once into ones fifties and things get a bit more difficult! JW would like to learn just enough to pass the RAE but in the event one could hardly avoid learning quite a lot more. Not much point in just acquiring a lot of isolated facts even though that could be enough to pass the examination which, in all conscience, could hardly be simpler! JW did try a night school class at a technical college but found the hour or so a week a waste of time and very protracted. Unfortunately, JW still awaits a reply to his suggestion, written on March 4th.

Paul Turner (Bishops Stortford) found 15m a good and improving band during the month, as did several other correspondents. Only to be expected with the summer coming on, I suppose. Paul’s main problem is the seemingly eternal QRN from the timebases of local colour TV sets but with the rise in the usable frequencies as we get further into the year this trouble ought to tend to diminish, being worse on the LF bands. Paul also noted an improvement in the 20m band especially in the afternoons when central and south African stations were prominent.

Steve Cottis G15294/A8961 (Harrogate) queried a station signing /P/4U which would appear to be an amateur with one of the UN forces, such as those on the Golan Heights, although the 4U prefix is generally used by stations in Geneva, under the aegis of the ITU. Steve also noted 4I6A operating in a contest which turned out to be a UG6 station! To forestall any enquiries Steve’s “call” G15294 is an identification issued on joining the International Short Wave League. I am glad to know that Steve has now made an audio oscillator so as to get on with the task of learning Morse. Don’t try to do it all by yourself Steve, try and find an experienced op to assist or you will get into some bad habits!

Nell Whiteside (Hitchin) sent in a brief log for 20m but has in fact been mainly listening on the 2m band but reports that nothing has happened there recently to be worthy of mention. On 70cms Neil has a Microwave Modules converter fed from two 6-element yagis with matching harness. He is looking forward to the operation of the 70cms Bedford repeater GB3BD which has been carrying out QRP tests apparently. Paul Flatman (Ipswich) decided to fix his HRO after all and as he says “when it is working properly it is really pulling them in” on an “old bit of bent wire” as he puts it. Paul is another to comment on the up and coming 15m band. On 40m he caught YV40W/P/T on SSB. Could this be a new country in the offing? QTH said to be Margarita Island.

Another Paul, of the Barker clan (Sunderland) always sends in two log sheets, one for SSB and the other for SSTV in which mode he got PY4AP for a new country. Paul is wondering if an article on SSTV would be of interest in the magazine. I think it would so he is being duly encouraged by me! I am sure a lot of people would take up SSTV if they could only get some practical advice to put them on the right track. As well as studying for the RAE Robin Bayley (Nr. Wolverhampton) has managed to complete a converter for 2m and to put in some listening time in the HF bands with his ex-RAF R1475 and long wire aerial.

L. Thompson (Reading) mentions the very much improved results obtained when his 350ft long wire at 55ft up had to be bent back to form a vee when the old elm at the far end had to come down. “Could this be some sort of beam?” he asks. It is, more or less, but if he feeds it with open feeder at the apex and uses an ATU he will have a very effective beam indeed and usable on all the HF bands. Seems it has around 200ft per side now. I know a lot of licensed chaps who’d be glad to get that sort of aerial up in their gardens!

Alan Doherty (Portrush, Co. Antrim) didn’t find the bands particularly good and apologises for the poor log covering 20, 40 and 80m SSB. Don’t know if his move to the spare bedroom, out of everybody’s way, has got anything to do with it! Still has his PR40/FR40/SDX setup and 120ft of wire. I dug only 100 yards from the sea he bemoans the fate of some of his aerials due to the Atlantic gales, but adds “I wouldn’t change it for the world”. He also comments on the lack of activity by yours truly on the bands. My head is duly bowed in shame! However I do have a rig which I am endeavouring to get on to the 80m band as soon as possible. It was a commercial rig with four switched crystal channels but by the time I have finished with it it ought to qualify for the appellation “home-brew”!

Stan Hunt (Wigan) BR56555 finally dragged himself away from his studies to write to us for the first time. Thank you Stan but don’t let amateur...
radio deter you until you have passed everything you have to pass. There will be plenty of time later. He has a Trio 9R59DS with a dipole for 40m which is also very effective on 15m. This is in the loft but he hopes to get a 14AVQ vertical up on a pole in the garden very shortly. Stan surprised me by asking how he can send cards through the Bureau. Presuming you mean the RSGB Bureau, Stan. I should have thought you would have been supplied with all the relevant info on this when you “joined up”! Briefly, all outgoing cards are sent to Arthur Milne G2MI, long time manager of the Society’s QSL Bureau but incoming cards are received by means of SAE’s, from your own Sub-Manager whose QTH you can find by reading Rad-Com or contacting RSGB HQ.

