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VOL. 52 NO. 7
ISSUE 837
NOVEMBER 1976

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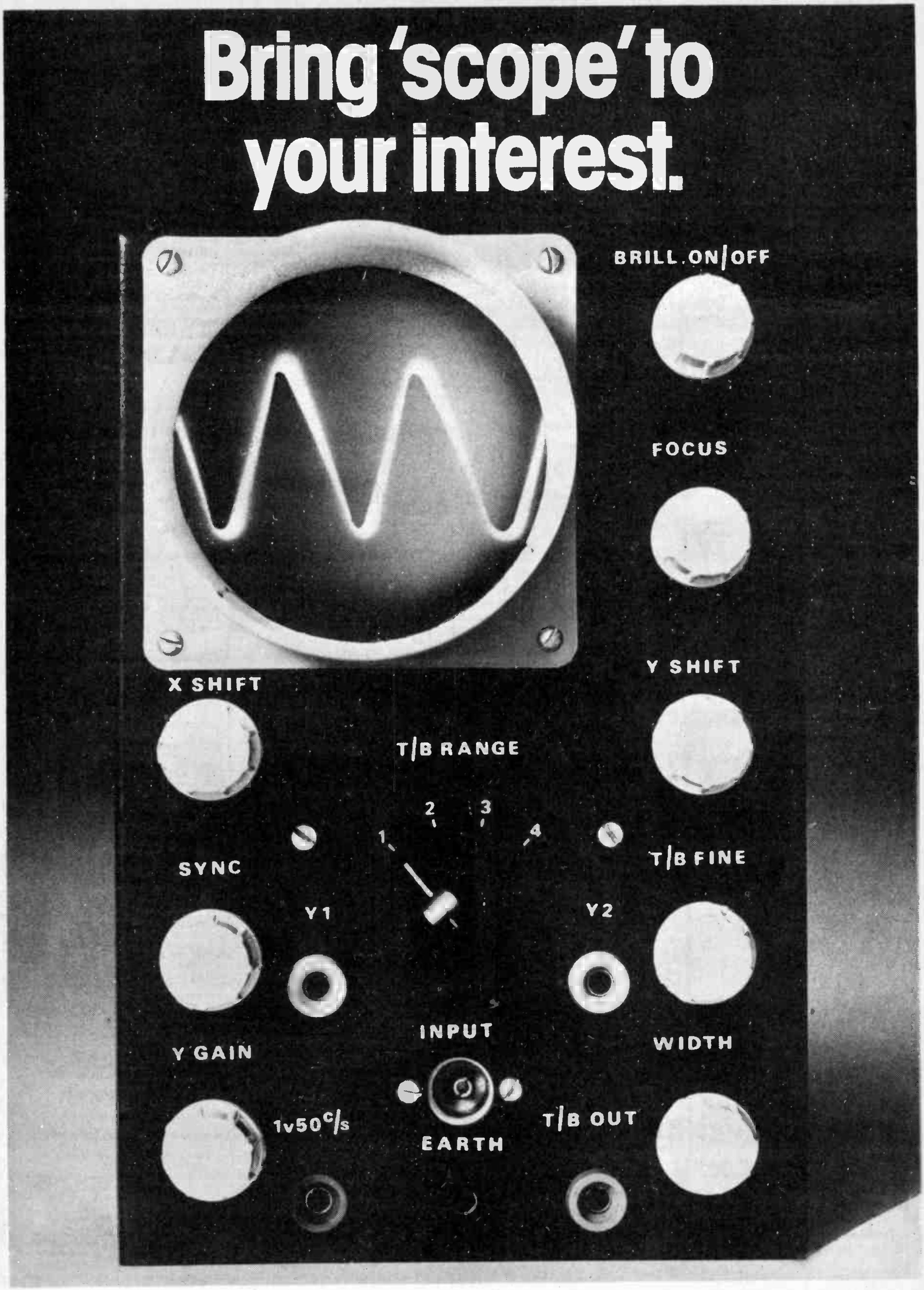
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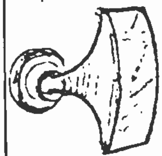

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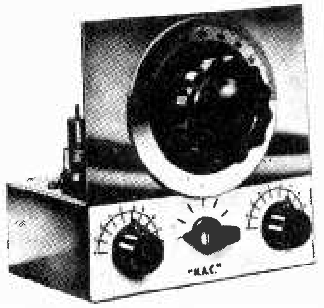

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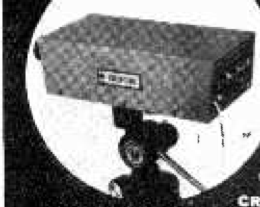

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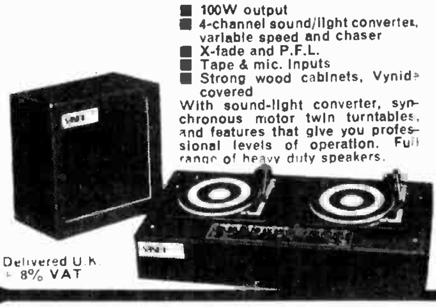

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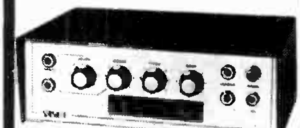

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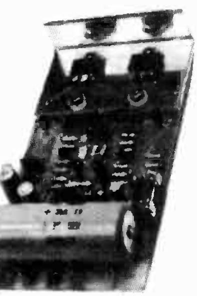

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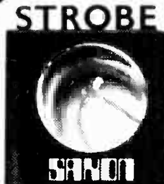

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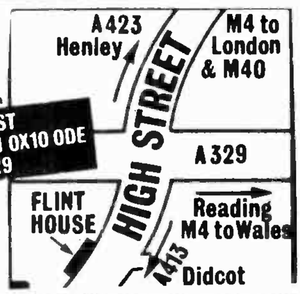

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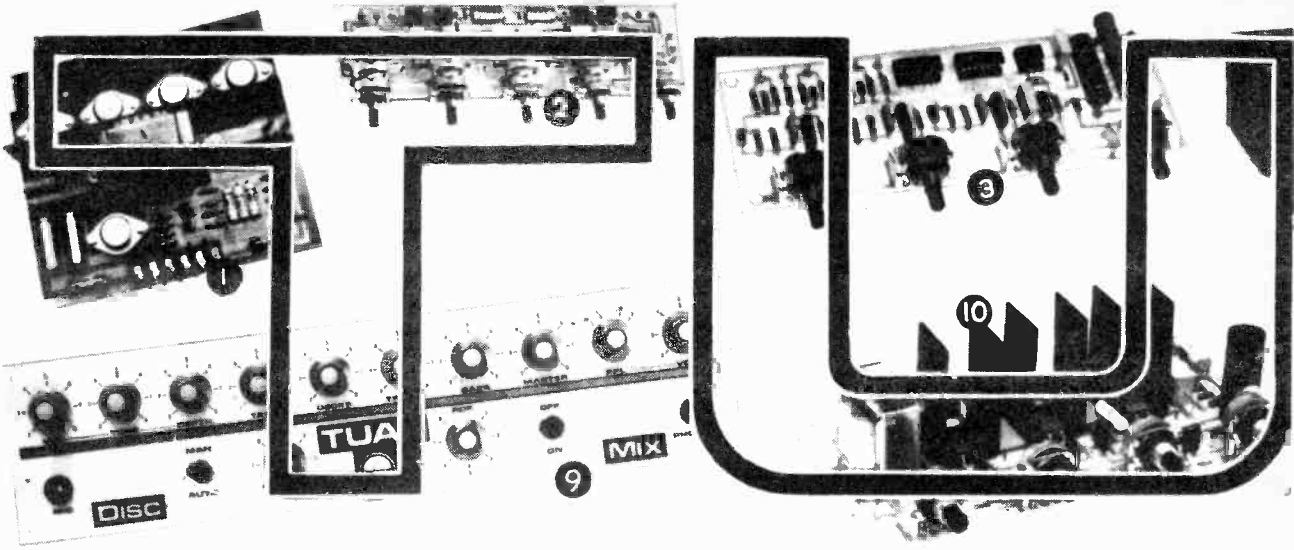

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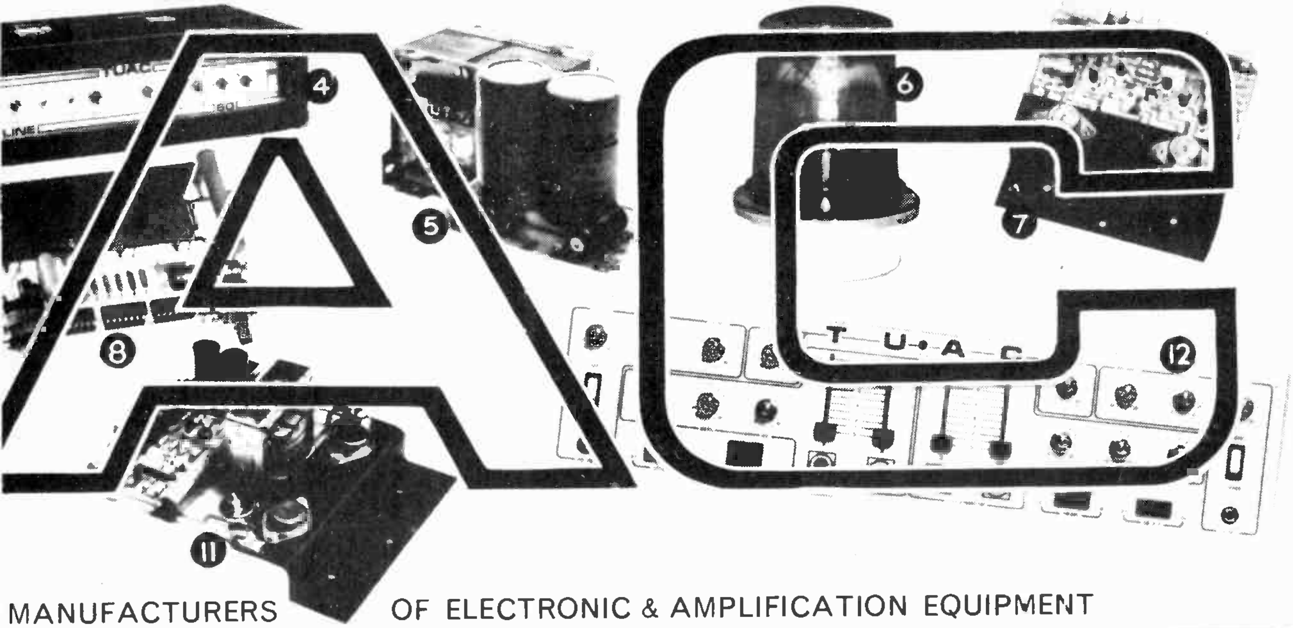

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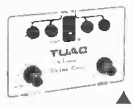

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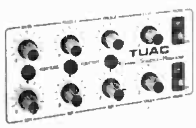

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Big Brother watches

SOME years ago, the BBC broadcast an intriguing play called, "Rossum's Universal Robots". These creatures had been designed by man, manufactured by man, for the service of man. They did all the menial tasks; house-keeping, cooking, cleaning, shopping etc.

But after a while, one robot said to another, "There's more of us now than there are of them." And so, like all good revolutionaries before them, the robots took over. Once in command, they became superior species and all mere humans were reduced to second-class citizen status.

The computer is an equipment, a kind of robot; designed by man, manufactured by man, for the service of man. There are lots of them about. Certainly not "more of them than there are of us" but . . .

In their electronic, unfailing, frighteningly accurate and detailed memories, data about you, me, him, she, them—everybody, is building up.

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Many people, both in the computer industry itself and outside it are asking just how far things are likely to go. Is there really a danger that, like Rossum's Universal Robots, the computers could take over?

Computer programmers (amongst others) often counter this suggestion by observing that the computer is the servant. Man provides the input and receives the output. It also requires man to interpret the output.

The argument has a certain truth and validity. Yet it is also true that the computer will play a major role (if not *the* major role) in the future development and, perhaps, in the ultimate destiny of the human race.

It is being used increasingly to "advise action" for many problems having first devised a solution. The "robot" offers its logical conclusions from the input data. The output is seldom questioned and decisions are based on this logical output—an output devoid of all human feeling and reduced to some cold, algebraic hypothesis.

The computer can store colossal amounts of information. In a police state this would prove useful or disturbing depending upon where you stood in the scheme of things.

Is there not an indication, too, that we could become so dependent upon the computer that to all intents and purposes we will be a slave to it and not the reverse?

Have we not seen this indication already in the field of electronic calculators? These are now commonly appearing in schools. The danger is that we no longer bother to add, subtract, multiply or divide, the "robot" in our pocket does all that for us. Ask anyone who uses an electronic calculator regularly, and they will admit that they use it even for the simplest of calculations. We are already a slave to one form of robot.

With the advent of microprocessors, desktop computers, new technologies and techniques developing all the time, there must surely be a case for caution or at least for a rethink and appraisal.

At Baglan Bay, in Wales, computers control and virtually run a gigantic chemical plant. Not only does the computer control individual valves, chemical processes etc, but it also operates an alarm system. If anything goes wrong the computer will immediately and automatically effect the best means to keep as much of the equipment working as possible and will shut down only the minimum of plant so avoiding hindrance of production as much as possible.

In between its millions of individual tasks of monitoring and instructing, the computer will fire a series of special signals round all its sensors and circuits to automatically check that it—the computer itself—is functioning correctly at all times. It is self-diagnostic.

Now imagine suddenly removing the computer from Baglan Bay and making man work the plant. The result would be chaos and probably failure because the whole complex is run and has been designed to run from a computer.

In the future our way of life is moving more and more towards dependence upon the computer. All the computers need do is to simply stop working—and we're dead.

The more reliance we place on computers, the more we use them, then by definition, the more we are dependent upon them. It is the slow, unsuspecting, tender trap and we're walking right into it.

Remember, too, that the "thing" (whatever it is) that controls need not assume human form just to please our visual satisfaction. The power behind the throne could just as well be a black box—possibly drawing its power from light and/or radio activity thus making sabotage impossible.

What about those UFO's or anyone else who wanted to take us over. All they need do is conquer our computers and they've got us!

What man does with the computer is now a major consideration. A crossroads has been reached. The computer is destined to be developed far beyond most people's wildest imagination. The final outcome will dominate our entire way of life.

Think about it—while you're still able!

LIONEL E. HOWES—*Editor.*

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

Mail Order Protection Scheme

THE attention of all readers is drawn to the details of the Mail Order Protection Scheme published on page 606 of this issue. We shall publish it again from time to time.

Please note that for the purposes of this scheme, mail order advertising is defined as:—"Direct response advertisements, display or postal bargains where cash had to be sent in advance of goods being delivered". Classified and catalogue mail order advertising are excluded.

Super Service

VERO ELECTRONICS LIMITED have announced the inauguration of their Verospeed Service Division. They undertake to despatch all written orders on the day they are received and a telephoned order before 3 p.m. will still get the goods in the post that evening.

The products in this service have been carefully selected from the most popular ones in the Vero Electronics range to enable R & D prototyping to be carried out with the same products which can be obtained in production quantities at production prices from Vero Electronics Limited themselves. The prices for components are quoted in the catalogue and there is no extra charge for postage and packing. Vero also state, that there is no minimum order surcharge. Vero Electronics Ltd, Industrial Estate, Chendles Ford, Hants. Tel: 04215 2956.

Solar on show

JUST a short note for those who enjoy a good exhibition, albeit one that has little to do with wireless. It appears that the Midlands is slowly overtaking London, when it comes to staging spectacular shows, and the latest, The International Ideal Home Exhibition, promises to be no exception.

To be held at the prestigious National Exhibition Centre, Birmingham, the theme of the show will be the "Family". On show will be three fully-furnished homes, a solar energy house, a theatre with cookery, Hi-Fi, TV, photography, fashion shows and personal appearances by stars of the entertainment world.

The Solar House being shown is equipped with solar panels to heat domestic water, is fully insulated to the latest standards, and equipped with the latest energy saving devices. To back up this new form of energy, researchers claim that for the average family, 50 per cent of the total energy used is for hot water and the sun can provide 70 per cent of this.

For those wishing to attend the Exhibition will be open for two weeks from Thursday, 14th October to Saturday, 30th October.

Catalogues for all

DORAM ELECTRONICS LIMITED, one of Britain's leading mail-order distributors of electronic components, construction kits and accessories have published a new 'Edition 3' catalogue priced at 60p and a new construction kit brochure priced 25p. Should customers order both publications together, Doram are offering a special price reduction of 15p so customers only pay a total of 70p. In addition each customer will receive two 25p vouchers which may be used at any time, as a refund, when placing orders with Doram.

A special feature of the main catalogue is that during the life span of the catalogue customers will receive, absolutely free, update amendment leaflets giving information on new lines and price changes.

Many new products have been added at the request of customers which include an extension to Doram's range of NPN, PNP, Unijunction and Field Effect Transistors; a Constant Current Charger and Rhythm Generator IC and 2m mobile aerials. In addition to the main catalogue Doram have published a fully illustrated brochure containing information on no less than 26 new "easy-to-construct" kits. Doram Electronics Ltd., PO Box TR8, Wellington Rd, Industrial Estate, Wellington Bridge, Leeds LS12 2UF.

Quad from the Beeb

ACCORDING to a BBC statement, no commercial quadraphonic matrix system so far broadcast has achieved international acceptance. The statement continues by saying that not only is the present array of quadraphonic techniques unacceptable, but by and large, they don't match up to the standard achieved by BBC VHF radio.

Further to these findings, the BBC Research Department has developed a new matrix system which has already undergone rigorous tests and comparisons with other systems already known. The tests are claimed to have been judged by panels of engineers, acoustic experts, musicians, and producers of all types of radio programmes. The findings of these tests on this new type of transmission, known as "Matrix H" are said to be very favourable and that the system is far superior to anything yet tried. "Matrix H" has also been found to combine excellent compatibility with very good quadraphonic reproduction.

The present BBC stereo distribution network it is claimed is capable, without modification, of carrying "Matrix H". However, the extension of BBC VHF radio services and stereo throughout the UK remains the first technical priority and unfortunately, no regular quadraphonic service is envisaged at present.

DISCOS AND ASSOCIATED AUDIO SYSTEMS

BEN DUNCAN

THIS article is intended to help the amateur design and build good high powered audio equipment for discos, groups and PA applications. (Abbreviated to D. G. and PA throughout this article.) Two basic factors predominate:

1) Good reliability. Most group, disco and PA, (G. D. and PA) equipment is used publicly, and breakdowns can be embarrassing at the very least. Also, such equipment is generally under infinitely greater stress than domestic equipment, which is rarely, if ever, run flat out for any length of time.

2) Inherent robustness. G. D. and PA equipment is generally subject to poor physical treatment.

Unfortunately, I know from experience that some constructors and manufacturers use domestic design philosophy for this class of equipment. Reliable equipment is based on good, simple designs, built of top quality components, using generous overatings at points of stress. Such excellence is expensive, but repays the owner a thousandfold in the long run. **IT IS ABSOLUTELY FALSE ECONOMY TO SKIMP.** The fundamentally commercial aspect of the uses of G. D. and PA equipment eases the higher expenditure involved, and in any case, sheer enthusiasm for loud music make it a worthy sacrifice to many.

In the past, G. D. and PA equipment has lacked sound quality, but there is no longer any technical reason why fundamentally Hi-Fi reproduction should not be possible.

Another factor is versatility. For G. D. and PA applications are broadly similar and it is logical to design a system that will either serve all three purposes and/or is readily convertible for alternative applications (Fig. 1). Consistent with this aim, nothing specific is described in the following text.

Power amplifier

High power amplifiers, until recently, had been a very acceptable stronghold of valves. However, second generation power transistors make all valve equipment technically obsolete. Only the elusive **valve sound**, beloved of some guitarists, makes the valve a must for a dedicated few.

The relationship between power output and actual loudness is commonly misunderstood. Reference to Fig. 2 shows that for a given volume of space, the output wattage must be multiplied by ten to double the loudness. Thus 100W is only three times louder than one watt. Careful consideration of this graph, and the cost of loudspeakers, shows the optimum power to be around 70/100W. Outdoor PA and (noisy) groups may need higher powers, and 300W would be needed for any worthwhile (50%) increase in loudness. Note that 300W is half as loud as 1,000W and **NOT** 500W as is commonly supposed.

Heatsinking and ventilation must be superlative for the sake of reliability, even if the output transistors run coolly on music and voice signals. The rough sine and square wave inputs derived from synthesisers, guitars and organs can cause rapid overheating and dissipation may well exceed peak

SPECIFICATION	DISCOTHEQUE	GROUP	PUBLIC ADDRESS
Power output (watts RMS)	25–100	25–1000*	50–1000*
Distortion (THD at *max.* rated output, 1kHz)	10%	10%	10%
Hum and noise—suggested level.	−100dB	−100dB	−100dB (min)
Phono input	Ceramic (Two)	—	Ceramic
Tape input/output	Pre-recorded effects and jingles	Reverb & pre-recorded effects	Pre-recorded speech & music
Microphone input	Dynamic	Dynamic (several)	Dynamic, Crystal
Other inputs	—	Guitar (several) Synthesiser, Organ	—
Specialities	Monitoring, stereo, autofader	—	—

* The wider range is accounted for by indoor v. outdoor usage.