From Bernard Hughes in Worcester comes a nice log courtesy of his FR500DX plus 20m dipole and 66ft of wire on other bands. Having a few days off work he took the chance to look at 20m in the afternoons and was pleasantly surprised to find plenty of VK’s coming through. Martin Chapple (Leamington Spa) A9900 gets best results on all bands when he connects half his 20m dipole with his 100ft wire. If you look at the total length of all the wire in use OM you will probably find a multiple of 66ft somewhere! Like 152ft?: A half wave on 80m and excellent on all the higher frequency bands. Martin also queries the lack of G4AR on the air but I hope my notes above will explain all.

M. P. Bennett BRS 3G644 just sent a log but, looking at the excellence of the entries, obviously had no time to write a letter! Back to Steve Cottis who was very impressed with the course on short wave propagation obtainable from Radio Nederland, PO Box 222, Hilversum, Holland, free of charge. Meant for the broadcast band boys but very useful still when they advance to the amateur bands! 9K2DT was so pleased with his report from Steve that he not only returned the IRC’s but put seven stamps on the envelope including a set of five featuring birds. Feathered ones, naturally, which incidentally, is my second hobby when I have the time! Wonder if 9K2DT should read 9J2DT?

Phew! Who said everyone is on holiday now and that I wouldn’t get any reports! Seem to be more than ever! Following on from my remarks on Tim Charles A8927 last month he was kind enough to telephone me to say he is now G4EZA and, as we both remarked together, that’s not too bad on CW! Tim was one of the few who regularly sent in logs of stations heard on CW, and now he’s lost to us, boo-hoo! SOS—will Paul Cowburn who wrote me a long letter please let me have his QTH? I have an envelope here with an answer and some goodies but no address to which to send it. Unfortunately I can’t find a previous letter from you, Paul.

Log extracts

P. Turner:— 15m ZS6U 9G1JX CX5BF 2m ON5UN PA0YZ (via aurora)
S. Cottis:— 80m A2CJP CT3AJ HJO8BU VP2KF YB0ABV ZB2CJ 20m C8AJ JR1UHM (Guam Is) KG6JBX HL9TX TU2GA VS6DO VR8A T8PAC 15m CT3BJ JA4JU UK0AAC
N. Whiteside:— 20m CP5DT HP1XMU KV4AB VP5MA
P. Flatman:— 40m YV4OW/P/T 20m HRI3JJR VQ9DF (Mahé Is) YB0ABV ZS4BP 5N2NAS 9V1NR
15m EL2FW JA5MP PT2AB VS6DO ZD8RD ZP5WU
P. Barker:— SSTV 20m CT1JJ HA5KFF 10FZW K4QPR 0E1HNW PFY4AP 8K2DO 20m AD7ZJD/AG6 (Guam Is) CT7BC KG6JBX T1JAF
R. Bayley:— 80m FP8DH 40m EA6DA VP8AA 20m A2CO KH6PP
A. Doherty:— 80m PYTHS ZE6JL 40m 5T5AR 6W8DY 20m AL7CSX(KL7) FG0GE TG9HW VP2LCG YJ8DE
S. Hunt:— 80m ZB2CJ 20m FG7AN HR6SWA (Swan Is) VE8NS 8P6CG 15m 5T5ZR 9J2GJ
B. Hughes:— 20m DU1DBT KG6JBX T1JAF YB0ACG 5D6BD 5R8BL 9M6MA
M. Chapple:— 80m EA8CRL ZL5FA 40m VK2AVA 20m VP8HZ 9X5SP
M. Bennett:— 80m AP2AD 20m A35AM (JA1XFB) HM2JM KG6AA TR8JCZ VK2PA/LH (Lord Howe Is) 8R7X 15m FY0PH TI2WX
P. Cowburn:— 80m HK0COP KZ5HP ZL1JC ZB4AJ 40m CE3BGL VK5PV 20m H18AB KV4IJ VP2KF 5N2NAS

BROADCAST BANDS

by Derek Bell

O R what to do with an egg insulator? John Curtis of Beaminster in Dorset, after reading the recent comments in this column on the problems of securing aerials to trees, passes along a tip first used by him in the ’20s. This involves fastening a length of stout rope to the tree sufficient to clear the tree branches on the end of which is fastened a pulley wheel with the aerial wire running through it. From the pulley wheel the aerial runs to a bucket or similar container filled with something heavy to keep the aerial wire taut.