Fig. 1 : Typical specifications for G.D. and PA applications with suggested standards to aim for. From these a composite specification may be obtained.

output power. Apart from overheated output stages, the transformer may overheat unless conservatively rated, due to the heavy load these signals will impose upon it. In order to effect cooling, heat is dissipated in three ways: (1) Conduction, the heat spreading out through the chassis, if of metal. (2) Convection, whereby cool air, in cooling a heatsink, becomes warm, and in rising, draws a fresh supply of cool air in, from underneath it. (3) Radiation. Heat is emitted directly from a heatsink. Matt black surfaces emit (and absorb) heat best. Heatsinks are best mounted inside an amplifier, as there is always the danger in externally mounted heatsinks that the live transistor casing may be shorted to chassis; a sure recipe for disaster.

Thermal resistance

Where the transistors are in contact with the mica washer and heatsink, these joints should be smeared with thermal conductivity compound. Silicon grease is an inferior substitute. All metal from which heat must be able to radiate freely should be painted matt black. The capacity, or thermal resistance of a heatsink is measured in °C/W and is determined as follows: There are generally three thermal resistances (Ø) to be taken into account. These, when added, together with the ambient (room) temperature give the actual transistor junction temperature, the maximum value of which, (T_j Max) is ascertained from data books. Dissipation is always assumed to be 100 per cent of the transistor's power output, though in reality it is usually closer to 50 per cent, thus giving an overload safety factor of 100 per cent.

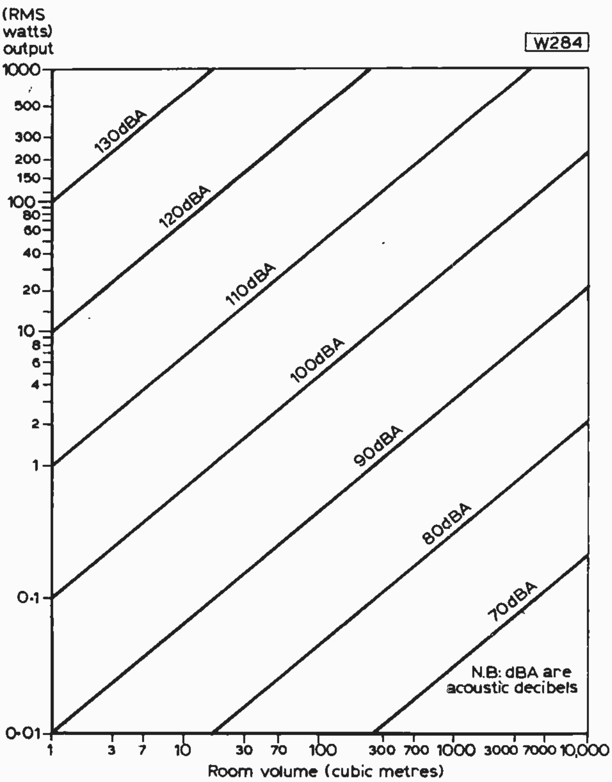

Fig. 2: Straight line graphs showing the relationship between loudness, wattage and room volume. An increase of 10dBA represents a doubling of the loudness. Also one acoustic watt is approx. 120dBA @ 1 metre, and 10W is approx. 130dBA @ 1 metre.

Typically, $Ø_1$ (junction to casing) ...... is 1·0°C/W
$Ø_2$ Across mica washer) ...... is 0·5°C/W
$Ø_3$ (Heatsink; Area and mass of sink are the basic factors) is (say) 1·5°C/W

Then $Ø_1+Ø_2+Ø_3=3$°C/W. Thus the junction temperature of a transistor, driven at 25W, mounted on a 1·5°C/W heatsink with a mica washer, would be (3×25) 75°C, plus ambient temperature (T_{amb}) (say 25°C)=100°C. Similarly, to calculate the required capacity of a heatsink,

$$Ø_3=\frac{(T_j\max - T_{amb})}{W} - (Ø_1+Ø_2)$$

W being the dissipation in watts of the transistor.

Lead lengths

It is highly inadvisable to mount preamp circuitry within the casing of a power amplifier. Apart from reducing versatility, it makes high frequency instability almost certain in many cases. Any oscillation in these circumstances is likely to be of a very high order and pass unnoticed, the only symptoms being overheated components. Any input level above 200mV is satisfactory, but in any case, input wires must be kept well away from the output stages and under no circumstances should input and output wires be run parallel at less than 60mm distance. If it is necessary for input and output wiring to cross over, minimal interaction is achieved by placing the wires mutually at right angles.

A low input impedance (600Ω) allows long input cables to be used without undue signal loss. However, high impedance inputs are more versatile as all lower impedances may be fed in without loss of quality. Thus provision of both low and high impedance inputs is suggested. The latter is tapped off a low impedance input by addition of a series resistor of a value corresponding to the impedance required. Naturally, there is some signal loss.

Electronic overload protection circuitry is ideal for G. D. and PA equipment, but is necessarily complex to be effective. Therefore low tolerance fuses are the most common form of protection, and are relatively satisfactory. These fuses are simply rated at just above the average peak current, whether in the speaker or power lines. A double throw switch, wired to two fuses allows rapid changeover to a reserve fuse in the event of an exceptional peak blowing the first. If, however, there is a genuine fault, the reserve fuse will blow, and in so doing, confirm this.

Loudspeakers

Good bass response is essential in this type of equipment, with 70Hz being a maximum satisfactory frequency. Bass response below 30Hz however, due to turntable rumble and LF acoustic feedback, and treble response above 10kHz, due to inevitable scratch and hiss on disco records is unnecessary. Most high power speakers tend in any case to be **bass heavy** and few extend beyond 10kHz.

It is essential when choosing speakers, to match both speaker and amplifier powers in RMS *or* peak ratings, and never to compare music ratings, as these vary from 20 per cent to 100 per cent above RMS, depending on the method of measurement. 100W RMS=200W peak=200W USA=120−200W music power = 150W IHFM! If a speaker is to be used exclusively with voice and music signals, a 20 per cent overload factor is recommended for the speakers. That is, for a 100W system, the speaker rating(s) should total 120W. Some speaker manufacturers significantly underrate their speakers and this possibility should be checked with the manufacturer. For example, a speaker with a nominal 100W rating, could be safely fed using a 100W amplifier with *all* types of signal input. If the roughly sine and square wave signals from synthesisers, organs and guitars are to be handled, a 50 per cent overload factor is considered mandatory. A significantly lower overload factor may result in premature speaker failure or burnt out voice coils. It is not unknown for speaker cabinets to catch fire!

Multiple speakers

In high power systems, it is rare to use a single speaker, and units over 100W are not commonly available. With 100W say, two 60W speakers could be used, giving a 20 per cent overload factor. Whether they are wired in series or parallel depends on the required impedance. The wattage rating of each speaker being simply added, provided they are of the same impedance, or if they are of differing impedances, they share the power according to the inverse ratio of their impedances, given that the total impedance matches the amplifier. This applies only to second generation (Constant current source) power amplifiers, the power dissipated being inversely proportional to the loudspeaker impedance, due to the ultra-low source impedance. Use of several speaker cabinets, instead of mounting several speakers in one cabinet allows sound to be evenly distributed with greater ease.

Cabinet design

Designs specifically for G. D. and PA applications are rarely met, but sensible uprating of a HiFi enclosure design is satisfactory. Here is a summary of cabinet design points: High density chipboard is suitable, and the thicker the better is an ideal maxim as long as it is not carried to extremes. A thickness of 18mm is suitable for most enclosures. Chipboard is easily damaged as are most materials if on the road. A solution is to build a framework of angle-girders around the cabinet, joined together with wing nuts. Its effect is to make enclosures virtually indestructable. Cabinet dimensions should be rectangular and as large as possible.

Bass reflex cabinets should have both their height and width greater than the speaker cone diameter, with a depth which is greater than a third of the width. Infinite baffle cabinets should be totally filled with tightly packed acoustic wadding. Bass reflex cabinets require lagging of some 6mm thickness on any three non-parallel walls, and only proper (acoustically transparent) speaker cloth should be used, eg "Tygan".

Bass reflex cabinets have a reputation of being difficult to get good results from. In my own experience however, no particularly arduous calculations or long hours spent tuning the reflex vent were engaged upon. The mere cutting of a correctly sized vent, obtained from tables, gave vastly improved and eminently satisfactory response. In the bibliography, books (2) and (6) give details of bass reflex cabinet design.

Speaker efficiency

The efficiency of a speaker is simply how many acoustic watts output compared to how many electrical watts input and is expressed as a percentage. At about one metre, one acoustic watt is about 120dBA, ten acoustic watts are 130dBA, and so on. Thus, if 10W drove 10 per cent efficient speakers, the loudness at one metre would be 120dBA, or a power of one acoustic watt would be emitted from the speaker. Efficiencies of reflex systems are generally between 5 and 15 per cent, and infinite baffle enclosures, between 4 and 8 per cent. These efficiencies are far higher than those normally encountered in domestic audio, and are due to the physical size of the speaker units.

If cabinets carrying the same signal face basically similar directions, the speaker cones must move in phase for good results, and vice versa for cabinets facing basically in opposing directions. Speaker terminals are usually marked with relative polarity and it is wise to see that all connectors in the loudspeaker line are coherently encoded for like polarity. For parallel connections, like terminals should be joined, and for series, oppositely marked terminals should be connected.

Cable types

The use of $1mm^2$ cable, as used for domestic permanent wiring, is recommended for speaker systems employing lengths below ten metres. The current capacity of this cable is 10A, and applying

$$I = \frac{W}{R}$$

Where I is average current, W is RMS output wattage, R is speaker impedance, it can be calculated that this cable is suitably overrated for most systems, up to, say, 150W (depending on the speaker impedance). This unused capacity is not wasted. Boomy bass, if not caused by poor acoustic damping can be attributed to poor electrical damping, due to too high a source impedance. For this reason, always run individual wires back to the amplifier for speakers in parallel and always use parallel connections in preference to series ones to keep the resistance between each speaker and the amplifier as low as possible. Long runs of fairly thin cable, exhibiting a relatively high impedance are also responsible for this. Use of the specified heavy cable will avoid serious loss of damping for lengths up to 20 metres, but PA often requires greater lengths. The usual solution is to use a line transformer to step up the impedance and voltage (typically to 25 or 100V), hence reducing the current and allowing long runs of thinner cable to be used, with minimal power loss. Special high impedance speakers are then required, or a second transformer to step down. Good line transformers are expensive and frequency response is bound to suffer, especially at the bass end. This is not unduly serious in PA work, but to say the least, bass is desirable for group concerts! The solution is to use $2{\cdot}5mm^2$ cable, of 20A rating, which is suitable for ultra high power systems, and exhibits extremely low impedance; thus long cable

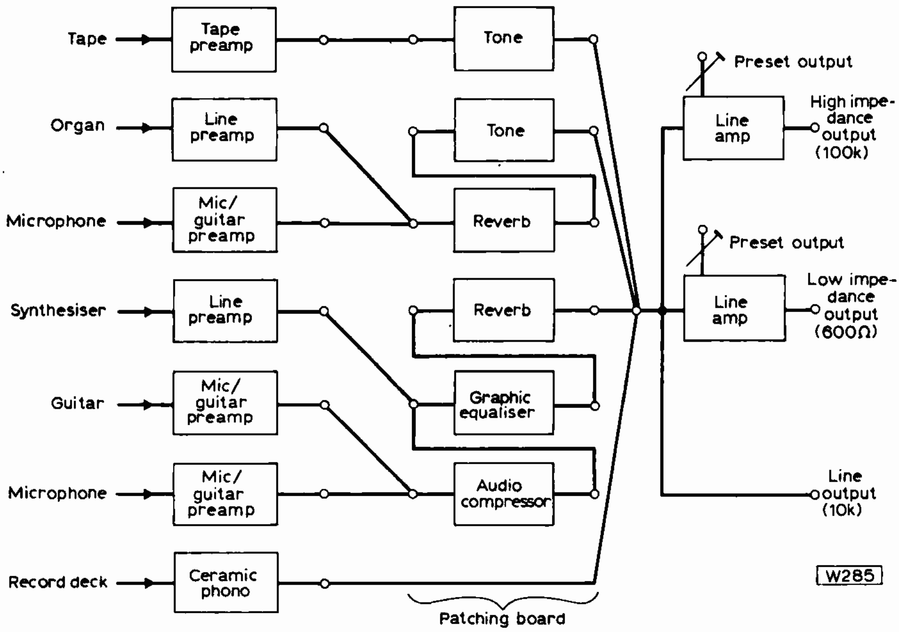

Fig. 3: Block diagram of a versatile group pre-amplifier, shown here with a typical arrangement patched in.

runs up to several hundred metres are practical. The cost of this cable, given that all cable is expensive today, is relatively low, and compared with the cost of line transformers, is trivial! 2·5mm² is of the order of £12 per 100 metres, and the smaller sizes, suitable for medium power systems, are correspondingly cheaper.

The pre-amplifier

The preamp determines the overall versatility of a system of this nature. Maximum versatility is obtained by providing preamps to handle all likely signal inputs, and for these to have a common output voltage and impedance (Termed "line level"). Tone controls and any effects units required can be simply inserted in series with the line, provided they have unity gain and match the line level. F. C. Judd described a system utilising this principle in *PW* some years ago, using a line level of 100mV at 10kΩ. The article is highly recommended, as it contains preamp circuitry for all common signals, though it would not be difficult to design circuitry using IC's.

The line level is raised after mixing to a suitable voltage for feeding power amps, generally between 100 and 1000mV. A preset output of one volt at 600Ω will feed satisfactorily into most amplifiers. Several of these are useful for feeding additional amplifiers, driving sound/light convertors, etc. The preset allows the line to be matched to the power amplifier, thus preventing damage and distortion from overloading. Fig. 3 shows a block diagram preamplifier employing patching, for group and PA use. A patch board is easily made, as only single pole connectors are necessary, there being no need to patch the earthy side.

Fig. 4 shows a preamplifier in block form for a disco. Line inputs can provide additional signals, from say, tape or phono sources. Note that the cross fader must be ganged log/antilog. The monitor signal is derived before the mic signal is mixed in, to avoid acoustic feedback via the headphones. The monitoring allows accurate cueing and control of the music signal sources, and thus the mic signal is superfluous. A 2W amplifier may seem extravagant for headphones, but power of this order is necessary when surrounded by, say, 110dBA of ambient noise. However, the resistor 'R' is determined so that at maximum volume, the level is safe for short term listening, though not necessarily comfortable! The autofader is an attenuator that reduces the music signal at a preset speed to a preset level when the microphone is used. "Fader on/off" shorts the autofader, allowing normal mixing of music and microphone signals. The line interceptor allows audio effects to be added, and when in the 'off' position (input and output terminals shorted), provides two extra line outputs, which are available for taping, monitoring or linking with another preamp.

Ceramic cartridges are ideal for disco use, in that they are robust and free from hum pickup problems, yet give good quality and can be safely used on high tracking weights (5g) to prevent the tone arm jumping.

Dynamic (moving coil) microphones are tough and relatively unidirectional, thus reducing the probability of acoustic feedback. They are eminently suited to all G. D. and PA applications.

Don't use vintage autochangers with tracking weights measured in ounces. These damage both records and styli, and lack the all essential cueing devices.

Interference

The potential for troublesome levels of noise and hum is high in these applications. Amplification levels are very high, and bass heavy speaker systems are bound to emphasise hum. The use of quality components throughout is a basic step towards noise reduction. Carbon film, or better still, metal oxide resistors are recommended. Wrongly polarised or leaky electrolytics can be noisy while occasional cleaning of slider tracks and audio connectors with switch cleaning fluid is helpful. Freezer aerosols aid location of noisy components.

Hum is usually capacitatively picked up from stray AC fields. The solution is to totally screen all internal wires carrying any AC currents, whether they be signal or mains currents. Directly radiated RFI will also be eliminated by these measures. Be extremely careful not to create more hum with earth loops. Earth connections should be made once only so that a common earthing point is made using a 'spider' arrangement of solder tags, to prevent earth currents interacting and causing instability.

Hum pick-up

Inductive hum pickup is caused when two inductors interact magnetically, commonly a mains transformer and microphone transformer. This type of hum can be difficult to eradicate, and for this reason, magnetic cartridges and microphone transformers are best avoided for these applications—the latter is easily substituted for with a transistor matching preamp. If this is not possible, rotation of both inductors to find a point of minimal hum and maximum separation are helpful.

Instability, mains-borne RFI and RF pickup are all similarly dealt with by connecting a 100nF 1000V capacitor across the AC mains entry point and across the secondary transformer terminals. If the DC power line is longer than 150mm, connect 1000μF and 10nF capacitors in parallel. Add a series resistor of value 1-33kΩ as close as is practical to the base lead of all low-level silicon common emitter/collector configuration transistors only. Connect also a capacitor of 250-1000pF from base to emitter, again as closely as possible. Keep all wiring short, sliding extra earthed braiding stripped from coax TV cable over low-level screened input cables in difficult cases. All metal within a unit must be earthed, but once only, to avoid hum loops and instability.

Power supplies

Stabilised supplies are strictly unnecessary for use with a well designed power amplifier, especially when used with music and voice signals only. It is desirable to use an overrated transformer and large value smoothing capacitors (over 10,000μF), the former for reliability under overload conditions and the latter to eliminate hum and prevent HF instability. If the output of an amplifier drops excessively on the heavy signals previously outlined, then proper electronic stabilisation is advised, though large value smoothing capacitors and overrated transformers should also be used as a matter of course.

Bear in mind that for safety, all smoothing capacitors should be rated at 1·5 times the RMS value of the transformer winding, whatever the nominal voltage may be to which they are subjected. Also, large value capacitors can damage rectifiers with their initial charging current. In any case, the rectifiers should be overrated, more than the transformer, for they are less tolerant to overloading. If the transformer is 100 per cent overrated, and the rectifiers 200 per cent overrated, the power supply will survive most disasters!

Chokes can cure extreme cases of power supply

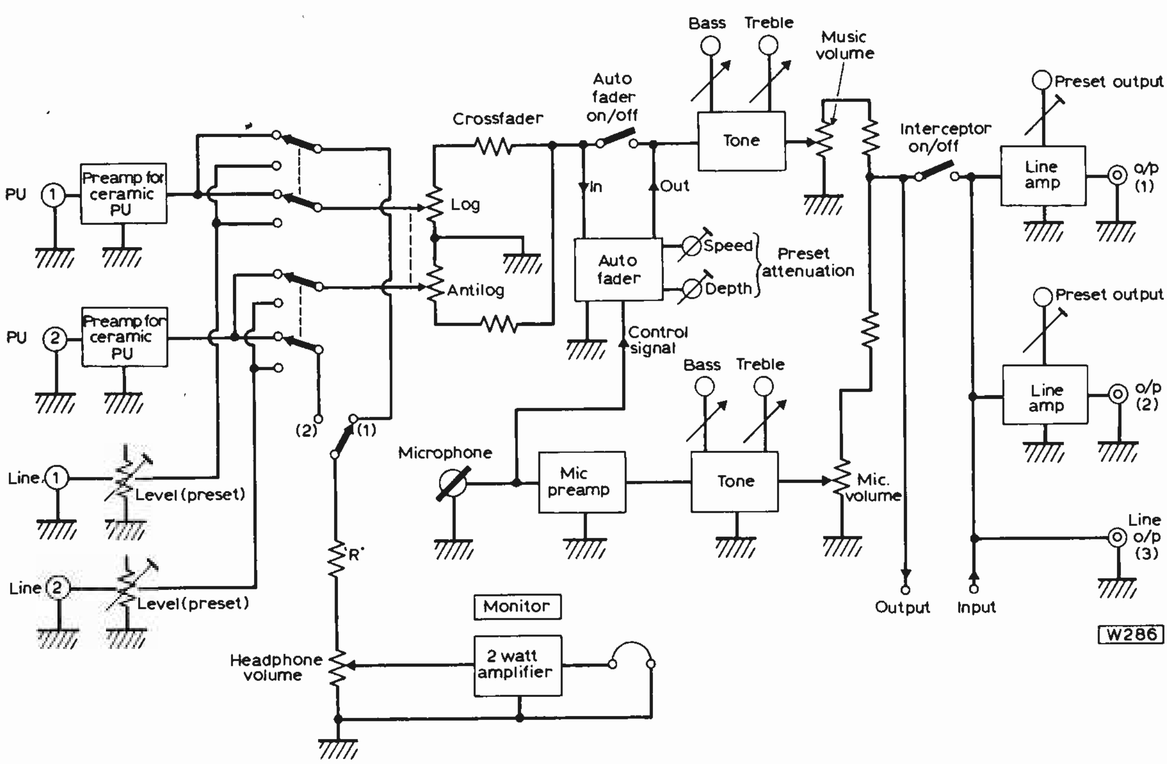

Fig. 4: Basic Disco pre-amplifier shown in block form. The Line inputs provide for additional input signals such as tape or phono.

hum, but should be screened and sited at least 150mm from other inductors to avoid transmitting inductively coupled hum along the power lines. The transformer must be well ventilated, and electrolytics should be mounted so as to remain as cool as possible. Ventilation slots in screening should not be in line with any non-screened circuitry, to avoid pickup of the leaking hum field.

Lighting

Between them, discos and groups use four types of lighting: Music modulated (Sound/light), random, strobed and gimmickry (Oil wheel, light pipes, etc.). It is worth noting here that it is dangerous to use strobed light for more than a couple of minutes and it must never be the dominant lighting. 9Hz or thereabouts is the most dangerous frequency and can cause epilectic convulsions, even in normally healthy persons.

Any design utilising external signal inputs must incorporate a quality isolating transformer for safety. For RFI suppression, chokes of the same current rating as the control devices should be close wired in series with the live terminal of these. These can be made of about twenty turns of suitable heavy wire wound on an insulated ferrite rod. Connect a 100nF capacitor across the mains supply, and keep all mains and audio wiring short and screened. Triacs are generally better than thyristor control devices, as they give full wave control, thus twice the lighting output of the latter. They may be directly substituted into many designs, though a diac must be added in series with the gate connection.

Bear in mind the massive current surge when lots of cold lamps, exhibiting a very low resistance, have mains current initially applied via the control devices. Rather than overrate these, an alternative solution is to connect a switch across them. Before using the unit, the switch is turned 'on', so as to short the devices, and allow the lamps to warm up and attain normal resistance. This switch can also be used to switch in full lighting.

Cable and bulbs

Electrical goods suitable for these applications can be obtained cheaply from wholesalers. 1mm^2 (10A) cable is suitable for most connections and is relatively cheap while rubber plugs and sockets, virtually indestructible, are essential for trailing connectors and extension leads. Low wattage bulbs (25-60W) are best for sound-to-light displays, where rapid response is essential, while the slower response rate of 100/150W spot bulbs is suited to strobe and random displays. Gelatine (Coloured, heat-resistant, plastic sheet, used for stage lighting) is indispensable, considering the astronomic cost and limited power of coloured bulbs. Though initially expensive its versatility is infinite, given a creative imagination, and it rapidly works out to be cheaper than coloured bulbs.

Miscellaneous

Though standard jack connectors are universally used in G. D. & PA applications, DIN connectors are useful for multiple connections, and provision of these and Cannon connectors would ensure compatability with Hi-fi and studio professional audio equipment, if desired. Jacks should not be used for speaker connections, as they cause a momentary short circuit on insertion, which may well be sufficient to blow a fuse. It also increases the likelihood of a microphone, for instance, being plugged accidentally into the speaker socket! 4mm connectors (Banana) are ideal for speaker connections, though care is needed to avoid shorting, they are cheap, extremely tough, of low impedance, and unlike DIN loudspeaker connectors, are single pole, thus reversible if neccessary.

Stereo is strictly unneccessary for disco systems, as apart from costing nearly twice as much as a mono counterpart, stereo separation on modern day singles is fairly poor, and few people at a disco would hear stereo separation anyway. On the other hand, discos are a lot to do with psychological impact, and effective multi-channel sound would be a welcome step.

Finally, I cannot overstress the goals of reliability, robustness and versatility, in that order. Bear in mind Murphy's law "If anything can possibly go wrong, it will"—and in the worst possible situation.

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Vagaries of VHF (Contd.)

Ron HAM F.R.A.S.*

WHEN it comes to propagation, June is a most unpredictable month; the only real certainty is that it is well into the sporadic-E "season" and that there will be disturbances to radio signals in the four to six metre bands. There is always a good chance (like this year) of fine hot weather, so, in June there should be days when the troposphere is "open", to answer the prayers of the 2m and 70cm DXers.

SOLAR ACTIVITY

At midday on June 16th, 1976, the writer recorded a small burst of radio noise from the "active" sun, and that was the first for a month and more evidence of the sunspot minimum. Maybe it was a good thing that it was "quiet" in June because there were enough other upsets to orderly radio communication without the sun stirring the pot up a bit more.

SPORADIC-E

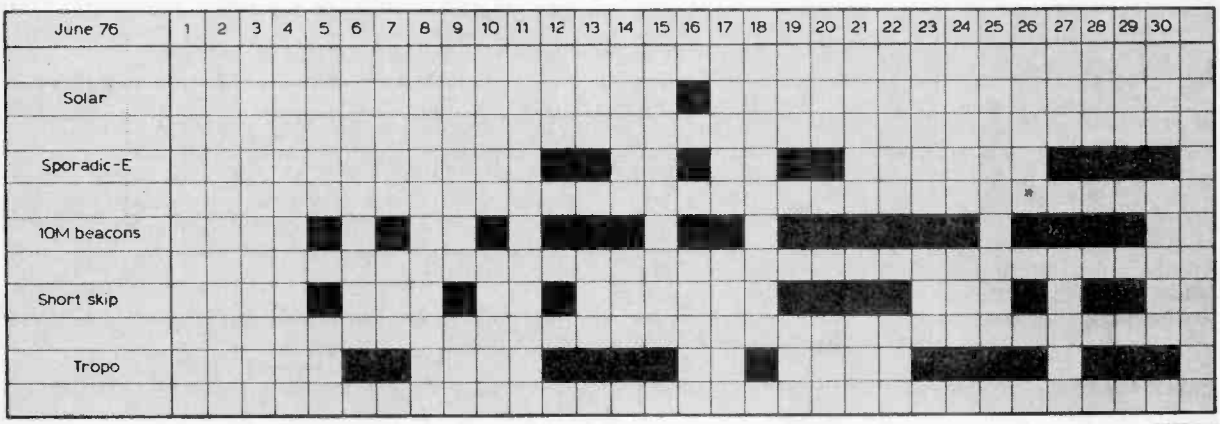
It is convenient for the students of sporadic-E that so many east-European countries use parts of the four and six metre bands for their national broadcasting, while those same wavelengths are relatively quiet in the United Kingdom. This situation means that home receivers can be tuned to the frequencies used by these broadcasters with little risk of "local" station interference. It's tough luck for the amateur who uses the four metre band because when sporadic-E is present his tiny bit (70 to 70·7MHz) is blotted out with strong broadcast signals, mainly from Poland

An average of 14 broadcast signals were heard for varying periods on June 12, 19, 20 and 28th. During the early evening of the 29th, an extensive sporadic-E manifestation enabled very strong signals from 39 of these stations to be heard with ease between 65 and 73MHz. At the same time a host of continental radio-telephone signals plus sundry automatic transmissions (beacons, printers, tones etc) were heard between 40 and 50MHz, causing interference to Band I television pictures, which, before the advent of UHF television, was a real pest around Wimbledon time.

The effects of sporadic-E manifestations were observed by the writer on nine days of the month (Fig. 1) and on each occasion strong pulses were received on the R1 vision channel (49·75MHz) and frequently, programme material was heard on the sound channel (56·25MHz). From experience the writer has found that the 50MHz region is most vulnerable to sporadic-E disturbances (even the minor ones not listed in Fig. 1) therefore the R1 vision signal is a most useful indicator as to the presence and extent of sporadic-E.

TEN METRE BAND

The most persistent early warning for the short skip conditions which prevailed on the ten metre band (Fig. 1) was, and still is, the signals from the German beacon DL0IGI which was frequently heard at 599, and those from the beacon in Cyprus 5B4CY, which was heard less often, but it told the UK listener that the path was open between "G" and the Middle East. DL0IGI was heard on all of the 18 days indicated in Fig. 1 (12 early morning, 7 at midday and 9 early evening) while the signal from 5B4CY was heard 5 times (5, 7, 19, 22, 28th) in the early evening and once (29th) during the early morning. Both of these beacons are part of the International Beacon Project co-ordinated by the RSGB and reports of these signals are welcomed by the Society because these are the rewards that they,



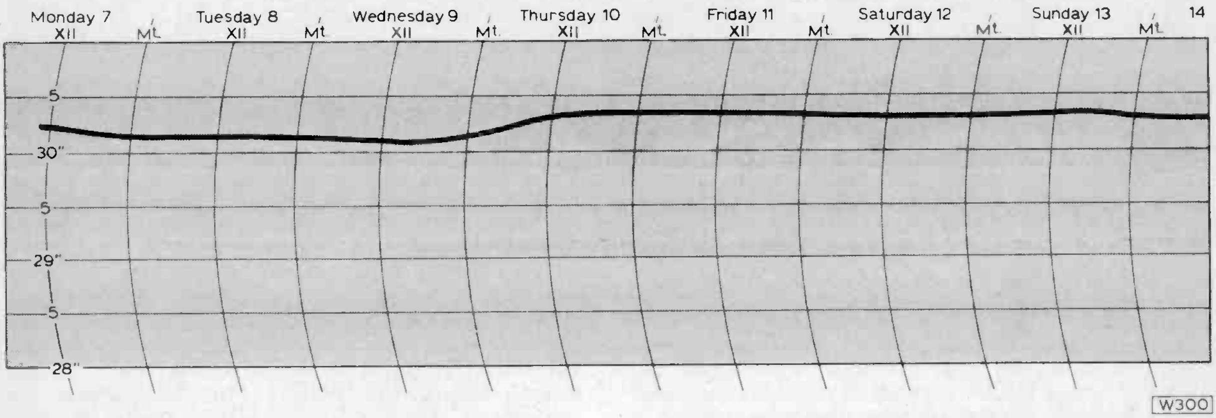
W299

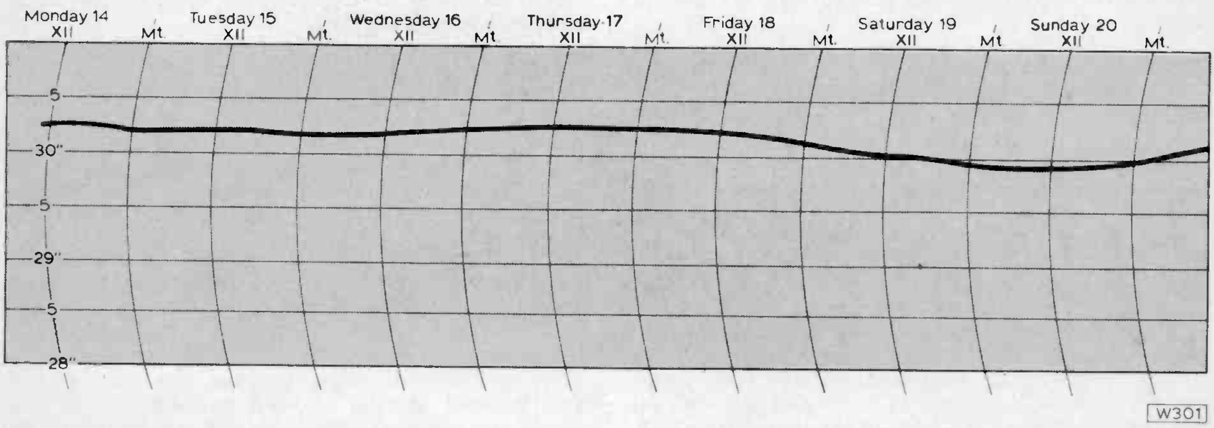
Fig. 1: The black squares show the days in June 76 when unusual atmospheric conditions were recorded by the writer at his home in Sussex. The various types of activity concerned are shown at the left.

and the beacon keepers, get for all of the voluntary work which they put into running the beacon service.

It is worth remembering that these beacon signals are also very good for checking the sensitivity and calibration of the home receiver, as well as for testing that new ten metre aerial.

Figs. 2 and 3: The barograph charts for June 7 to 14 and 14 to 20 showing the changes in barometric pressure over that period. What may appear to be small changes in pressure can have a profound effect on the transmission properties of the troposphere. For example, the drop occurring on the 18th was responsible for an opening to the Continent on part of the VHF broadcast band.





TROPOSPHERIC

The atmospheric pressure recorded on the writer's barograph throughout June remained consistently high and only fell below 30in. (1016 mb) for about 24 hours during the week-end of June 19/20th. There were several slight changes lasting for a few hours at a time which were enough to "open" up parts of the VHF/UHF spectrum for short periods over a limited frequency range. A good example of this can be seen in Fig. 2. Note the slightly falling pressure early on the 12th; at 0635 GMT the writer logged strong signals from eight continental FM broadcast stations between 89 and 100MHz. A similar fall occurred during the evening of the 13th and at 1838 the writer heard nine continental broadcast signals in Band II. The pressure continued a slight decline and at 0735 on 14th, nine continental broadcast stations were again heard. None of these "extra" stations was heard while the atmospheric pressure was rising.

Reference to Fig. 3 will show a sharp pressure fall during the afternoon and evening of the 18th; at 1239 five continentals were logged between 95 and 100MHz and at 1800 13 continental broadcast signals were heard between 89 and 100MHz. Band II was open periodically on 6, 7th and again during the early mornings of 12, 14, 15, 23, 24, 25, 26 and 29th and the evenings of 13, 18, 24 and 29th.

A good picture was received in Sussex on Channel 8 from the IBA transmitter in Lichfield, Staffs (with only a dipole) around 0800 on both 26 and 28th showing a path to the north on 189MHz. A UHF opening occurred early on the 26th when a very strong signal was received by the writer from the 70cm beacon at Sutton Coldfield (GB3SC), again with only a dipole feeding the receiver.

**Faraday, Greyfriars, Storrington, Sussex RH20 4HE.*

Readers experiencing unusual reception of stations on the VHF/UHF bands of the nature described by Ron Ham in the first two articles are invited to send brief reports to him at the above address. NOT to the Editorial offices!

If there is sufficient response a regular feature could be compiled for inclusion in PW—Editor.

Dear Sir,

letters

HF losses

I was surprised to see an old hand such as G2BCX advocating the use of Paxolin, PVC tape and even Sealastic for formers and sealants at frequencies of 144MHz. Being very lossy at frequencies well below 144MHz they could introduce a power loss of up to 3dB when used in combination. PTFE is ideal but Nylon 66 would be preferable to Paxolin for formers. For protection of the loading coil and open ends of co-ax, Polystyrene cement is a very much better material than Polyurethane varnish and sealastic is almost worse than nothing.

As to his statement that the standard 0dB reference radiator is a dipole, I would refer him to Antennas by Krauss, F. E. Terman and others. The standard reference for gain and field strength effective radiated power, etc., is the unipole, i.e., the common quarter wave radiator. **J. Bradbury G3AVR** (Hayes).

The young idea

I have been a DXer of the SW broadcast bands ever since I was just 14 (I am now almost 16). I would like to add my views to your mail concerning the subject of CB radio.

If carefully controlled, CB radio could provide a great boon for example, to house-bound people and unlike the USA, I consider that full power operation on CB should be made available to young people if a UK citizens band comes about. Perhaps even putting aside several channels exclusively for people under 18, to prevent the entire band being totally jammed up by us or adults.

I too feel that SSB is essential, in these days of crowded frequencies, also if we are starting at the beginning then we may as well make the best possible use of the space. Perhaps though, one channel could be set aside for use by low power AM walkie-talkies.

To all the Hams—in particular Mr. Dowdeswell in his August "On the Air" column, who appears to be against CB, I would like to say something. What about the people who just are not interested in technical matters? Some people just want it for company—especially the elderly and infirm. All they want is somebody to talk to—which is in my opinion what CB is about—just pure communication, nothing technical.

If as I hope we get CB then there is one thing we must have. Strict control. We must not learn too late as the Americans did, but control it from the beginning. We must get the "pirates" before they start, not when they are in full swing. **Simon Hicks** (Swindon).

More amateur gear

I am in agreement with your Editorial completely as the education of the young is a most important feature of your task. The PCB service which you have introduced is really excellent in its concept, I have used it, the service is very good and I will continue to use it.

I have been a Licensed Radio Amateur for many years and very much regret the changes that have taken place. The use of so much foreign made apparatus is a matter to be very much deprecated. The reasons are:

(1) Self training, the springboard of Amateur Radio is grossly diminished.

(2) Foreign imports are increased.

You have a public duty to form opinion and direct it the right way, it is important to satisfy the reader of course, but I suggest that to lead and direct in the right direction, to increase the quality and number of persons who are concerned about Electronics, Telecommunications, etc, is a fine ideal.

Naturally my interest is in Amateur Radio, and to this end I would welcome in the space allotted in your magazine more sophisticated PCB apparatus to suit my tastes.

It was a pleasure to see in your Editorial excellent concepts with fine ideals. **David Foster G3KQR** (Tolworth).

Please repeat

I read, with interest, the comments by E. Watt (Kidsgrove) (September 1976 issue *PW*) with regards to "channelised/mobilised debris" found occupying 2m today.

His vast knowledge concerning the take over of the band by FM repeaters seems devoid of the true reasoning behind the use of repeaters.

Their prime purpose is to ensure a reliable communication link between MOBILES. Granted, there often appears more fixed stations using them, but let us not forget the true objective.

No doubt his idea of true mobile communication is 100 AM QSO's on 145 (the good?, old days).

His remarks about the frequencies being used by the repeaters.

Let us consider: 5 repeater channels are at present in use (R_3, R_4, R_5, R_6, R_7) with, say, $12\frac{1}{2}$kHz frequency "windows" for input and output,

Total $5\times12\frac{1}{2}\times2=125$kHz

in a band 1·35MHz wide (excludes CW, SSB and Oscar bands).

If he cannot find room in the 1·225MHz remaining (over half allocated band) what a poor system he must have.

Please do not think I am all for repeaters and repeater working, I very rarely use them, but I would not remove the chances of those who do and enjoy doing so.

As regards 4m, has he seen the new CHANNELISED band plan, which after the World Radio Conference in 1979 may be meaningless anyway? **P. Salisbury GW8KSF** (Wrexham).

Entranced by a frog!

Since time immemorial, I have been going to suggest that a feature be included, dealing with the various problems encountered in servicing and construction, but have never done so, because I realise that very few of these have anything like universal interest. To say "since time immemorial" may be a slight exaggeration, but when I had made the Scott-Taggart Four in nineteen hundred and—when was it? —I had already two three-valve receivers "under my belt". What a marvellous set that was; at 4 a.m. I once received Pittsburgh on MW, using a very queer aerial erected in our back yard, in the shape, I suppose, of an irregular trapezohedron, in a youthful attempt to get out as much wire as possible.

In passing, I should like to reply to your correspondent Alexander Dodd (letters, September 1976), who so eloquently laments the passing of the thermionic valve. I think he is right to do so, but Wireless Telephony is Wireless Telephony, whatever apparatus it employs. Much as I like the valve, I have to admit that in almost every respect solid state devices are far superior. It would be absurd for Practical Wireless to dwell in the past, and become a journal for antiquarians.

However, one problem that I do have, is the removal of the enamel insulation from copper wire of 30 SWG or thinner. I have tried burning it off, but the wretched wire itself disappears. I have tried careful scraping with a knife, but the result is a number of tiny lengths of wire, an interesting result, but unproductive. There must be some chemical dip which could be used, if only one knew. Then there is fine Litz wire. It is essential, we are told, to solder every strand. This means that each one must have its covering removed. I have tried, but have little skill in this subminiature kind of knitting. Can anyone give me the answer? In spite of my terrible problems, I must say how much I have enjoyed fifty years of radioactivity, and Practical Wireless.

In the winter of 1924, my sister and I came home from school to find Dad bending over a strange contraption in a corner, on which were two brightly-glowing lamps. Without a word, he separated a pair of headphones, and gave us one each. I was entranced. I heard a woman singing "A Frog he would awooing go", and my father said it was from Manchester, fifty miles away. I have never forgotten the magic of that moment. What a wonder that was —and still is.

In many ways sound radio is more remarkable than TV, though less complicated. One has only to look up at the night sky to realise that the unaided human eye can see distances millions of times greater than the human ear can encompass by itself. It is indeed a great wonder, and modern inventions are daily making it more so.

My thanks to Practical Wireless for playing such an important part in my electronic education, and helping me on my way. Long may it flourish. **Howard Padmore** (Blackpool).

Low-down on peaks

It was disappointing to read Lionel Howe's Editorial (August issue) "Hear Hear?" *Practical Wireless* does not pretend to be in the Hi-Fi bracket, but your Editor does betray some ignorance of what is true High Fidelity. Part of the reason for high output concerns headroom (never heard of it?).

It is well known that a typical domestic set up delivering an average programme level of 1W would be required to deliver 50W in order to avoid clipping at transient peaks. Most of the rubbish which appears at £26·25 is cramped at best, is highly selective about loads and inputs, and very high on distortion! If the editor is happy with that state of affairs—he ought not to inflict the paucity of his hearing on others. There's nothing wrong with aspiring to heights, providing one knows to what one is aspiring!

Just listening is a fair test, but the difference between poorly designed equipment and the best is incredible. If the Editor would care to compare any reasonable amplifier (at £26·25) with say the Naim 160, I'm sure he will appreciate the difference in "musicality".

I am sure the time has come when specifications are virtually meaningless to the majority, but they do have their uses! I am all for a little education, but your Editorial is very backward looking.—**J. C. Nuttall** (Worthing)

Disgusted

Perhaps I may be allowed to say a few words about your comments concerning the letter *"You've Been Warned"* by T. W. Hillyard.

As a citizen in a supposedly free society I found it extremely distressing that you should condone what amounts to legalised theft and attempted theft by a government department. Please let me state now that I agree that Mr. Hillyard should have been fined and his "transmitting" equipment confiscated, but the taking of other domestic electronics equipment is a gross infringement of civil liberties.