Pulley wheels can be expensive, so why not substitute an egg insulator? This, as its name suggests, is in the shape of an egg and is made of a ceramic substance for good insulation. Through it are two holes at right angles to each other so one hole can take the securing line while the other has the wire running free through it. This then runs down to the ground and is held taught by a suitable weight. The cost is mainly for the eggs, one for the tree end and one for the building end. This one is secured to an appropriate point by another lashing with the aerial running through or tied off to it, if you prefer the lead-in away from the house wall.

David Birch of Trowbridge has another sort of aerial, this is a Yagi coupled to a Wien Multi-Five set and was enough to pull the following goodies:

Radio Australia on 9570 at 0745
As you know, I'm fairly well in with the Managing Director of Home Radio Components Ltd. He was deep in thought when I called on him the other day. "Cooking up something new?" I said. "Yes" he replied "I'm thinking of giving a piece of Veroboard to everybody who buys one of our catalogues, but I'm wondering if the idea is a bit gimmicky." "Certainly not" I assured him "Several electronic magazines have done it before and I'm sure lots of customers appreciate it". Encouraged, he went on "I thought that if I offered 4 projects for which the board could be used it would make it even more useful and interesting". That set the ball rolling, and with the co-operation of Vero Electronics Ltd. and of Mr. Fred Bennett, Editor of 'Practical Electronics' he is now able to make this unique offer... to every purchaser of a Home Radio Components Catalogue will be sent a piece of Veroboard and four projects for using it. The offer lasts for one month from the publication date of this journal. If you have not already got a current Home Radio Components Catalogue here is a wonderful opportunity to correct the omission (no constructor should be without one) and at the same time to win a useful piece of material and four interesting projects—a Touch Switch, a Thermometer, a Waa Waa Unit and a Light Operated Switch. The catalogue costs only 99p (including 34p for packing and postage) and it includes vouchers to the value of 30 pence if used as directed. This is too good to miss—send the coupon below with your cheque or P.O. for 99 pence. Why delay? Do it today!

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Practical Wireless, July 1976
Radio Kuwait on 11940 at 1745
HCJB Quito on 9760 at 0800

a sure sign that summer is on its way when Kuwait is heard after tea. Can anyone tell us if the pop show is still going on this slot?

A Joystick package is used by Lawrence Bennet, tagged on the front of his Trio 9H50DS. There have been varying claims made for this system and it seems that there is some justification for them since Lawrence logged the following:

AIR Delhi on 3255 at 1730
Radio Chad on 4904 at 1910
Ghana National service on 4915 at 1915
Ghana Commercial service on 4980 at 1920
Radio Mauretania on 4850 at 1930
Benin 'Voix de Revolution' on 4870 at 2015
Radio Togo on 5047 at 2055

Recently in this column there appeared a comment by Ian Walker on the fact that Radio Peace and Progress was popping up at an odd spot on the dial of his rig. This and other remarks on this station so moved Alan Potter of Bristol that he provided a long screech on the mathematics of intermediate frequencies to prove that this signal was a spurious one. In words of one syllable and numbers under ten, that my poor enfeebled brain can cope with,

Alan proved that many receivers have an IF of 450-470kHz and thus the indicated freq was, in fact, spurious. Were it to be put through the mathematical mill it would show one of Radio P&Ps true frequencies. Working the proper way round Alan shows that if one takes the true freq, it is possible to calculate the probable freqs that spurious will inhabit.

Radio Pakistan, Alan tells us, is asking listeners in the UK to report to them on the quality of the evening signal on 7375 and 9465 between 1915 and 2145, so if you care to co-operate the address is: 82a Satellite Town, Rawalpindi, Pakistan. For the benefit of Radio Pakistan I have a report that 7375 is usually a good signal while 9465 is drowned in QRM.

I also have in front of me the scheds for "Peace and Progress" up to October of this year. This, although sent to the UK, only deals with the Asian portion of our globe and is in Chinese and English, is shown in "metres" only and the air time is from 0800 to 1600 with gaps into which the Chinese broadcasts are inserted.