The state is far too fond of exceeding its authority in respect of individual liberties and for a person such as yourself in a most responsible position to condone this action leaves me with a feeling of disgust. One cannot be expected to respect the law unless one manifestly sees it as open, fair and just. **R. Morgan Lloyd** (Spalding).

Err-well!

I refer to the report published in the September issue of *PW* on the Exhibition of Civilian and Military Radio. It stated on page 429 that BBC approval for a piece of radio equipment had to be obtained first, before a constructors licence could be issued in 1923. This is not so. The true facts are that this rare licence covered the home construction of any apparatus, but theoretically one was not supposed to listen to BBC broadcasts with it. It covered experiments under the Wireless Telegraphy Act 1904.

An ordinary BBC stamped licence was issued for listening to BBC and other programmes with a receiver purchased with a BBC transfer on, and made by firms who were members of the British Broadcasting Co. Ltd. However, most enthusiasts listened to anything on the air, from the true transmitting Hams on 10W to KDKA and WJX. The air at this time was reasonably clear, apart from reaction whistles for long distance reception. **C. E. Largen** (Worthing) ("Old Timer" — 40 years Hon. Sec. Ilford and District Radio Soc. Ex. 2OT, 2OU, 3QU).

PRODUCTION LINES

bill tull

NEW RANGE FOR LEAK

New from Rank HiFi is a range of Leak equipment called the 3000 Range. There are four loudspeakers featuring time delay compensation, 35 and 25 watt tuner amplifiers, an 80 watt amplifier, a belt driven turntable and a pair of head-phones using an improved form of the isodynamic principle. The 2075 loudspeaker continues having established itself at the top of the loudspeaker market.

Holography has been used extensively in the development of this new range of loudspeakers and in particular in the design of the treble unit, which is common to all four loudspeakers.

Rank HiFi has aimed this new range at the knowledgeable enthusiast, one who is capable of appreciating technical excellence coupled to a good appearance design and who expects reliability.

Leak 3000 Range of Loudspeakers

Embodying the latest research and production techniques of the engineering team at Bradford, these

four 8-ohm designs mark a radical departure from previous Leak acoustic products for the following reasons:—

The subjective effect of such a time delay compensated system is subtle, but nevertheless demonstrable. When listening to a single loudspeaker an improvement occurs in perceptual depth and transparency of the sound image, adding a further degree of realism. The effect in stereo is a greater spatial effect and feeling of depth, where one listens through the loudspeakers instead of to them. This gives a more accurate construction of stereo images in the sound field.

A far greater design effort has been applied to the appearance of this range than to previous Leak ranges.

All the new drive units have plastic cones or diaphragms and the physical relationship between the drive units in space is accurately preserved by the use of a moulded polyurethane foam front baffle.

Due to a greater understanding of Doppler distortion, intermodulation distortion, delayed resonance and the design of crossovers it has been possible to extend the operating frequency range of the bass units into mid frequency areas. The engineering team has been particularly successful in measuring these distortions, especially with regard to their audibility.

The four designs in the Leak 3000 Range of loudspeakers will be offered in teak with black grill covers. The estimated selling prices are expected to be in the region of (per pair):

3020	£90
3030	£125
3050	£175
3080	£262

Rank HiFi, P.O. Box 70, Great West Road, Brentford, Middlesex, TW8 9HR.

AIR BLAST CLEANER

Available from importers Pelling & Cross Ltd., is a very useful cleaning device for the hi-fi and electronics enthusiast. Dust-Off is a 14oz. can containing a liquified gas (freon) which emerges as a pressurized, super dry but inert gas, capable of dislodging even well ingrained dust and oxide from delicate tape recorder mechanisms, tape heads, and record stylii without the danger of creating static by conventional forms of wiping or brushing.

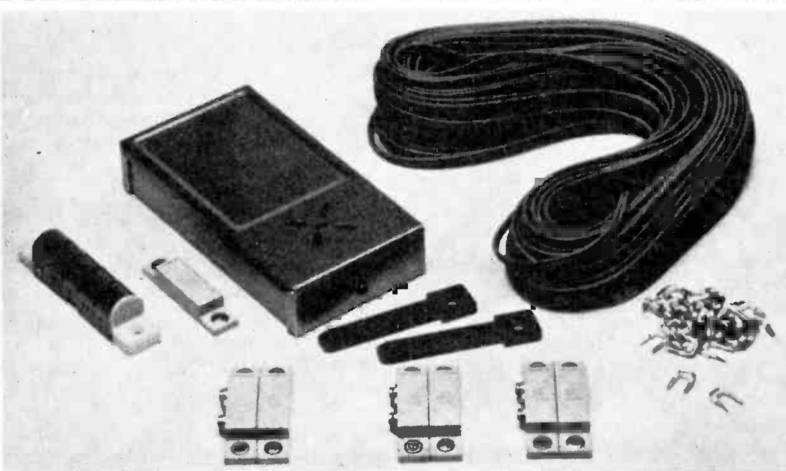
The cost of the initial Dust-Off can and trigger nozzle is £8·57 inclusive of VAT, plus post and packing at 65p. Flexible extension nozzle £1·49 plus post and packing 35p. For further information please contact *Peter Recklin, Pelling & Cross Ltd., 104 Baker Street, London W1. Tel: 01-487 5411.*

EAGLE ALARMS

A new range of fire and burglar alarms introduced by Eagle International of Wembley, Middlesex meets the need for moderately priced automatic security systems in homes, schools and offices.

For the detection of intruders Eagle market two alternative alarms AB10 and AFB15. The AB10 is a door or window alarm with key and magnetic sensor switch. It is very simple to install and incorporates an instant/delay action switch which allows setting of the alarm without triggering siren. The AB10 is also suitable for use on car doors.

The AFB15 (illustrated) burglar/fire alarm employs the same master unit as the AB10, but has three remote detectors, one fire detector, plus plenty of cable, staples and self adhesive pads. *Eagle International, Precision Centre, Heather Park Drive, Wembley, HA0 1SU.*



NEW HEATHKIT CAT.

Shown for the first time in the new Heathkit catalogue are: an AC voltmeter, X-Y chart recorder, IM distortion analyser, harmonic distortion analyser, amateur radio receiver, triple-output power supply and digital electronic floor and shelf clocks. Also included are details of a 'Big Ben' electronic chimes. Free catalogues may be obtained from *Heath (Gloucester) Limited, Gloucester, GL2 6EE.*

BIB KIT

Four useful accessories have been put together to make up a new Bib kit ref. 104. They are: cassette storage tray which holds ten cassettes and includes self-adhesive pads for wall-fixing, a Bib Fast Hand Winder, a cassette head tape cleaner, a pack of 20 cassette and 10 library case replacement labels. Price is £2·81 including VAT and this kit is ideal for owners of cassette machines. *Bib HiFi Accessories Ltd., P.O. Box 78, Hemel Hempstead, Herts., HP2 4RH.*

DECIMO WATCH

With their digital watch Decimo have gone 100% for liquid crystal display. Not only are the digits large enough for all ages to read, but they are constantly displayed and a battery lasts about 18 months as opposed to about six months for the LED electronic type watch.

"The Blue Max is the name they have chosen for their watch. It was of course the name of the famous medal given for extraordinary acts of bravery and achievement in the First World War. Only officers were eligible to receive it. Later it was extended as an award for the highest achievement in the arts and sciences." Price is £49·95. Further information from: *Douglas A. Dorsett—Managing Director, Decimo Limited, Park House, Chobham Street, Luton LU1 3BS, Bedfordshire. Tel: Luton 38881.*

PERIPHERAL

A peripheral printer which broadens the usage of TI handheld programmable calculators has been announced by Texas Instruments. The new PC-100 print cradle now allows any TI hand-held programmable calculator to become a desktop printing calculator.

When the calculator is locked into the cradle, the user is able to print anything shown in the display or print the step-by-step execution of a program. Programming the calculator becomes simplified, because the "list" feature of the PC-100 will print out program lists for editing, and the "trace" mode provides a complete audit of every step in program execution.

The PC-100, has a suggested retail price of £199·00 inc. VAT.

Since it expands the usefulness of TI programmable calculators, the PC-100 will be available from all retailers which carry either of the recently announced SR-52 and SR-56 calculators. *European Calculator Division, Texas Instruments Ltd., 165 Bath Road, Slough, SL1 4AD. Tel: 35544*

SONUS CARTRIDGES

C. E. Hammond & Co. Ltd. announce the availability of the Sonus line of cartridges:

Blue Label cartridge: This unit is fitted with a micro-miniature multi-radial diamond tip, ground and polished to a precise contour in order to trace extremely high frequencies while maintaining a relatively large groove contact area. Although originally developed for use with discrete quadraphonic records, these characteristics considerably improve groove tracing in general, with a consequent reduction in distortion in all forms of micro groove records, particularly in the inner grooves. The stylus mounting, although very small, has extremely high mechanical strength and precise orientation. This diamond, combined with a moving system of exceptional lightness and strength definitely represents a 'state of the art' system. Price: £59 plus VAT.

Red Label cartridge: This has a conventional elliptical (bi-radial) diamond tip. Except where an extended frequency range is essential, this tip provides most of the precise tracing virtues of the Blue Label, although the stylus groove bearing area is considerably smaller. Again, the stylus mounting and general characteristics provide high mechanical strength and precise orientation in a moving system of exceptional lightness and strength. Price: £46 plus VAT.

Green Label cartridge: This unit is fitted with a micro-miniature spherical tip for general purpose use, where minimum stylus and record wear is desired under day to day conditions such as transcription or radio station work. It is also optimum for records compensated for inner groove distortion. Price: £39 plus VAT. *C. E. Hammond & Co. Ltd., Revox: 105-109 Oyster Lane, Byfleet, Surrey KT14 7LA.* All other products: *111 Chertsey Road, Byfleet, Surrey KT14 7LA. Tel: Byfleet 41131.*

The PW 4 'CHROMACHASE'

IN NEXT MONTH'S PRACTICAL WIRELESS

Drive it from your Disco or Hi-Fi

—PLUS—

Selectable Programming of Coloured Light Display

—PLUS—

full dimming facilities

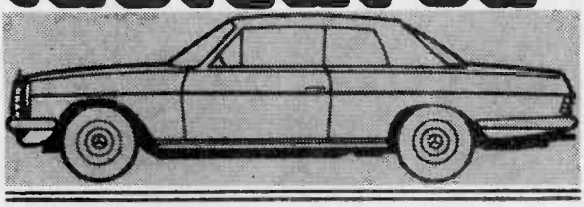
ALSO:

SIMPLE VHF CONVERTER
S~DEC PROJECTS (NEW SERIES)
MORE ON CAR ELECTRONICS

ON SALE IN NOVEMBER

Practical Wireless 8-Page Supplement Nov. 1976

LOW LEVEL BATTERY INDICATOR

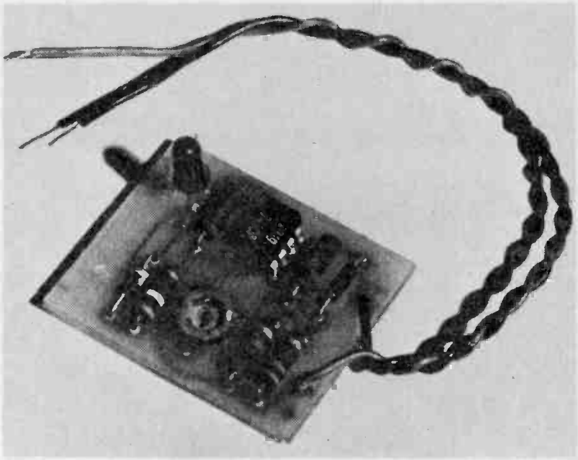


BATTERIES in equipment and cars are often prone to failure at inconvenient moments because no-one remembered to check the battery. More often than not, with the exception of cassette recorders, a monitoring meter is not fitted.

This circuit is designed to monitor the battery voltage and light an LED when it falls below a precisely set level. It is cheap, small and more rugged than a meter. Moreover, a meter has to be looked at and can be mis-read, whereas a light is reasonably eye-catching. The unit consumes very little current (about 2mA), and can be permanently wired across the battery.

CIRCUIT

A 741 operational amplifier is used to compare a proportion of the supply voltage, V_m, at one input, with a fixed reference voltage at the other input Fig. 1.



Photograph showing the prototype printed circuit board with the LED mounted on the board. In practice however, the LED would probably be mounted remotely.

As V_m falls slowly with use, the voltage at pin 2 drops below that at pin 3 which is fixed by the Zener diode, and the 741 changes state. The 2·2MΩ resistor supplies positive feedback to ensure sharp switching action.

The output at pin 6 goes from about 2V when 'off' to just below V_m when 'on'. In order to prevent the LED emitting

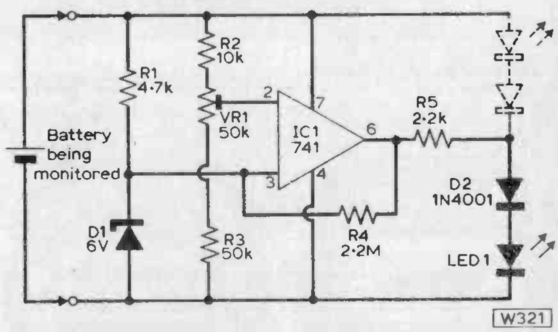


Fig. 1: Circuit diagram showing LED1 and D2 in the two positions enabling either a normally ON or normally OFF display.

slightly when supposedly off, a 1N4001 diode, D2, in series with it drops this 2V to about 1·4V, at which the LED definitely remains in the 'off' state.

The preset enables triggering levels to be set from the Zener voltage to just below the line voltage. With a 9V battery the trigger level would probably be about 8·0V. The value of the Zener should be about half to two-thirds of the battery voltage when new. Circuit values are given for a 9V monitor, but no component is critical.

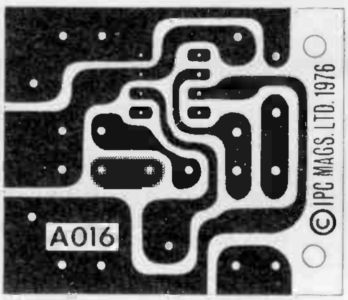
Should it be desired that the LED is normally 'on', and switches 'off' when the voltage falls, then just reverse the polarity of the 1N4001 and the LED and take the LED to the positive line instead of the negative. (Shown dotted in Fig. 1).

★ components list

Resistors
R1 4·7kΩ
R2 10kΩ
R3 50kΩ
R4 2·2MΩ
R5 2·2kΩ
VR1 50kΩ Horz. preset
All ¼W, 10%

Semiconductors
IC1 741
D1 BZY88 6·2V 400mW zener
D2 1N4001
LED1 0·2in Red

Miscellaneous
PCB, 45 x 35mm (see readers PCB Service, page 576).



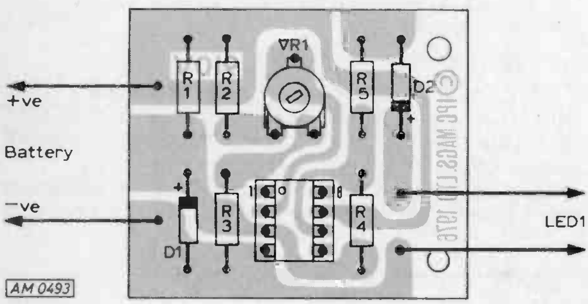
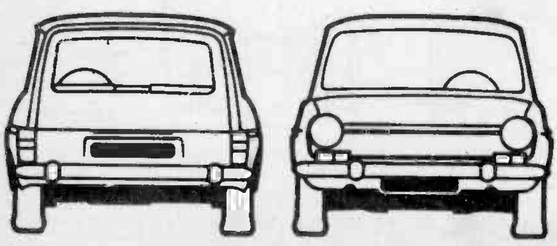


Fig. 2: Actual size PCB showing the foil side above and the component overlay below.

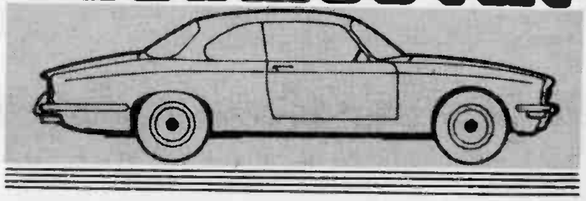


CONSTRUCTION

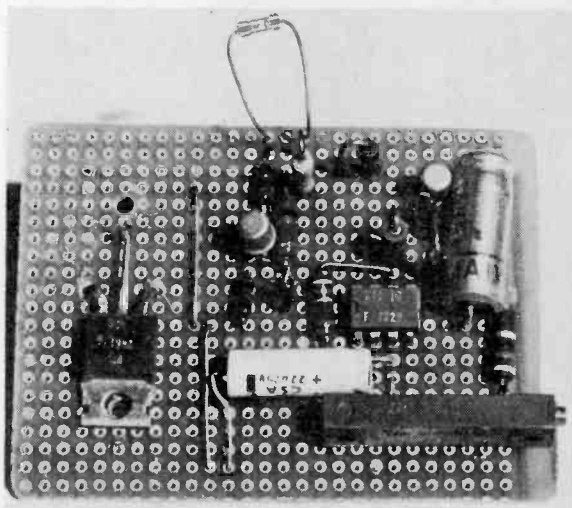
A PCB layout is shown in Fig. 2, and makes for a neat, compact unit. Construction and component layout is very straight-forward, but ensure the LED is inserted with the correct polarity. The LED's the author used had the negative lead indicated by a flat on the body.

To set up, adjust the preset to cause the LED to light at what is considered to be the voltage of a near dud battery. The circuit may be used with batteries up to about 30V but R1 may need to be increased to keep the current drain low at the higher voltages.

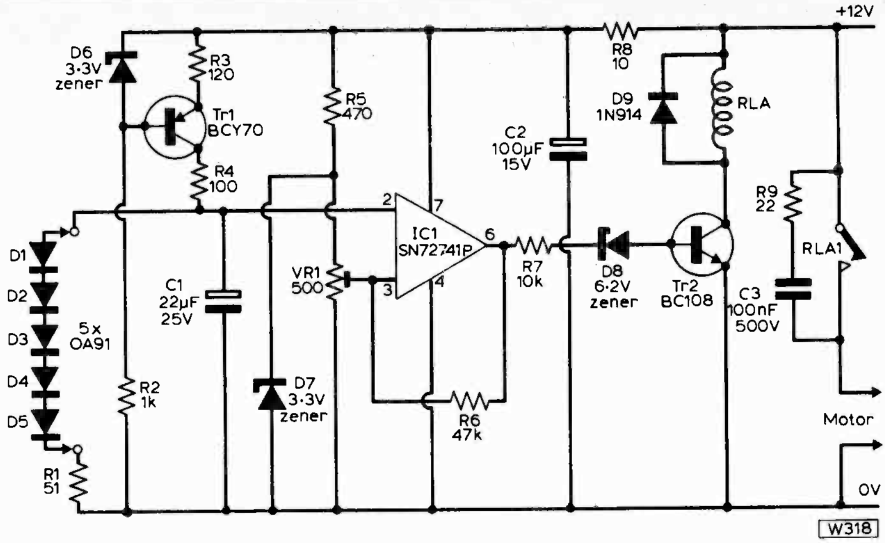
ELECTRONIC THERMOSTAT



THE mechanically operated fan fitted to most cars is an unnecessary waste of power, causing overcooling and increasing warm-up time. If the engine is operating below its optimal operating temperature, the petrol/air mixture will be weakened due to premature condensation causing a reduction in power output. The fan also absorbs actual power from the engine, and on some cars can absorb up to 5%. The fitting of an electronically controlled fan driven



The prototype shown here was constructed on Veroboard and used a transistor for switching (see Fig. 2.) The design shown in Fig. 3 is the modified PCB and uses a relay for switching purposes.



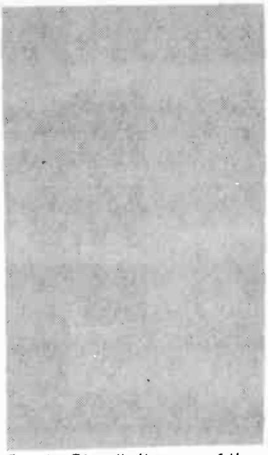


Fig. 1: Circuit diagram of the Electronic Thermostat, showing the string of five OA91 diodes which form the sensing device on the radiator.

by a small heater type electric motor can stop most of these unnecessary power losses.

Fan cooling is only required when the coolant in the radiator rises above about 5 deg. centigrade above the opening temperature of the coolant thermostat. Under normal motoring conditions the ram effect of the air forced into the radiator by the forward motion of the car is adequate to cool the engine, but if, for example, the car engine is left idling in a traffic jam, then some artificial airflow is required, and this is provided by the electric fan. The electronic thermostat described here controls the operation of the electric fan.

The temperature of the radiator coolant is "measured" by a string of germanium diodes D1-D5, which are secured in thermal contact with the top of the radiator at the opposite end from the inlet pipe (this is to ensure that the radiator is allowed to fill completely with hot coolant before any assistance is given to the cooling airflow). The forward voltage drop of germanium diodes changes by −10mV per deg. centigrade approximately. Therefore the combined forward voltage drop of five series connected diodes will change by −50mV per deg. centigrade and if this voltage change is compared with a reference voltage, then a fairly simple, but effective thermostat can be made.