The Principality of Wales comes next in station news with John Higginbotham's letter passing on the tip that dear old Radio Nederland is starting to include propagation predictions in its "DX Jukebox" show. This seems to me to be one of the best ways of getting up-to-date information and I would like to see more propagation spots in DX shows. While on the subject of Radio Nederland it is with sadness that I pass on the news that they announced during March, the death of Eddy Startz at the age of seventy-seven. Many long-time DXers will remember Eddy who created the Happy Station shows and who was associated with them for over forty years. While he had retired it was not in Eddy's make-up to sit back and vegetate, and only four or so years ago he was travelling the world lecturing and writing his memoirs. I suggest that any gathering of DXers should list a glass to Eddy's memory.

From Les Waldron, in Stoke-on-Trent, comes a plea for information on a set that he rescued from a junk yard and thinks is an ex-Service rig. The set has four bands from 1.4 to 20MHz and has on the back a plate stating "Vancouver Radio Labs Inc.". So, if you can help, contact Les at 60 Catharine Road, Chell Heath, Stoke-on-Trent.

Our final word this month is once more on aerials. J. Watson from Bolton enquires about an aerial for a loft that he saw ages ago. The thing about this set-up was that it was in the form of a square. This form of aerial is perhaps not very common but one advantage is that the sides can be formed to the length desired. Maximum directivity is generally at right angles to the line of a wire thus by forming a square one can achieve equal input from all points of the compass. A downlead of low impedance coax from the centre of the wire can be fed out through the eaves and down the wall and back in through the shack window. The wire of course should be suspended from the roof joists with insulators. With that I will declare the innings closed and wish you best 73s.

MEDIUM WAVE DX
by CHARLES MOLLOY

Reader J. M. Kreinicki reports from Newcastle-on-Tyne with an interesting log of DX from south east Europe and the Middle East. He uses a Philips 10BL59D transistor portable with internal aerial and in spite of the limitations of this type of receiver for DXing he picked-up Bucharest on 605kHz (after Lyons had signed off) the BBC Eastern Mediterranean relay in Cyprus on 636kHz and 1322kHz; Belgrade on 683kHz; Baghdad on 760kHz; the Voice of America relay at Kavalla in Greece on 791kHz; Dyakabir, Turkey on 1061kHz and Sofia, Bulgaria on 1223kHz. He also asks about a Middle East station on 200kHz on the long waves, behind Radio 2. This is Ankara in Turkey which has been on this channel since early last year when it moved from 181kHz.

The internal aerial in a transistor portable is directional. Maximum pick-up is at right angles to the ferrite rod or slab and there are two nulls, directions of minimum pick-up, along the length of the rod. These nulls enable the DXer to reduce or even eliminate interference simply by rotating the receiver. A ferrite rod aerial could be connected to a communications receiver, but DXers have developed the medium wave loop, which is based on the frame aerial used in the early days of radio. The directional properties of a loop together with the sensitivity and selectivity of a communications receiver provide the DXer with a powerful tool with which to explore the medium waves.

A medium wave loop has similar properties to a ferrite rod aerial; it is directional and tunable, but on account of its greater size its pick-up is much...
greater. The type of loop in use by many DXers consists of a main winding of seven turns of plastic-covered wire of about 22SWG wound in the shape of a square of 4in. side. A one turn coupling winding is wound parallel to and centrally on the main winding. The two windings are supported by a frame made out of two pieces of 1in. square wood which are joined at right angles to make a shape like the letter X. The turns are supported by four paxolin spacers fitted to the ends of the arms. These spacers have saw cuts 1/4in. apart along one edge to keep the windings in place.

The main winding is connected across a 500pF variable capacitor which is mounted at the centre of the loop and is used to tune the loop. The coupling winding goes to a small terminal block mounted on the loop from which a length of twin feeder (or twin lighting flex) is taken to the aerial and earth terminals of the receiver. The loop is mounted on a stand in such a way that it can be rotated around its vertical axis. When using a loop, tune-in a station on the receiver, peak-up the signal with the loop tuning control and then rotate the loop for minimum interference.

J. Watson (Bolton) and M. J. Watson (Enfield) are constructing loops. So is F. T. Shortridge of Llandudno who remarks that he had better results on the medium waves in the 1930s when using a "straight" set than he has now with his AR68. Interference (QRM) was a lot less in the '30s hence the need for a loop! Some DXers claim that a loop gives a "cleaner" signal than a longwire. The reduction in overloading and cross modulation would no doubt give this impression. An improvement in signal-to-noise ratio is nearly always obtained with a loop while, in summer, atmospherics caused by thunderstorms in the southern hemisphere can be considerably reduced when the DXer is listening towards the west or the east.