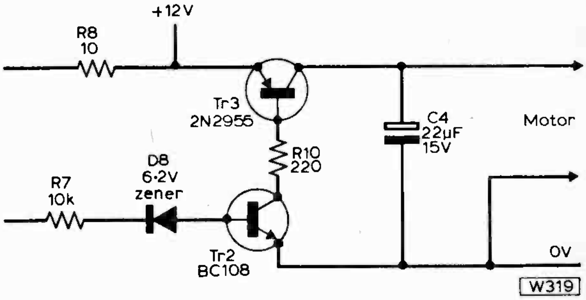


Fig. 2: Alternative switching is achieved by the use of a power transistor instead of a relay as shown above.

★ components list

Resistors

R1 51Ω	R7 10kΩ
R2 1kΩ	R8 10Ω
R3 120Ω	R9 22Ω
R4 100Ω	R10 220Ω
R5 470Ω	R11 47Ω
R6 47kΩ	VR1 500Ω preset

All ¼W 10%

Capacitors

C1 22µF 25V	C4 22µF 15V
C2 100µF 15V	C5 500µF 25V
C3 100nF 500V	C6 500µF 25V

Semiconductors

Tr1 BCY70, 2N3906 or equiv.	D8 BZY88 6·2V 400mW zener
Tr2 BC108, 2N3904 or equiv.	D9 1N914
	D10 1N4001
IC1 SN72741P	D11 BZX61 12V 1·3W zener
D1–D5 5 x OA91	

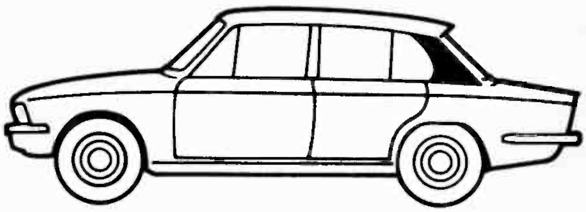
D6 BZY88 3·3V 400mW zener
D7 BZY88 3·3V 400mW zener

Miscellaneous

RLA, 12V relay with contacts rated at 4A and coil resistance or more than 200Ω i.e. Doram no. 348-131.
T1, mains transformer with 12V secondary and rated at 6VA, i.e. Doram 207-201. PCB 125 x 50mm (see page 576 for readers PCB Service)

REFERENCE VOLTAGE

As the battery voltage changes considerably with engine speed, state of charge, etc., some form of stabiliser is required to provide the reference voltage and also to supply the forward current for the diodes which are thermally



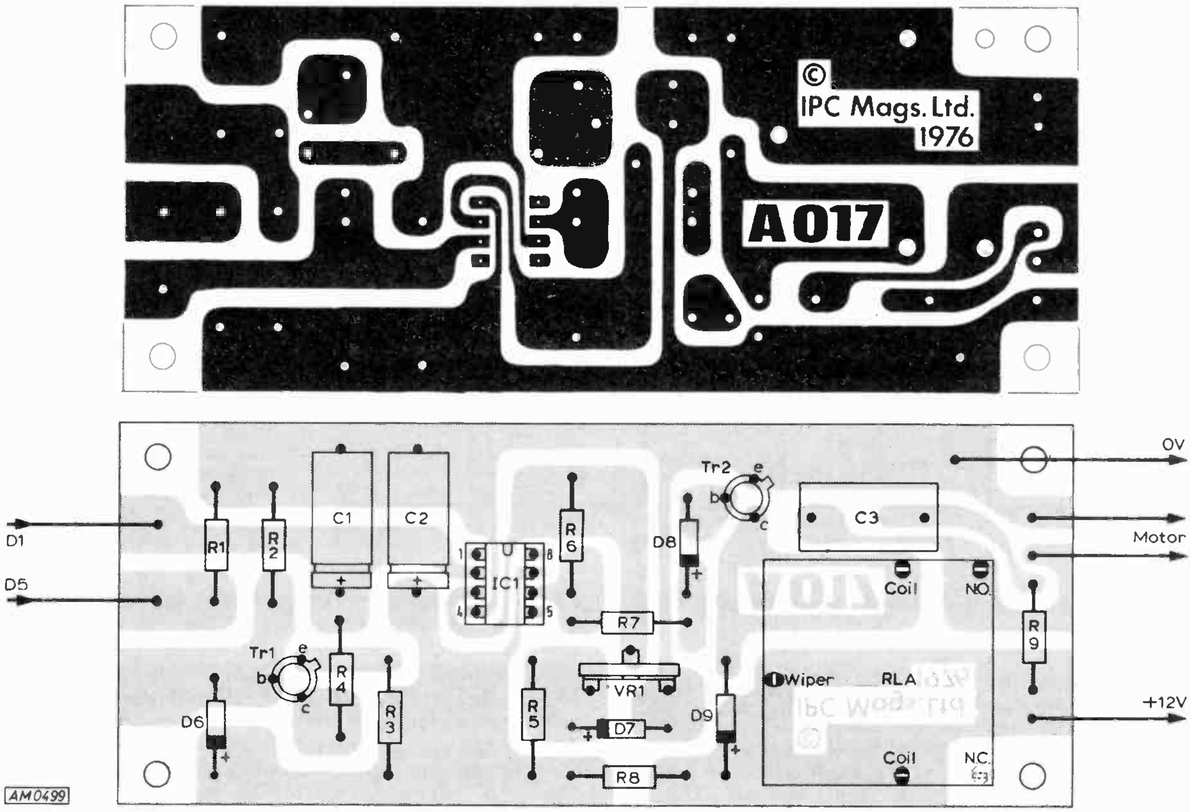
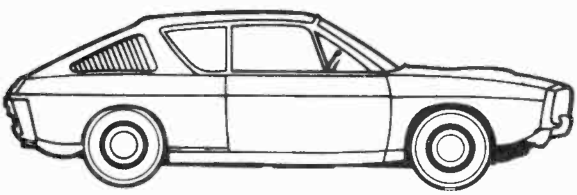


Fig. 3. The PCB shown above is full size and is designed to use the Doram 12V relay, number 349 131.

connected to the radiator. A regulated current to supply VR1 and the diodes D1/5 is provided by constant current generator Tr1. If the voltage across the diode chain and R1 is greater than that set on the slider of VR1 (threshold temperature) then the output from the voltage comparator



IC1 will be low (about 2V), but if the radiator coolant temperature rises high enough, then the voltage across the diode chain will drop sufficiently for the voltage on VR1 slider to be the larger and in this condition the output of the comparator will go high (about 10V). To prevent "chattering" and to provide some hysteresis for the thermostat, R6 is included to give the voltage comparator some positive feedback—Fig. 1.

When the output of IC1 is at 10V, then D8 conducts providing base drive for Tr2 which switches on and energises the relay, thus starting the fan motor. When the output of IC1 is at 2V, i.e. the radiator coolant is at a lower temperature than requires artificial cooling, D8 does not conduct, Tr2 is not switched on and the relay is not energised. Components C1, C2, and R8 are essential to eliminate the high energy spikes present in most automobile electrical systems which can damage some of the components (notably IC1 and Tr2).

The circuit will work equally well with any negative temperature coefficient device, such as a thermistor; the only proviso being that the device has a resistance of between 20 and 1000 ohms at the desired switching temperature. A power transistor can also be used to switch the supply to the fan motor, and if this is desired, then the circuit should be modified as shown in Fig. 2

The circuit can also be used as a central heating controller, but in this case it is necessary to switch something off, normally the mains powered circulating pump. One of two solutions to this problem is to use the normally closed contacts of the relay instead of the normally open ones in the case of the fan motor. This solution has one disadvantage in that it is not fail safe, so a better way of reversing the function of the thermostat is to reverse pins 2 and 3 of

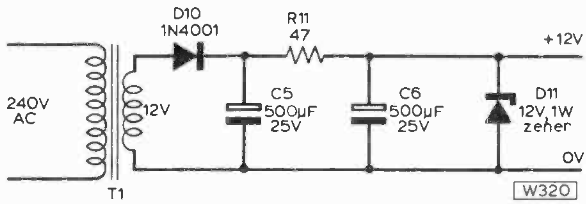
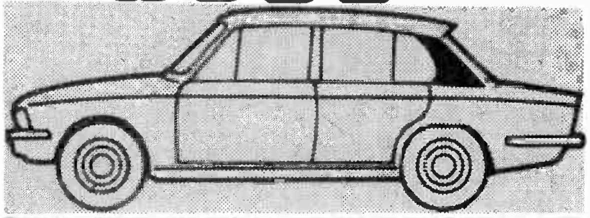


Fig. 4: If this device is to be used for any purpose other than a car thermostat, the power supply shown here is recommended.

IC1 and use the normally open contacts of the relay. For the domestic situation of a central heating controller, a mains power supply will normally be necessary, a suitable unit is shown in Fig. 4. The circuit has various other possibilities such as a fish tank heater controller, or if the diode chain is replaced by a photocell, the unit can be used to automatically switch on parking lights on a car.

'CIRTEST' PROBE



TRACING faults in a car's electrical system, one often requires to know whether a certain point is at earth potential or a live supply point, irrespective of the polarity of the vehicles electrical system. This device indicates by means of coloured LED's, the state of any such point. The device

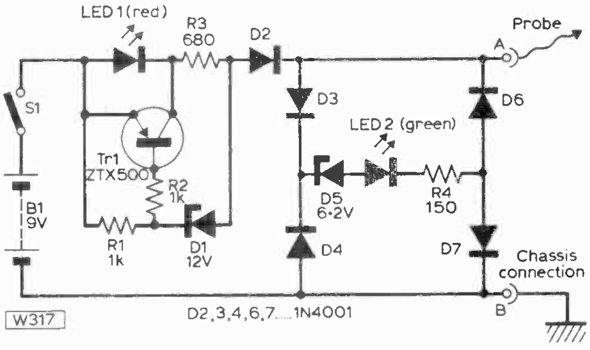


Fig. 1: The above circuit of the Cirtest Probe enables the user to determine the state of any electrical point on a car, whether the car is positive or negative earth.

is completely self contained and works on both positive and negative earth vehicles with a 12V battery. Only one connection, to any chassis point on the vehicle is required plus a probe contact to the point to be tested.

★ components list

Resistors
R1 1kΩ
R2 1kΩ
R3 680Ω
R4 150Ω
All ¼W, 10%

Semiconductors
Tr1 ZTX500
D1 BZY88 12V 400mW zener
D2 1N4001
D3 1N4001
D4 1N4001
D5 BZY88 6·2V 400mW zener
D6 1N4001
D7 1N4001
LED1 0·2in. Red
LED2 0·2in. Green

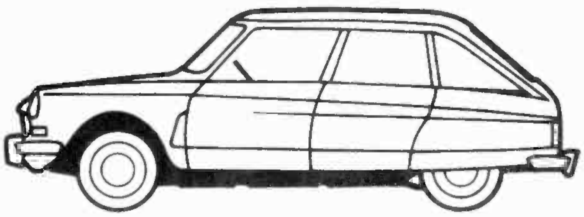
Miscellaneous
S1, single pole slide switch. Crocodile clip. Diecast box 89 x 30 x 35mm (Doram 509·923) PP3 battery and connectors. Material for probe i.e. knitting needle. Grommet, nuts and bolts. PCB 75 x 25mm available from the PW PCB Service (see page 576).

CIRCUIT DETAILS

The circuit is shown in Fig. 1. Point B in the circuit is connected via the crocodile clip, to any conducting part of the car's chassis, and point A is connected to the probe.

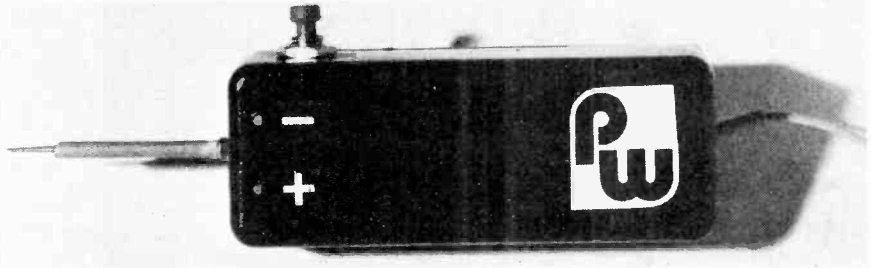
If the probe contacts a point at chassis potential, there is no voltage across the bridge rectifier D3, D4, D6 & D7, and LED2, which is supplied by the bridge, fails to light. With the probe at chassis potential however, current from the battery B1 flows in the circuit formed by LED1, R2 and D2, and LED1 lights, indicating a point at chassis potential. No current flows in the circuit D1, R1, since the supply voltage of 9V is below the zener voltage of D1, and Tr1 remains biased off.

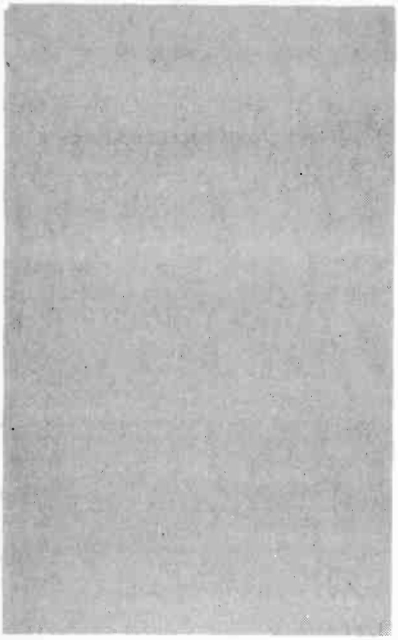
If the probe contacts a point at +12V with respect to earth, this voltage appears across the bridge rectifier which



supplies a voltage of the correct polarity to the series circuit D5, LED2 and R4. This voltage being higher than the zener voltage of D5, current flows in LED2 causing it to light and indicate a supply point. LED1 remains off, since with the probe at +12V with respect to earth, D2 is reverse biased, and no current flows in LED1.

A small box, such as the Doram model shown here, is most convenient for housing the electronics, and for ease of handling.





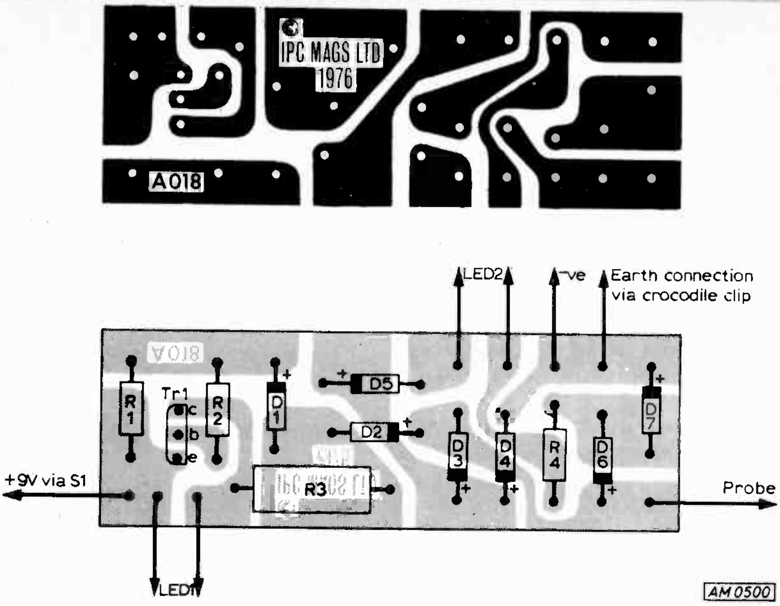


Fig. 2: Designed for fitting in a small diecast box with the battery, the above PCB is reproduced full size with foil side above and component overlay below.

If the probe contacts a point at +12V with respect to earth potential, this voltage appears across the bridge rectifier as before, and LED2 lights as before, indicating a point at supply potential. Simultaneously, a voltage of 21V appears across the circuit LED1, R2, D2. In order to prevent LED1 from illuminating, D1 conducts as the voltage has exceeded its zener voltage. The voltage developed across R1 due to this current flow appears via R2 at the base of Tr1 which as a result conducts. This prevents LED1 from lighting, since the saturated collector-emitter voltage of Tr1 is below the voltage required to forward bias LED1.

D5 is included in the circuit to prevent current from B1 flowing through LED1 to earth, via R3, D2, D3, D5, LED2, R4, and D7. The zener voltage of D5, plus the forward voltage drop of the other diodes in the path, prevents this from happening with a 9V battery for B1.

PROTOTYPE HOUSING

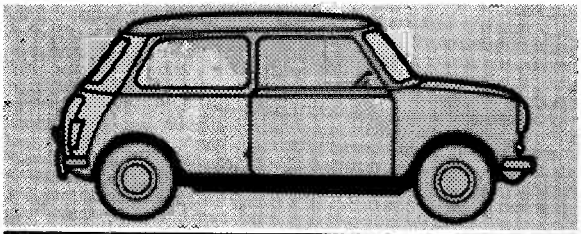
The printed circuit board, Fig, 2., was housed in a small diecast box as shown in the photograph. A PP3 battery was used to keep the overall dimensions small, and the components mounted neatly on the PCB for the same reason. In the author's prototype, a small slide switch was used for S1, but a spring return push-button switch could be fitted if so desired. Two bolts with spacers support the circuit board, and a small right angle piece of aluminium, bolted to the box, serves as a battery clip. The two LED's fix into holes in the end of the box, using the fixing clips supplied with them. A red LED was used for LED1, and a green one for LED2.

The probe consists of a steel knitting needle, cut to the appropriate length, with a piece of plastic sleeving (the plastic covering from screened lead was found to be ideal) slipped tightly over the end. This was fixed into a hole in the end of the box, using an epoxy resin adhesive. If desired, the fixed probe could, of course, be replaced with a probe on a flexible lead. The earth lead was formed from a suitable length of wire, with a crocodile clip fitted on the end.

IN USE

To check any point in a car's electrical system, of either polarity, the crocodile clip is affixed to any conducting point on the car's chassis, and the probe applied to the point to be tested. If the point is at chassis potential, the red LED will light, if the point is at supply potential, the green LED will light. The device will be found to be of use in checking lighting, ignition, and auxiliary circuits in any 12 volt electrical system.

BURGLAR ALARM

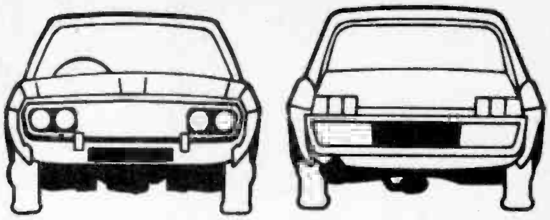


THE alarm unit described here is suitable for use in the home, car or shop display, and will supply an alarm requiring up to 6A.

CIRCUIT OPERATION

The circuit of the complete unit is shown in Fig. 1. The Thyristor or Silicon controlled rectifier, SCR1, is triggered by a voltage from Tr1 collector. If the alarm loop is kept closed i.e. Tr1 base is connected to ground, the voltage at this point will be zero, and the voltage across resistor R2 will also be below the trigger voltage needed to fire SCR1. When the circuit is broken by the intruder the base of Tr1 will become negative with respect to ground. This will alter the voltage across R2 to the state of trigger on the gate of the thyristor, and will supply power to the alarm.

The resistor R4 is to make sure that the holding current



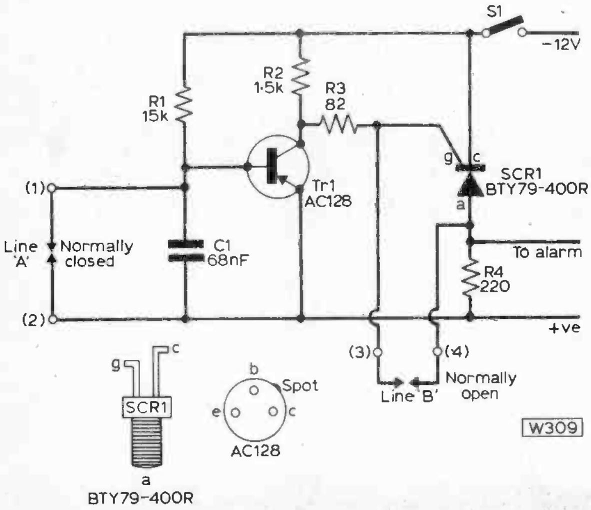


Fig. 1: Complete circuit of the Burglar Alarm, showing just two contact points. The Thyristor SCR1, should be mounted on a small heatsink if current in the order of 6A is to be drawn.