Glyn Morgan (Tredegar, Gwent) who has been using an Astrad VEF17 portable temporarily for his DXing has at last succeeded in repairing his HA230 communications receiver. The middle wafer of the wavechange switch had developed a "short" on the rotary section. The col unit had to be stripped, the wafer removed and the carbon scraped away and filled-in with Araldite! A truly remarkable repair by a determined DXer. Glyn used to be a service engineer before an illness deprived him of the full use of his hands and forced him into early retirement. Since the repair he has logged the BBC Eastern Relay on Masirah Island, Oman on 1421kHz and Algiers on 1421kHz (with Saarbrucken, which is on the same channel, off the air). Glyn uses a 40ft long wire fastened to a tree in the garden but a loop is now under construction!

News of another repair comes from Harold Emblem of Mirfield in Yorkshire. His Eddystone 730 developed a high noise level and poor sensitivity which was cured when the frequency changer valve, which had worked loose, was pressed fully into its holder. It is always worth while keeping a spare of each type of valve in the receiver so that one can be replaced should a fault develop. With his receiver back in service again Harold pulled in All-India Radio at Lucknow on 760kHz and Radio Pakistan in Hyderabad on 1010kHz, both stations being heard after 0130 GMT.

Broadcasting in Spain is complex. Radio Nacional Espana, which is state owned, operates a number of high power regional outlets, many of which can be heard easily by the listener in the UK. Local radio, too, is well established. Chains of low power commercial stations operate across the country under the callsign prefixes EAJ, EAK, ECS and EFE each belonging to a different network. Over a hundred are on 1106kHz, 1133kHz, 1365kHz, 1594kHz, 1412kHz, 1430kHz, 1475kHz, 1520kHz and 1570kHz. Picking out these stations can be a real challenge to the DXer as well as being a source of interest. Listen at midnight when many sign off, usually with a full identification. These locals are good verifiers if an International Reply Coupon is enclosed with the report. Many will send the listener a 25p card, picture or postcard of the locality. Listen on 1133kHz for Radio Juventud Muela (EFJ19) and La Voz de Malaga (EFJ56); on 1365kHz for Radio Centro Madrid (ECS11); on 1394kHz for Radio Popular Vigo (EAK35) and RP Santander (EAK78); on 1412kHz for Radio Tarrasa (EAJ25) and on 1570kHz for La Voz de Alicants (EFE8). A full list of Spanish locals is contained in the World Radio TV Handbook 1976, obtainable now for £4·50 from Argus Books Ltd, Station Road, King's Langley, Herts.

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### Broadcast Bands

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

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

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### Subscriptions

"PRACTICAL WIRELESS" - "TELEVISION"

We are still receiving letters requesting subscriptions to Practical Wireless and Television magazines. For those readers who are not aware, we regret that our magazines can no longer be supplied on direct subscription by IPC Limited due to escalating costs.

This action is very much regretted, but it should not mean that any reader is deprived of his/her regular copies of Practical Wireless or Television. Readers should order directly from their local newsagents. Any readers outside the UK who have difficulty in locating a supplier should write to the Editor, PRACTICAL WIRELESS, FLEETWAY HOUSE, FARRINGTON STREET, LONDON EC4A 4AD, ENGLAND.
### T.T.L. 74 I.C.'s. Prices include Postage and V.A.T. plus BIG QUANTITY DISCOUNTS

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Part Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>100</td>
<td>TDA1412</td>
<td>Varicap Mosfet with 4 tuned RF ccts.</td>
</tr>
<tr>
<td>100</td>
<td>TDA2020</td>
<td>Varicap FET/Bipolar min. tuned head.</td>
</tr>
<tr>
<td>100</td>
<td>TDA4400</td>
<td>Frequency meter, scale 50 – 100.</td>
</tr>
<tr>
<td>100</td>
<td>TDA4401</td>
<td>Strength meter, scale 0 – 10.</td>
</tr>
<tr>
<td>100</td>
<td>TDA4402</td>
<td>Tuning meter, scale 3 – 0 – 3.</td>
</tr>
<tr>
<td>100</td>
<td>TDA4403</td>
<td>'Off-air' UHF TV sound receiver tuned, with interstation tuning, and automatic detection at 38 MHz (Built-in, inc. P.S.U.).</td>
</tr>
<tr>
<td>100</td>
<td>TDA4404</td>
<td>6 station automatic station selector for any output, incorporating a muting output, AFC lock and scan tuning. Built.</td>
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<tr>
<td>100</td>
<td>TDA4405</td>
<td>Top quality tuner/RF to audio Varicap tuned with 3 meter outputs.</td>
</tr>
<tr>
<td>100</td>
<td>TDA4406</td>
<td>Tuneret with built-in stereo decoder.</td>
</tr>
<tr>
<td>100</td>
<td>TDA4407</td>
<td>Varicap tuned.</td>
</tr>
<tr>
<td>100</td>
<td>TDA4408</td>
<td>Dual Mosfet tuner head as used in 7252.</td>
</tr>
<tr>
<td>100</td>
<td>TDA4409</td>
<td>Dual amplifier kit.</td>
</tr>
<tr>
<td>100</td>
<td>TDA2020</td>
<td>Heat sink for one TDA2020 (only with 1C).</td>
</tr>
<tr>
<td>100</td>
<td>TDA2020</td>
<td>Comprehensive 1301 decoder, with notch filters and 5x gain.</td>
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**Suffix** "k" indicates kit, otherwise supplied built and tested.

### NEW MODULES (EDGE TERMINATED)

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<tr>
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<td>6 stage, dual mosfet UHF tuned head.</td>
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<tr>
<td>7020K</td>
<td>10uV FM IF system with muting, audio.</td>
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<tr>
<td>92310K</td>
<td>Main tuning voltage AFC system.</td>
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**New LOW PRICE**

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<th>Part Number</th>
<th>Description</th>
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<td>7412</td>
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<td>7423</td>
<td>90p Each</td>
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<td>95p Each</td>
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**Other**

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<td>7419</td>
<td>55p Each</td>
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<tr>
<td>7420</td>
<td>60p Each</td>
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**General Terms:** CWO please. Orders 22p per £1.50. Where items are marked * only add 8%. In stock orders despatched within 48 hours.

**Mail Order Only**

XEROZA RADIO
1, EAST STREET, BISHOPS TAWTON, BARNSTAPLE, DEVON
**INTEGRATING A GARRARD DECK**

Garrard 3 speed Deck automatic, manual facilities together with stereo cartridge and cueing device.

Stereo 2.5 easy to assemble audio system kit. No soldering required.

The unit is finished in Simi Teak, and the acrylic top presents an unusually interesting variation on the modern deck Plinth.

Includes 3 speed deck, automatic manual facilities together with stereo cartridge and cueing device.

Two speakers with cabinets.

Amplifier module. Readied built with control panel, speaker leads and fully ready to follow assembly instructions.

Specifications - For the technically minded.

Input sensitivity 120mV, Power output 2.7 watts per channel. Power impedance 8-15 Ohms.

Stereo headphone socket with automatic cueing switch. Suitable for auxiliary inputs - radio, tape, etc., for cutting disc recording.

Overall Dimensions. Speakers approx. 12 x 9 x 5; Complete deck and cover in finished position approx. 13 x 12 x 8.

Extras if required. Optional Diamond Stylus £1.50.

Specially selected pair of stereo headphones with individual level control. Facilitated with few basic tools.

**EASY TO BUILD SPEAKER KITS**

These superbly finished bookshelf speaker kits have been specially designed by RTV-C for the cost-conscious hi-fi enthusiast who wants top quality speakers but doesn’t want to spend the earth. Built to EMIs exacting specification, these new RTV-C speaker kits(30 watt kit) incorporate 13 x 8” woofer, 3” tweeter and matching crossover.

Easily put together with just a few basic tools.


**EMI 350 KIT**


**VISCOUNT IV STEREO AMP**

**COMPLETE 20 x 20 SYSTEMS**

**SYSTEM 1** £65.00

The new 20 x 20 watt Stereo Amplifier incorporating the latest silicon transistor solid state circuitry. The RTV-C VISCOUNT IV gives you a powerful 20 watts RMS per channel into 8 ohms. Superb finish—fitted cabinet with simulated teak finish, and fitted with quality 8” speaker, maximum power handling 7 watts, impedances 8 ohms nominal, magnet size 24”, approx., with 1½% parasitic tweeter.