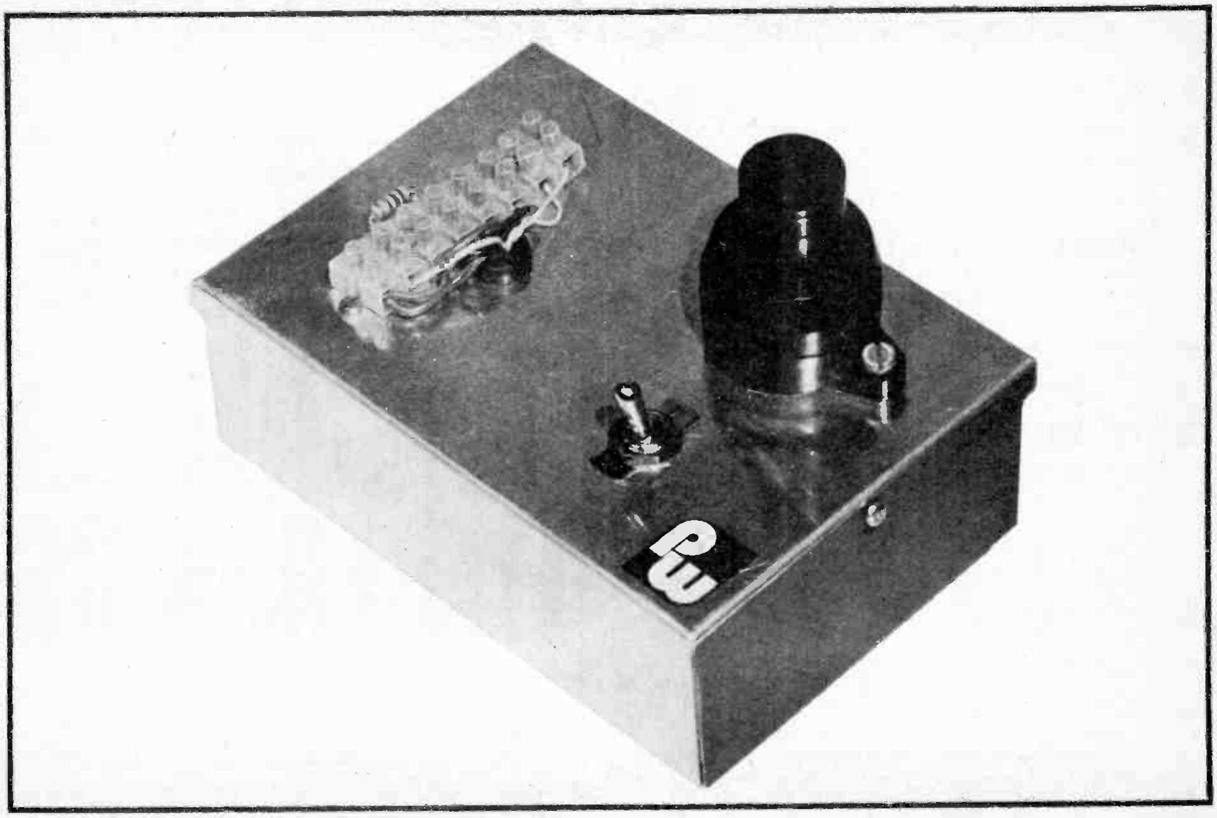
★ components list

Resistors
R1 15kΩ R3 82Ω
R2 1·5kΩ R4 220Ω
R1, 2, 3 ½W 5%. R4 1W 10%

Capacitor
C1 68nF 400V Polyester.

Semiconductors
Tr1 AC128 or OC81 or equivalent.
SCR1 BTY79-400R

Miscellaneous
Alarm, Audible Warning Device, Doram number 248-808. 4-way terminal block. S1, SPST switch. 75 x 30mm PCB. HP1 12V battery. Aluminium box 114 x 55 x 89mm, Doram 509-945. Aluminium mounting bracket for SCR1.



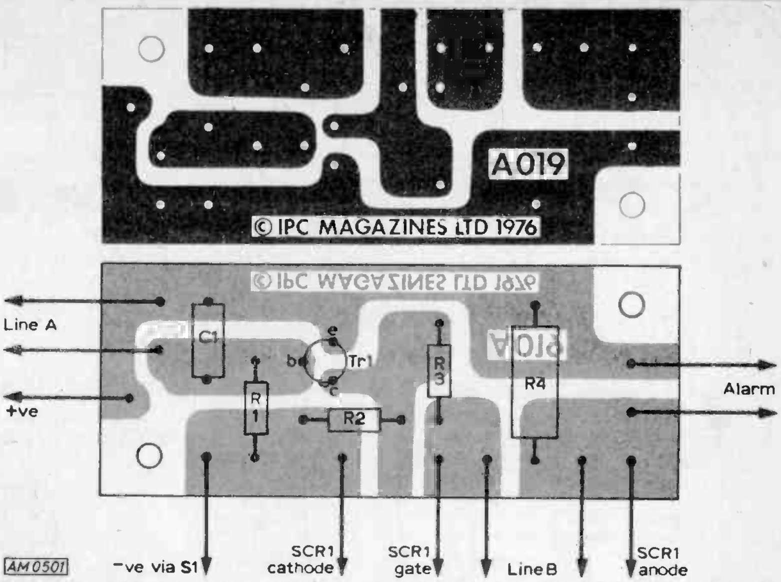


Fig. 2: The PCB shown above was designed to fit into a case, together with the alarm and switch. The sensing switches—pressure mats etc. are external to the unit, and placed where most useful.

of the thyristor is around 30mA, as without it, the SCR will reset. The only way to stop the alarm after it has been triggered, is to interrupt the supply i.e. switch the unit off and then back on again to reset. One could add a key switch to stop anyone but the owner resetting the unit, but if its well hidden the author felt that the extra cost was prohibitive.

SETTING UP

To set up the alarm it only needs a battery, the normally closed circuit connected to 1 and 2 (line A), and/or normally open circuit to 3 and 4 (line B). These switched circuits can be of any design such as pressure mats or window contacts. The alarm itself, should be connected between the anode of SCR1 and the positive supply.

The unit should now be switched on, and as long as the circuit on line A is closed or line B open, the alarm should not sound. However, if either of these two circuits are in the reverse mode, the alarm will be activated. After this, switch off, reset the contacts that were broken and switch back on again. The unit is now back to its standby mode.

CONSTRUCTION

All the components except the alarm, switch and SCR1 are mounted on the PCB shown in Fig. 2. The two former components are screwed to the case together with a connecting block, while the SCR is fitted to a piece of aluminium for heat sinking. Two holes are drilled in the lid, a small one for the external wiring and a larger one for the alarm to sound through.

CONCLUSIONS

While the unit is in the standby mode it is only taking a few milliamps and will give good life to an HP1 battery. The battery should be capable of delivering up to a few amps for the alarm, since this will be the only time there will be a large drain.

When the unit is complete, with sensors in position, attention should be made to hide the cables and position the unit in an effective but unobtrusive position.

THE FOUR PCB's SHOWN IN THIS CAR SUPPLEMENT ARE OBTAINABLE FROM THE READERS PCB SERVICE. FULL DETAILS AND COST CAN BE FOUND ON PAGE 576 OF THIS ISSUE.

DFM prescaler

& MODIFIED DISPLAY BOARDS

T. J. JOHNSON

THE Frequency Meter described in the June/July issues of PW, had certain limitations, one being the upper frequency limit, typically 28MHz. This is obviously no use if it is desired to measure the frequency, of say, an amateur 2m transmitter, where the limit is 146MHz. To overcome this limitation a prescaler is used to divide the input frequency by 10, thus extending the range up to 280MHz.

Circuit description

The circuit of the prescaler is shown in Fig. 1, and comprises integrated circuit IC1, capacitor C2, which provides a small amount of smoothing on the power

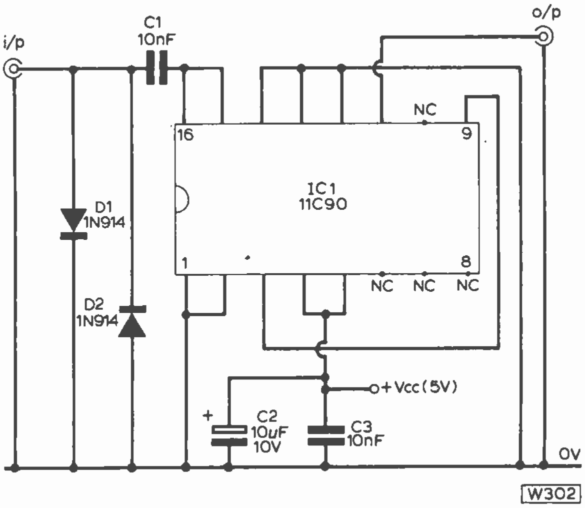


Fig. 1: Circuit diagram showing the small number of components required for this project. When used with this circuit, the DFM's frequency coverage is extended up to 280 MHz.

supply, and C3 which smooths any RF noise. The input signal is AC coupled to the IC via C1, while the two diodes protect the IC from excessive input voltage.

The IC is one from a range of prescalers manufactured by Fairchild, and designated 11C90, and is capable of operating up to 650MHz, although the limit of the DFM reduces this to 280MHz.

Construction

The use of a PCB is a must if instability is to be avoided, the one shown in Fig. 2 is to be recommended, but on no account use veroboard.

It is also advisable to use an IC socket, the price of the socket just does not compare with the price

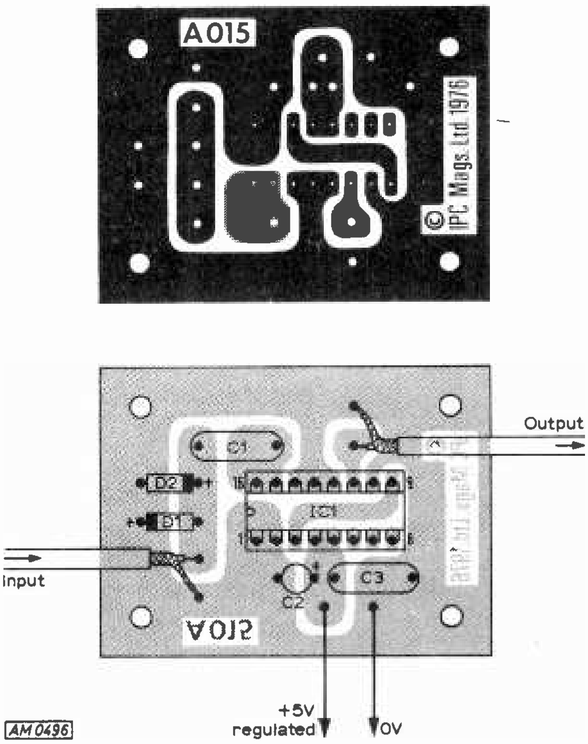


Fig. 2: Full size drawings of the PCB required for this project. This design is recommended if instability is to be avoided.

★ components list

Capacitors
C1 10nF
C2 10µF 10V
C3 10nF

Semiconductors
D1 1N914
D2 1N914
IC1 11C90 (Fairchild)

Miscellaneous
PCB 50 x 38mm. 16 pin DIL socket. Length of single core screened cable. Length of wire for supply. DPDT switch.

of a damaged IC! The input and output are connected via screened leads, the length of which should be as short as possible.

Use

It is up to the constructor as to whether the prescaler is to be used inside the main DFM or external to it. When used in the main DFM, the power supply may be taken from any convenient point on the main circuit board. If used externally, then it is advisable to screen the power leads, and to keep them as short as possible.

When used in the DFM, the circuit board may be mounted near the input socket and a small switch used to change over the inputs. A suitable system is shown in Fig. 3.

The minimum operating voltage is 350mV pk to pk sinewave, although tests carried out found the prescaler reliable down to 100mV, for a range from 100kHz to 100MHz. It was also found that operation below 100kHz was too erratic, but since this type of frequency can be measured direct on the DFM this is no set back. In all cases a sinewave was used. PW

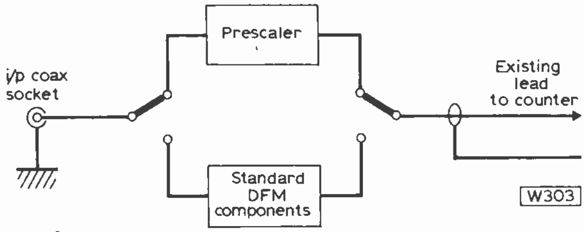


Fig. 3: The prescaler should be connected in parallel with the standard input wire (between SK1 and S2), and either one of these two inputs selected by a DPDT switch.

MODIFIED DISPLAY BOARDS

OWING to the demand for the four Doram display boards for the DFM (June/July '76), stocks have run short, and we are now able to offer these boards in the PW readers PCB service (page 576).

Although all four boards are the same in design, connections to these boards differ. Below is listed the connections to the main board and power supply board and the links required between the display boards themselves.

(1) +5V regulated, +5V unregulated and 0V to board 1, and then links taken from this board to the other three via the holes ready drilled. Also links on all boards bridging the 0V track near pins 7/8 of the 7490.

(2) Input lead from pin 3 IC10 to board 1 (pin 14 IC14) and links taken from pin 11 IC14 to pin 14 IC13; from pin 11 IC13 to pin 14 IC12, and from pin 11 IC12 to pin 14 IC11 (refer to Fig. 8, DFM, July '76).

(3) Lead from pin 8 IC8 to board 1 (pins 4/13 IC18).

(4) Lead from pin 6 IC8 to board 2 (pins 4/13 IC17).

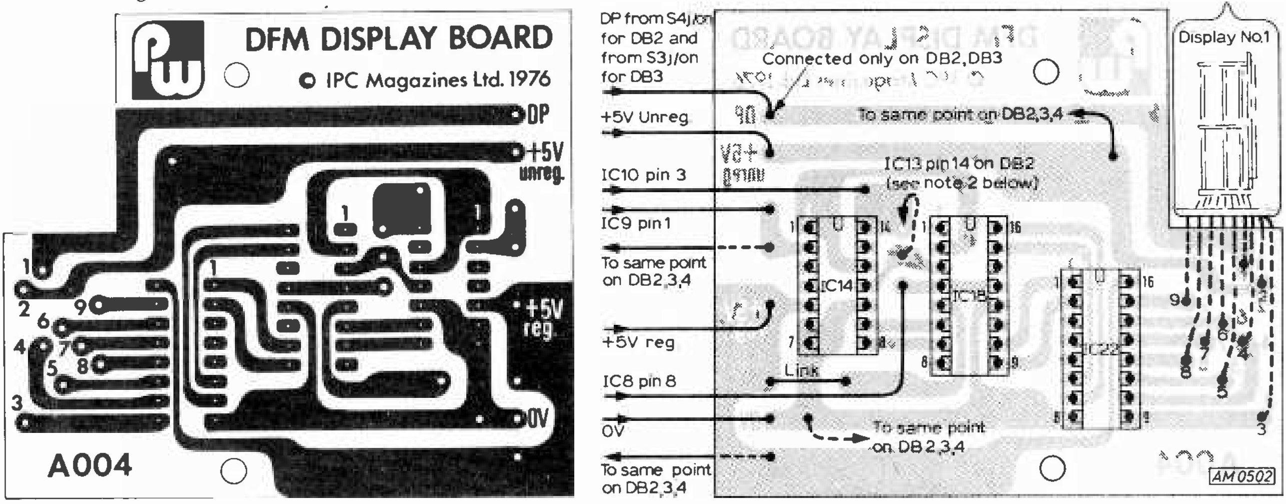
(5) Lead from pin 2 IC8 to board 3 (pins 4/13 IC16).

(6) Lead from pin 4 IC8 to board 4 (pins 4/13 IC15).

(7) Lead from S4J/ON to DP on board 2.

(8) Lead from S3J/ON to DP on board 3.

(9) Lead from pin 1 IC9 to board 1 (pin 2 IC14), and then links taken from this board to the other three. PW



Component and foil side views of the modified display boards for use in the PW DFM as published in June/July 1976.

HOTLINES ON RECENT DEVELOPMENTS

WHITER THAN WHITE

Have you ever seen those advertisements on the telly where some dolly bird leers at the lens displaying a mouthful of dazzlingly white gnashers—like a piano keyboard with no black notes? Well, those teeth are going to be twice as white soon, thanks to the Japanese.

A new colour television tube which is claimed to be almost twice as bright as its earlier brothers will be marketed later this year by Hitachi. The increase in whiteness/brightness is achieved by persuading twice the number of electrons to get to the phosphor dot screen via the shadow mask. This in turn has been managed by applying a voltage between the mask and the screen. Interesting that the system calls for some 24kV for the electron guns. Clearly a method with great potential!

DEATH CODE

Say the word 'Crypt' during a conversation and there will probably be a grave silence—smokers may even start coffin! But leave off the letter 't' and you've got something quite different.

Cryp is the name of a new range of communications security equipment which uses digital techniques for voice transmissions. It can be used with data transmission and other types also.

Some systems operate by stretching out and compressing the voice data. Time-element scrambling is one title often used.

Cryp makes things very difficult for the 'enemy' i.e., the unauthorised listener. It takes the message data and mixes it all up with long, long digital code sequences. These digital sequences are generated on a completely random basis.

For the eavesdropper the statistics of making what he hears intelligible are truly horrendous. For example, if he's looking for a sequence so that he can synchronise his own equipment and thus pick up the start of a sequence of code, the manufacturers guarantee that the encrypted sequences will not recur or recycle in less than 17 thousand million bits. Even worse: every customer has the option of something like 10 thousand million unique settings for his code. Someone with a mathematical bent has worked out that even if you were able to check out each different code taking only one single second to do it—it would still take you 300 years to check them all. Well 10111001 me!

SMALLER FINGERS WANTED

Now that just about everyone has an electronic calculator, and prices have sunk to almost nothing for simple four-rule machines, I thought that this area of electronics would remain quiet. After all, what else was there.

Just to prove me wrong, a Japanese company has produced a tiny little calculator which measures 61 x 43 millimeters and is only 15 millimeters thick. Price in Japan is around the £17 mark. Not only does this mighty midget give addition, subtraction, multiplication and division, it also offers calculation by powers, division and multiplication by a constant and it has floating decimal point. Liquid crystal displays are used and the power drawn is only one hundredth of one Watt. It uses a single silver-oxide type battery and this will give over 60 hours of use. Commenting on the calculator, the company believes that it is the smallest size calculator which can be operated by bare hands. To go smaller is possible, but one is limited by the size of human fingers.

CHIPS WITH EVERYTHING

The conservation of power has been highlighted in recent times and I learn with great interest of what appears to be the ultimate—an electronic circuit which doesn't use a battery, just light. It is a tiny chip which is intended for use in the new Kodak Fast Development Camera. A minute photodiode supplies power to a tiny oscillator. The greater the light intensity, the higher the frequency of the oscillator. Output from this oscillator feeds an "ever so tiny" converter which in turn shows its gratitude to the oscillator by producing around 500mV of output. Frequency of the oscillator varies (with light intensity) from just over 100Hz up to nearly 1MHz. The photodiode receives its light through the lens and is, therefore, proportional to the scene being actually photographed. Now the chip manufacturers, realizing this, were not slow to see greater possibilities for their baby chip (the light-to-frequency converter measures only 36thou by 12thou).

For the Kodak Instant type of camera, the photodiode chip and a linear IC are packaged together. This little bundle indicates when the light levels are too low, gives warning that the battery in the camera (used for other things) gets low, it also looks at ambient light levels at the time of taking the photograph and automatically selects the aperture, and finally it times the automatic shutter. Now that's what I call the efficient use of energy.

STERILE BEAM

I hear that the laser continues to find new tasks—carrying out light work no doubt. One manufacturer is using a laser beam to cut out shapes of ceramic used in the manufacture of electronic circuits. The substrates are held on an X-Y table which is computer controlled, and thus the substrate is moved under a stationary laser beam which does the cutting. The power of the laser is only around 100W continuous wave but this still works out at 10MW (ten million Watts) per centimetre. It is also reported that the same laser is being modified so that the beam itself can be guided very precisely by hand. The application here is to use the beam for surgery. The beam has the advantage of being completely sterile and would cauterize blood vessels instantly.

It's nice to know that someone is shedding a little light on the internal workings of the human body.

Ginsberg

PW 'Easybuild' VIDEO-WRITER

PART 4

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

The first 3 sections have covered the General Concept, the Power Supply and the Sync Pulse Board.
This section deals with the Address Counters and Registers in theory and practice.

As explained in Part 1 we have to produce discrete sets of binary codes which designate portions of the television display raster to the different character cells. These are called the Character "Column" and "Row" Addresses respectively. We have also to produce similar codes which designate portions within each character cell. You will remember that each cell comprises a matrix of 6 picture points in width by 8 picture points in height. Each of the six vertical picture point columns needs a code to tell the multiplexer the sequence in which they must appear when they are assembled into the final video signal. The Read Only Memory also needs to know which row of picture points (within the cell) it should be operating on hence eight binary codes are required to identify them.

These address codes have to be produced in a very regular fashion and in exact synchronism with the television raster so that they always relate to precise positions on the screen in the final display.

Fig. 14 is a schematic of the address code generators, which we call counters. The word counter is a perfect description because that is all they are. Within the circuit there are four fairly straightforward binary divider chains. They vary from ordinary divider chains in that some of them do not start at a count of zero and all of them are forced to reset before they have completed their natural counting cycle.

MULTIPLEXERS

Take the Multiplexer Address Counter for instance. This is IC20, a four stage binary divider IC. The first stage is not used because we need to divide the 4MHz clock by 6 to define the codes for each of the six picture points within the width of the cell. To count on a scale of six only, a 3 stage counter is required which has a maximum range of eight. To get it to cycle on six we have to force it into a reset condition after the count of "5". This is done by IC21b in conjunction with IC21a.

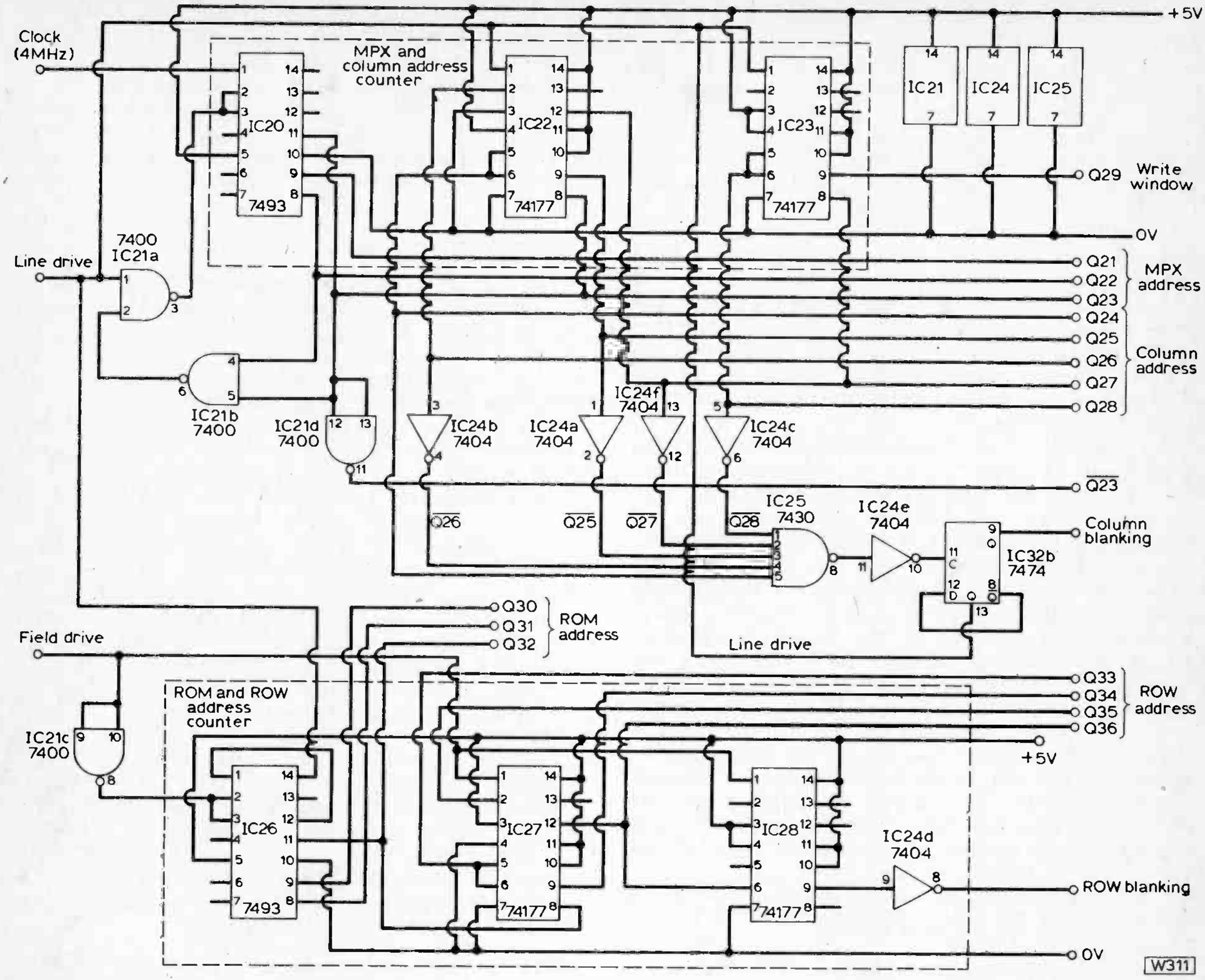
To ensure that the counter always starts at a count of zero at the beginning of a television raster line (this is to ensure synchronism) we use the line sync pulse (Line Drive) to override the internally generated reset. This is particularly important because there are a potential 256 picture points along a line (including the line sync period) and this number is not exactly divisable by six. Without an overriding reset at the start of each line the counter would precess relative to the lines of the display and the final result would be rubbish. IC21a accepts the line drive reset as well as the "scale of six" reset from IC21b and feeds a reset signal to IC20.

If you refer to Fig 15, you will see the waveforms that are generated by the three outputs of IC20. We call these the Multiplexer Address lines and they are designated Q21, Q22 and Q23. Notice that, apart from the reset to zero period when line drive is active, Q21 is simply a divide by two of the 4MHz clock. Q22 does not get a chance to take up its second "high" before the counter is reset on the scale of six and the "high" of Q23 is curtailed by the reset. This sequence requires 6 clock pulses after the line drive signal has ended and if the three address lines are looked at as binary numbers you can see the six discrete codes that they represent in the table under the region marked as the first "Cell Width". The code 000 describes the most left-hand picture along a row in the cell while 001 represents the second from the left and 101 represents the sixth. The counter is then reset to 000 and this describes the most left-hand picture point of the next cell and so on.

COLUMN ADDRESS

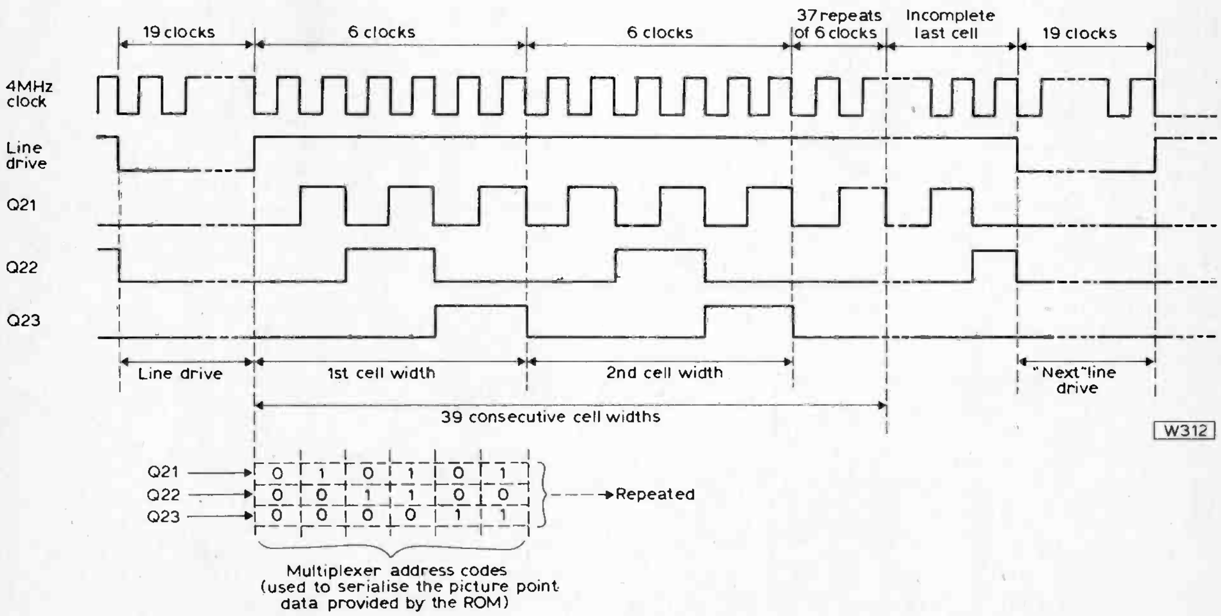
A total of 39 complete cells can be described along a television raster line in this manner but, as mentioned before, there is an incomplete cell on the extreme right hand end of the raster line which only has three picture points. The line drive reset takes over in the middle of this cell and resets the counter in readiness for the next television line.

The first five cells along a raster line are not used for display as they form the left hand margin while the last two complete cells plus the forshortened cell form the right hand margin. The fact that the last



▲ *Fig. 14. Schematic diagram of the Address Counters.*

▼ *Fig. 15. The waveforms from IC20 (modulo 6 counter).*



cell along the line is shorter than the rest does not affect the appearance of any character as it falls in the margin.

The Q23 signal occurs once and once only in each cell and as it has a transition to zero at the end of every cell it can be used as the signal source for counting the cells across the width of the screen. This counting is carried out by IC22 and IC23 which are used as a five stage binary divider to generate the address codes for each column of cells. It is convenient to use the code 00000 to describe the first cell which will contain a character of the final display.

As said before the first five cells after the line drive signal are to form the margin therefore we need the code 0000 to occur on the SIXTH cell. To achieve this we ensure that the five stages of the counter are reset to a predetermined code on receipt of the line drive signal.

The way this counter operates can be seen in the waveforms of Fig. 16. The top two signals (Line Drive and Q23) are the same as those shown in the previous figure but this time we have put in all the Q23 signals for a single television line. Remember that it occurs only once in each cell therefore every time it reverts to zero in this diagram it corresponds to the right hand edge of a character cell. These transitions are counted by the first five stages of the Column Address Counter in binary form; the outputs of the counter being Q24, 25, 26, 27 and 28 respectively. Line Drive is used to reset the counter so that all stages except Q26 are at "1".

This means that at the end of the fifth cycle of Q23 the output code of the counter, taken as a whole, will be 00000, the zero address position for the first display character cell. Note that this is how the five character cell wide left hand margin is formed. The counter then proceeds in conventional binary fashion for a further 32 cycles of Q23 defining the 32 different column address codes for the character cells across the width of the screen. These codes are shown in the table at the foot of the diagram.

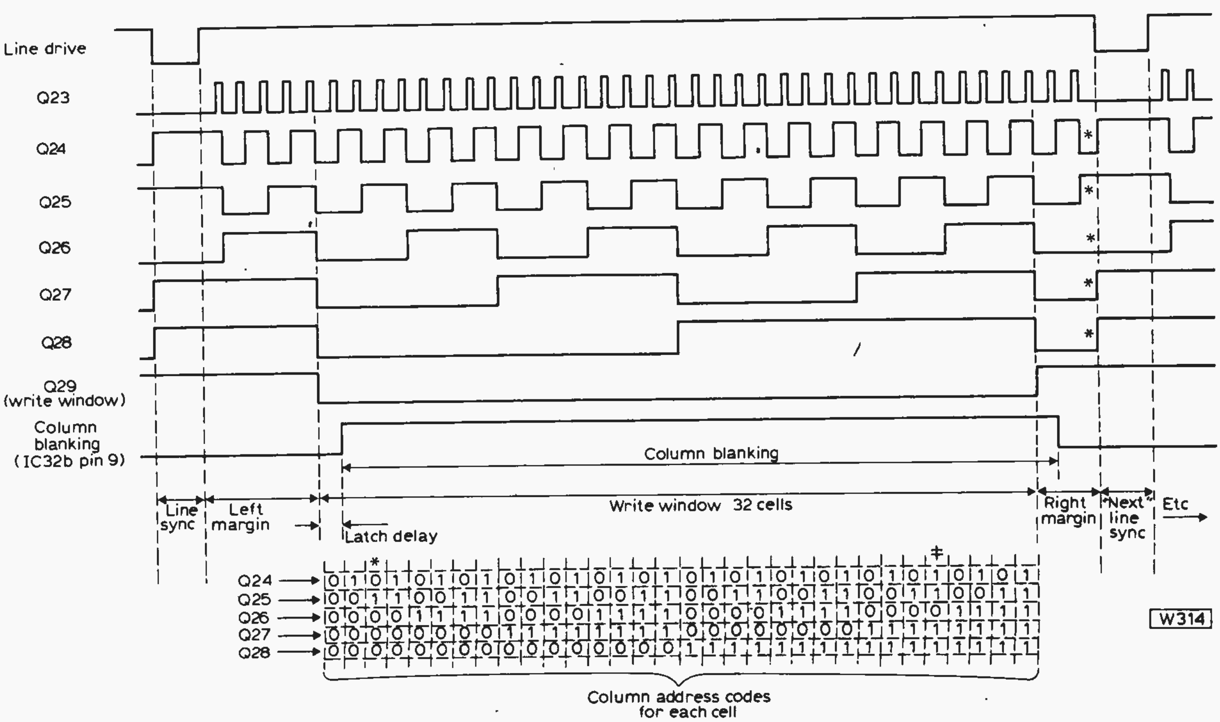
After the latter 32 cycles of Q23 we receive two more before the next line drive pulse comes along to reset the counter to its start position. These two extra pulses conveniently form the right hand margin.

WRITE WINDOW

Apart from the address codes for the columns of character cells we also obtain a special signal from the next stage of this counter (Q29) this we call "Write Window". The purpose of this signal is to prevent an ambiguous case occurring during the Write operation of the instrument.

You will note that the code for the third display character position is 00010 and this occurs briefly for a second time just before the occurrence of the line drive reset signal. This in itself is no problem except the pulse which is used to instruct the Random Access Memory to accept input data (the Write instruction) happens to fall in the middle of a character cell. As the last cell along the TV line is foreshortened—see Fig. 15—this writing instruction spreads into the code produced by the Column Address Counter during the reset period. This code is 11011 and is identical to that for the twenty-eighth display character position. If we did not take steps to prevent it happening, whenever we write something into address position 00010 the same character would appear further down the row in the position corresponding to the Address 11011! The simplest way of preventing this problem is to inhibit the writing pulse at all times except during the time called the Write Window which is defined by the signal Q29. You will see this signal entering the comparator later in this description.

Fig. 16. Waveforms from the Column Address Counter. Note that the code 00010, marked by an asterisk, also occurs immediately before the line sync period (see text).



MARGIN BLANKING

During the read cycle of the instrument the address counter will be going through all its code combinations and unless something is done about it we would get true addresses thrown up at the times of the left and right hand margins. The effect of this would be to repeat some of the characters (that have equivalent addresses) in the margins. In reality it does not matter if this happens as long as we don't see them, so we arrange to blank the video signal as we are going through the margin address positions. This is slightly complicated by the fact that we have to embody a character cell delay between addressing the Random Access Memory and displaying the information. This was mentioned in Part 1. The column blanking signal must therefore be one character cell delayed relative to the addresses. This is clearly seen in the bottom waveform of Fig. 16. This delayed waveform is generated by the circuitry associated with IC32b.

ROM ADDRESS

Having defined the horizontal positions of the cells we now have to prescribe Addresses to them to designate their vertical positions and at the same time generate lower level address codes to denote which of the eight rows of picture points within the cell is active (this is needed for the Read Only Memory). It is the latter which we produce first and we call it the ROM Address. The counter which produces it is IC26. You should refer also to Fig. 17.

Because each row of picture points within a cell is made up of two raster lines the first thing we do is divide the line rate by two. This is done by the first stage of IC26. We have not given a designation to this half line frequency signal as it does not play any further part in the circuitry but, if you have an oscilloscope, it can be seen at pin 12 of IC26.

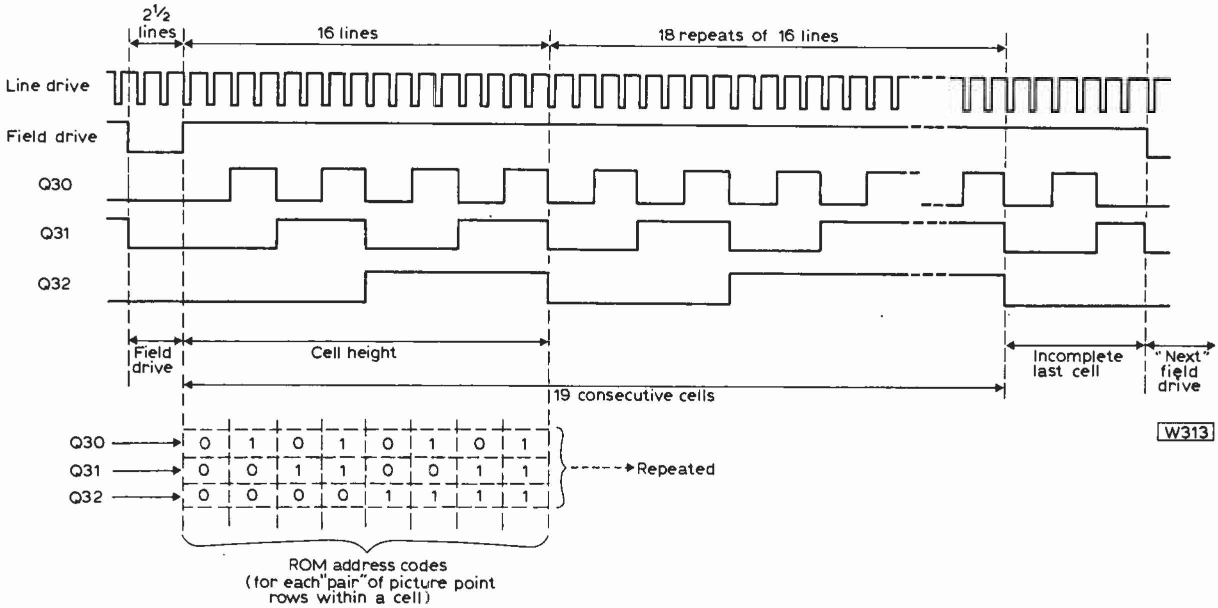
The following three stages of IC26 produce the ROM Address signals shown as Q30, Q31, and Q32 in Fig. 17. These three stages are reset to an "All Noughts" starting condition by the inverted field drive signal. This ensures synchronism with the field rate of the television raster. Conventional binary division takes place with the counter of IC26 completing 19 full cycles. It then starts an extra cycle but is unable to complete it before the next field drive signal, which resets the counter in readiness for the next field. There will be a short delay (half a line period) before the start of cycling for the next field—due to the staggering of line drive pulses brought about by our locked interlace system. On the third field this delay will not occur, but on the fourth it will be present again and so on.

ROW ADDRESS

One complete cycle of Q32 defines the height of a character cell and the eight codes generated by the Address lines are shown in the table of Fig. 17. As already mentioned we obtain "19 and a bit" cells; the top two and bottom "One and a bit" are reserved for top and bottom margins respectively so we require the Row Address for all the cells occurring on the THIRD row from top of the screen to be 0000.

An identical technique is used to that already described for the Column Address Counter. The four stages within IC27 give the Row Address as Q33, Q34, Q35 and Q36. Field drive is used to reset this counter to "All Ones" with the exception of Q33. Reference to Fig. 18 shows that this gives us an address of 0000 for the third row. The counter operates up to 16—producing the address for each row of cells—and then starts to re-cycle just before the next field drive pulse. For the same reasons as before we have to prevent the appearance of characters in the top and bottom margins so we use the first stage of IC28 to divide Q36 by two and this gives us (after inversion by IC24d) our Row Blanking signal. There is no need for this to be subjected to the delay that was needed in the case of the Column Blanking signal.

Fig. 17. The waveforms appearing at the outputs of IC26, the ROM Address Counter.



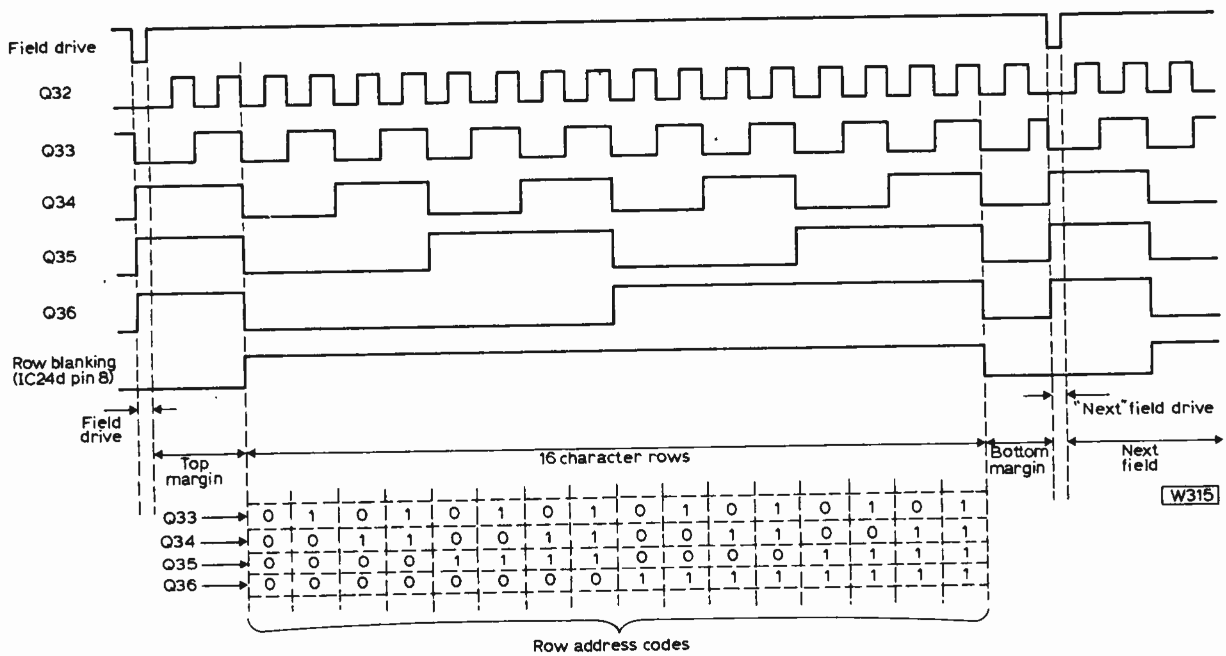


Fig. 18. The waveforms from the outputs of IC27 and IC28 (these form the Row Address Counter).