**SYSTEM 2** £80.00

Vicount IV amplifier (As System 1a)

MP60 type deck (As System 1a)

Two Duo Type III matched speakers—Enclosure size approx. 24” x 13” x 11½”, Finished in teak finish, drive units 13” x 9” bass drivers and two 3” (apex) tweeters. 20 watts RMS, 8 Ohms frequency range — 20 Hz to 20,000 Hz. Complete system with these speakers £80.00 + £7.00 p & p.

**SYSTEM 3** £105.00

Vicount IV amplifier (As System 1b)

MP60 type deck (As System 1a)

Two Duo Type III matched speakers—Enclosure size approx. 27” x 13½” x 11¼”, Finished in teak finish, drive units 15” x 8½” bass drivers and two 3½” (apex) tweeters. 20 watts RMS, 8 Ohms frequency range — 20 Hz to 20,000 Hz. Complete system with these speakers £105.00 + £7.00 p & p.

**SYSTEM 4** £125.00

Vicount IV amplifier (As System 1b)

MP60 type deck (As System 1b)

Two Duo Type III matched speakers—Enclosure size approx. 27” x 13½” x 11¼”, Finished in teak finish, drive units 15” x 8½” bass drivers and two 3½” (apex) tweeters. 20 watts RMS, 8 Ohms frequency range — 20 Hz to 20,000 Hz. Complete system with these speakers £125.00 + £8.00 p & p.

**EMI 350 KIT**


**EMI 350 KIT**


**EMI 350 KIT**


**EMI 350 KIT**


**EMI 350 KIT**

PUSH BUTTON CAR RADIO KIT—THE TOURIST TT

NOW YOU CAN BUILD YOUR OWN PUSH BUTTON CAR RADIO!
This construction kit comprises a fully built and aligned R.F.I.F. module. Printed circuit board, with ready mounted integrated circuit output stage, and all other components. The push button tuning mechanism is fully built and tested ready to mate with the printed circuit board. (Once it is assembled.)

NOTE: No test equipment is required for alignment.

TECHNICAL SPECIFICATION
(1) Output 4 watts RMS output. For 12 volt operation on negative or positive earth. (2) Integrated circuit output stage. Pre-built three stage IF Module. Controls volume manual tuning and five push buttons for station selection. Illuminated tuning scale covering full, medium and long wave bands. Size chassis 7" wide. 2" high and 4 1/2" deep approx. Speaker including baffle and fixing strip £1.80+50. p.d. Car Aerial Recommended - fully retractable £1.45+40. p.d.

STEREO CASSETTE TAPE DECK KIT

Kit comprises of ready built cassette tape transport mechanism. Featuring pause control, solenoid assisted auto-stop. 3 digit tape counter, belt driven balanced flywheel. DC motor with electronic speed control, ready built and mounted record/ replay PC board, and two VU meters, power supply. PC board, mains transformer, input and output sockets and two level controls. Specification power source 240V 50Hz. Output more than 0.5v input mike - 55dB. 10Kp. DIN - 47dB. 10KΩ. Track system 2 channel stereo record play back. Tape speed 4.8CM/SEC. Frequency response 50-12000 Hz sensing signal to noise ratio - 42dB. Recording system AC Bias. Erasing system AC erase. Bias Frequency 5/7KHz. Size of mechanism 8" x 5" x 3½" approx. Unit easy to mount into your cabinet 3" required to clear base of mechanism approx.

NEW PRODUCT

DISCO 35 MONO AMPLIFIER
An ideal general purpose 35 watt monaural amplifier with full mixing facilities. Suitable for DISCO. PUBLIC ADDRESS & GUITAR MUSICAL INSTRUMENTS. Unit is fitted in an attractively styled veneer cabinet. 4 inputs: DISC 1 & DISC 2 (BOTH FOR CERAMIC CARTRIDGES), tape and record controls. All input and volume controls are fitted with integral switches, push button type. DISC 1 & DISC 2. Volume combined treble filter. TAPE: Volume combined bass booster switch. MASTERS: Volume control combined Mono. MIC: Volume combined bass booster switch. INDEPENDENT Bass and Treble Controls.

TECHNICAL SPECIFICATION

BUILD YOUR OWN STEREO AMPLIFIER
For the man who wants to design his own stereo - here's your chance to start. With Unisound - pre-amp, power amplifier and control panel. No soldering - just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120v AC (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion at the audio output. 240V AC. AC only.

INCORPORATES: Pre-Amp with twin mixing facilities, including switched input for mix with volume control, switched input for auxiliary with volume control, bass and treble controls, volume control and binaural control for turntables. Two B.S.R. MF80 type single phase professional series decks, fitted with crystal cartridges.

8 TRACK HOME CARTRIDGE PLAYER

Elegant self selector push button player for use with your stereo system. Compatible with V_SOURCE IV system, Unisound module and the Stereo 21.

SPECIAL OFFER
As above but complete with build yourself Unisound Amplifier Kit (see opposite page) + 2 'Compact' easy to build speaker kits (see opposite page).

PORTABLE DISCO CONSOLE

All prices include VAT at current rates
Mail orders to Acton, Terms C.W.O. All enquiries stamped addressed envelopes. Goods not dispatched outside U.K.

DO NOT SEND CARD
Just write your order giving your credit card number

WARNING: This equipment has been designed for indoor use in a domestic environment. It is not suitable for use in damp areas such as bathrooms, kitchens or cellars.

21C HIGH STREET, ACTON, LONDON W3 6NG
323 EDGWARE ROAD, LONDON W2
Personal Shoppers EDGWARE RD: 9 a.m. - 5.30 p.m. Half day Thurs ACTON: 9.30 a.m.-5.30 p.m. Closed all day Wed.
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**PERMEABILITY TUBES**

M.W. two stage ideal for use with ZN14 or similar circuit. Price £1 each, 50p post and VAT.

**Mains Transistor Pack**


**Light Pipe**

A mains operated travelling light array 24ft, long to use 120 miniature bulbs which flash to sequence to make hands of light move along the tube. The tube can be shaped around various objects, and can be made to attract attention—complete kit consists of—240 pieces of trunking, 8 main pipe and 8 yards multicore cable—motorised switch—mains supply. For quick connections and moving. Price £2.50 each. Price £4 for the complete kit. Price £9.50 post and VAT.

**Honeywell Programmer**

This is a drum timing device, the drum being calibrated by equal divisions for switching purposes with trip which are individually adjustable. All circuits are arranged to allow 2 operations per switch, per rotation. There are 15 changeover micro switches each of 1 amp type per rotation. These are so arranged that 15 circuits may be changed per revolution. Every motor is mains operated and 6 per min. Some of the many uses of this timer are: Machinery control. Battery charging. Dispensing and vending machines. Display lighting. Announcing and Signalising. Price from makers probably over £2 each. Special offer price £9.60. £1.09 Post and VAT. Don't miss this terrific bargain.

**Breakdown Unit**

Contains hundreds of small parts some of which are as follows—66 silicon diodes equivalent 3201, 69 resistors, mostly 1 watt 1% wound to cover a wide range of values 4 x 1 mil precision 18 x 0.1-1 mil precision 150 V.D. condensers, 3 x 150 microf. Toft caps 8 x 59 valve holders, 1 x 10 Weston, 1x 1430 transformer, 1 x 2000v. containing 4 delay lines also tags, brackets, etc., on a useful chassis plate sized approx. 3" x 3" x 1" Only 75p. The 66 diodes would cost at least 10 times this amount. If you are a skimp it is a snip not to be missed. Price £9.50 VAT.

**This Month's Snip**

**Power supply made by Bush Radio**

A PS80/PS90 battery charger for use with the new Bush PS90. Offered as this month's snip £8.95. Price £9.50 and VAT.

**Windscreen Wiper Control**

Switch to fit your wiper to suit conditions. All parts and instructions to fit in box plus 50p post and VAT.

**Sound to Light Unit**

Add colour to your amplifier. Will operate 1, 2 or 3 lamps (maximum 40v) at 7v. £5 6v. in box not ready to work. £7.95 plus 50p VAT and postage.

**Spit Motor**

200-220v induction motor driving a Carter gearbox with a ratio of 17 to 1, runs at 5 r.p.m. for regular postbox—drives window motor—windshield coloured disc lighting effects. £15.95 plus 50p post and VAT.

**Oven Thermostat**

More reliable than the old method. The Company, this has a sensor joined to a capillary to a variable control and when the thermostat is ideal for many ovens or processes, 50p each plus post and VAT 12p.

**Mains Transformers**

All standard transformer types

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<th>0.15p</th>
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