ADDRESS ROUTING

As might be expected the MPX Address codes are fed directly to the multiplexer (which will be described later), the ROM Address codes go straight to the Read Only Memory and the Column and Row Address codes go to the Random Access Memory to call up the correct data to describe the character that should be occurring at the prescribed place on the screen. The Column and Row Addresses are also fed to the comparator (Fig 19) to start the process of generating a writing signal.

CELL IDENTIFICATION

As explained in the first part of this series we have to keep a record of where on the screen we expect the next character to occur when we are typing into the system. Clearly every character cell can be described in terms of a Column and a Row Address code and a combination of any pair of these codes will be unique for a particular position on the screen. We can use a static register to hold any pre-determined code and compare its contents with the Column and Row Addresses as they are generated. Whenever the contents of the register exactly tally with the codes generated by the Address Counters we can say that the television raster is going through the cell that is designated by the code we have stored in the register.

ADDRESS REGISTERS

To keep life simple, and practical, we have split the register into two logical portions. One is the Row Address Register and the other is the Column Address Register. In a typewriter we do not often wish to go to a particular place on the screen at random but usually follow a certain pattern. For example we usually want to step to the next character position along a line (towards the right) after we have typed the last character. At the end of a line we want to return to the start of a new line (i.e. a carriage return) and then to step down a line. It should be clear that stepping along a line from left to right is the same as moving from one column address to the next higher one and stepping down the screen from one line to the next is simply an operation of incrementing the Row Address.

A carriage return is simply a means of telling the Column Address register to return to an address of zero. The registers are therefore nothing more than counters which react to asynchronous signals generated at the user's command.

UP/DOWN FACILITY

To add flexibility we have chosen to make the counters reversible so that, if desired, we can step the address codes in the other direction—this enables back spacing and stepping UP the screen for correction purposes.

It would have been possible to incorporate a "tab" facility so that, at a touch of a button, the column address register would take up a pre-determined code which might be of help in compiling tables of numbers. We felt that this was an un-necessary luxury and although simple in theory would have complicated the wiring of the system.

The only condition we have built in, of this nature, is "Reset to Zero" which zeros the address codes for both columns and rows. This enables the user to do a rapid return to the top left hand corner of the screen to start a page of type.

IC35 forms the Row Address Register. Like all the counters used in this part of the circuit it is an UP/DOWN counter that receives its direction instruction at pin 5. In this case the instruction is generated by a flip flop (IC32a). One press of the Forward/Reverse control key will make the counters operate in an UP mode and a second press will toggle the flip flop making them count down. A "0" on pin 11 of IC35 will reset it to zero in this circuit and this signal is obtained from SW2. Counting pulses (for stepping from one row to the next) are generated by the Line Feed key of the keyboard and this signal is detected by the keyboard interface circuitry (to be described later) and fed to pin 14 of the Row Address Register.

DEAD END COUNTERS

There are 16 discrete row address codes and the four binary stages within IC35 are a perfect match. This allows us to use another feature of this integrated circuit. It has a Maximum/Minimum count output at pin 12. When the counter reaches "All Ones" when counting UP this output goes to "1" and the same happens when the counter reaches "All Noughts" when counting DOWN. By feeding this signal back to the enable input of the circuit it allows us to turn the unit into a "Dead End Counter". This facility ensures that when the bottom row of the screen is reached a further depression of the line feed button does not set the counter back to zero—which would result in the writing position jumping back to the top row of the screen.

Because the outputs of this stage correspond to the Row Address Waveforms as generated by the Row Address Counter we give them similar designations suffixed by an "a". They are Q33a, 34a, 35a and Q36a. They are eventually compared with their equivalents Q33, 34, 35 and Q36 in the comparator comprising ICs29 to 31 but more about this later.

The Column Address Register works on exactly the same principle. IC36 is a four stage UP/DOWN counter as is IC37 which provides the fifth bit of the comparison address. These two integrated counters are cascaded one into the next and both receive their direction instruction from the same flip flop as the Row Address Register. This register has to increment, every time a character key is depressed, on the release of the key. It also has to increment on receipt of the non-writing "Cursor Step" signal. These two signals are combined in the keyboard interface circuit and we see their combined signal (called Character Step) coming in to pin 14 of IC36.

To prevent the register cycling round to restart addresses for the row in question we again have to make it a "Dead End Counter". This is rather more complicated than for the Row Address Register because we cannot make use of the Maximum/Minimum signal from IC37 directly. This is because only its first stage is used. We therefore have the

Fig. 19. The schematic diagram of the "Up/Down" Counter, the Row Address Register, the Column Address Register, the Comparitor and the "Direction Indicators".

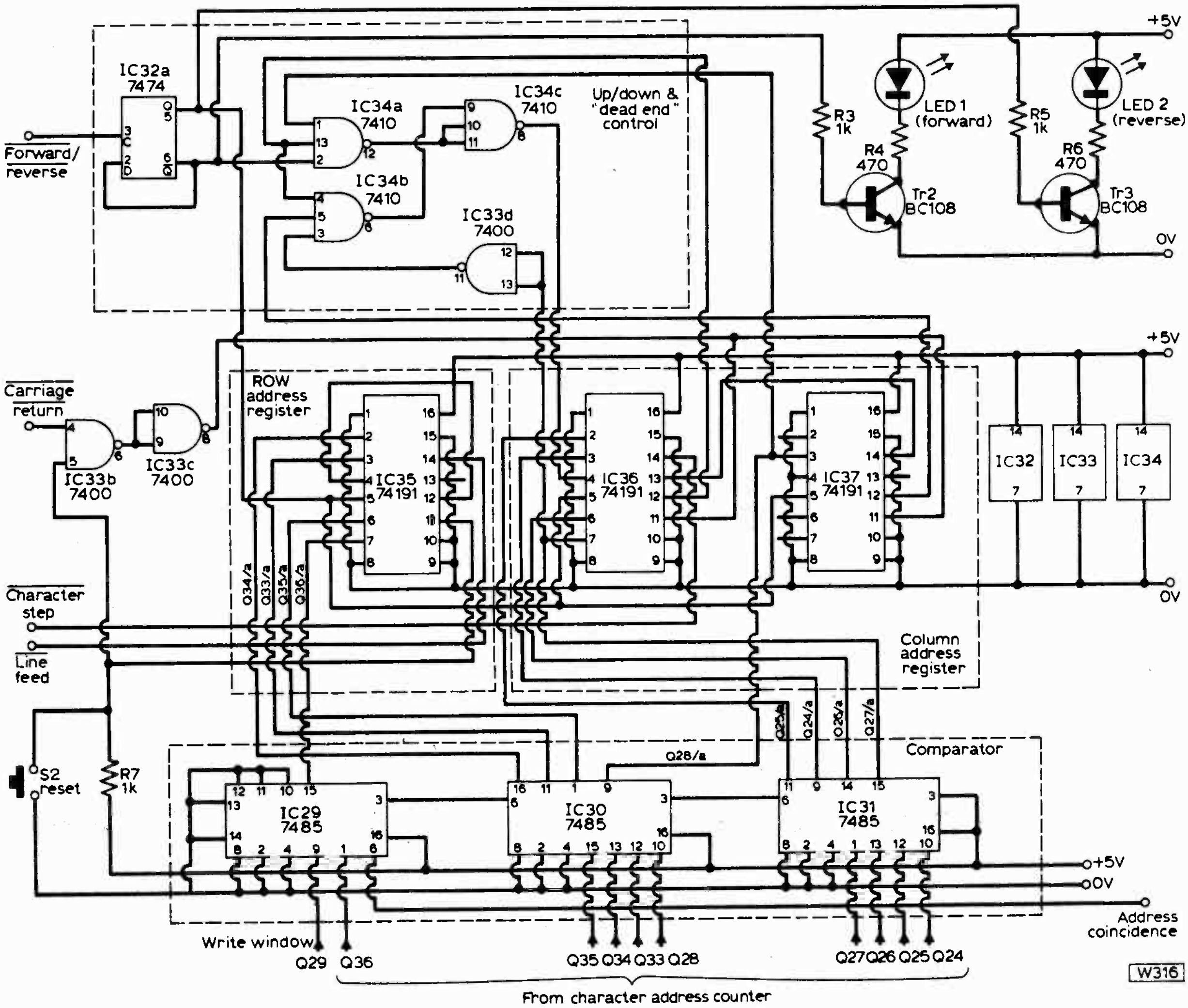


Fig. 20. The major portion of the wiring pattern on the etched board. The remaining pattern is on the component side of the board and can be seen as Fig. 21.

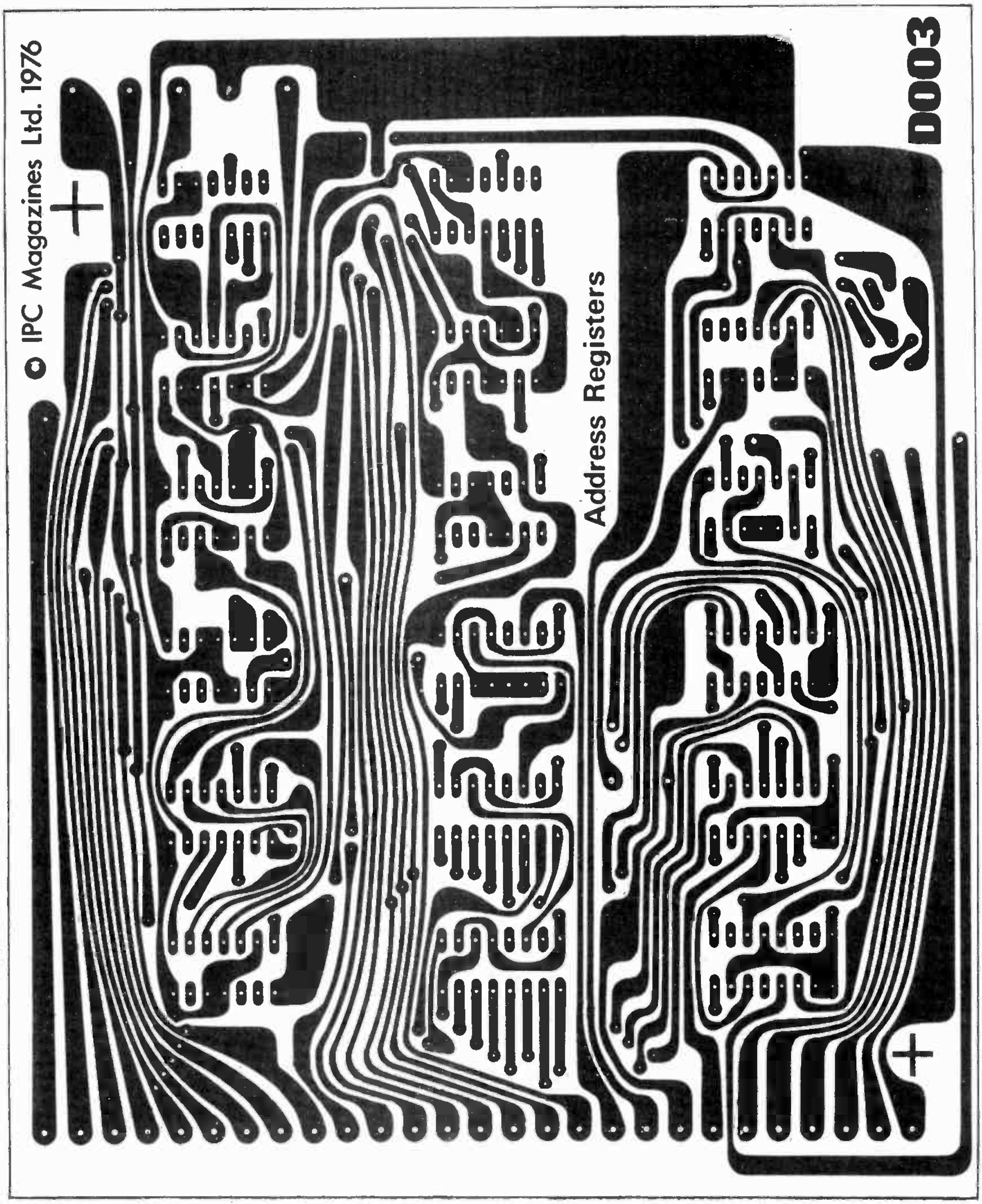
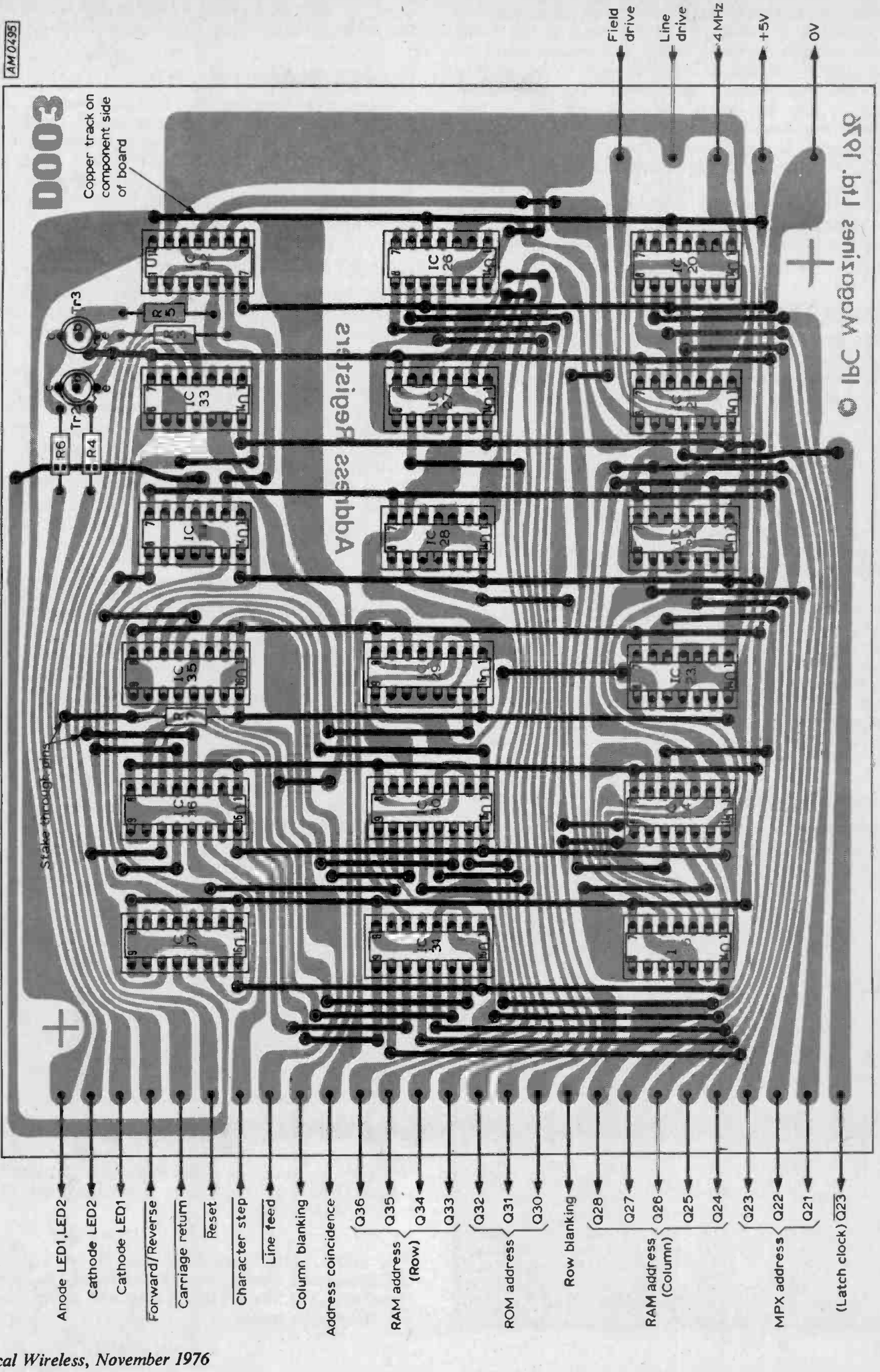


Fig. 21. The component locations on the board. Note that IC32 is reversed in orientation compared to all the other ICs on this board. Since R7 acts as a stake between the two sides of the board it is essential to solder both sides of both ends.


AM 0495
D003
Copper track on component side of board
Field drive
Line drive
4MHz
+5V
0V
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Stake through pins
Tr2
Tr3
R4
R5
R6
IC 26
IC 27
IC 28
IC 20
IC 33
IC 35
IC 34
Anode LED1,LED2
Cathode LED2
Cathode LED1
Forward/Reverse
Carriage return
Reset
Character step
Line feed
Column blanking
Address coincidence
Q36
Q35
Q34
Q33
RAM address (Row)
Q32
Q31
Q30
ROM address
Row blanking
Q28
Q27
Q26
Q25
Q24
RAM address (Column)
Q23
Q22
Q21
MPX address
Q23
(Latch clock)

circuitry comprising IC33d and IC34a, b and c which detects the state of the counter and depending on the direction of counting and the state of the count it will activate, or de-activate, the enable input of IC36 (pin 4). Again it is convenient to be able to reset the register to "All Zeros" for an instant return to the left hand end of a row but in this instance we have to consider two sources of the reset signal. It might come from the reset button (SW2) which is used for starting from the top left hand corner of the screen or from the Carriage Return signal generated from the keyboard. These two signals are combined in IC33b and c before being fed to the reset inputs of the Column Address Register.

COMPARATOR

The five outputs, Q24a, 25a, 26a, 27a and Q28a are fed to other stages of the comparator with their counterparts from the Column Address Counter. If we consider the four Row Address bits and the five Column Address bits together we can define any one of the 512 possible positions of character cells with a nine bit word. Provided we compare like bit with like (from the counter and register respectively) there will only be a perfect comparison of all nine pairs of bits when the Address Counter is addressing the cell position defined by the Register. Our comparator therefore has to be capable of handling nine pairs of variables and when coincidence occurs it must produce an output which is later used to generate the Write instruction.

We call the comparator's output "Address Coincidence." Note that we have one extra signal coming into the comparator at pin 9 of IC29; this is the Write Window which has already been described. We can use it at this stage to inhibit the generation of an Address Coincidence signal during the left and right hand margins by simply comparing it against logic level "O". When the Write Window is at "O" and we have a perfect match of addresses the Address Coincidence signal goes "high".

DIRECTION INDICATOR

Because a toggling flip flop is used to control the direction of the registers it would not be clear which way they were likely to go without some form of indicator. LEDs 1 and 2 are driven from the Q and $\overline{Q}$ outputs of the direction change flip flop. When LED1 is lit it indicates "Forward" operation whereas LED2 indicates "Reverse" operation.

CONSTRUCTION

The inter-component wiring for this unit is again provided by a double sided PCB. The major portion is shown in Fig 20, whilst the "overflow" is combined with the component layout of Fig 21.

From Fig 21 it is clear that most of the construction consists of inserting integrated circuits into their correct holes. However, we make no apology for repeating our previous warnings, namely:— check the orientation of the devices, ensure no pins are folded under, keep the heat from the soldering iron to a minimum and solder all the stakes on both sides. On the subject of stakes, note that R7 acts as a stake so each side of each end needs to be soldered.

IMPORTANT CONSTRUCTIONAL NOTE

To prevent erratic logic conditions arising from current spiking—caused by the very high switching speeds of TTL and the heavy current drawn by its output during switching operations—it is usual to incorporate small value capacitors across the power rails. When the prototype was originally designed it was felt that these capacitors could be soldered across the power supply leads on the top of each board. As it turned out, there were no problems with spurious pulses hence the illustrations of the boards do not show the capacitors. If, after construction, there is any indication of erratic operation the constructor should connect four 0·22uF capacitors between the +5V and OV rails at convenient positions on each board. These can be soldered directly to the topside printed wiring—if double sided boards are used. They should be distributed so that the de-coupling effect of each will affect as many of the IC packages as possible. There are no rules for this but, equally, there are unlikely to be any problems if the recommended layout is adopted.

You will notice that provision is made for flying leads to be taken to the two LEDs which should be mounted on the front panel in a convenient position. On the prototype there was room for them on the keyboard metalwork.

The third major board of the three, containing the Memories, the Keyboard Interface, The Cursor Generator and the Video Stages will be covered in our December issue.

★ components list

Address Counter/Register/Comparitor

Integrated Circuits

IC20	SN7493
IC21	SN7400
IC22	SN74177
IC23	SN74177
IC24	SN7404
IC25	SN7430
IC26	SN7493
IC27	SN74177
IC28	SN74177
IC29	SN7485
IC30	SN7485
IC31	SN7485
IC32	SN7474
IC33	SN7400
IC34	SN7410
IC35	SN74191
IC36	SN74191
IC37	SN74191

Resistors

R3	1k	10%, ¼W
R4	470	10%, ¼W
R5	1k	10%, ¼W
R6	470	10%, ¼W
R7	1k	10%, ¼W

Semiconductors

Tr2	BC108
Tr3	BC108
LED1	MV5025 or similar
LED2	MV5025 or similar

Miscellaneous

Printed circuit board, code D003, from Readers PCB Service. Dil sockets, 12 off 14 way and 6 off 16 way (DIL strip sockets could be used). Tinned copper wire for staking. Board pins.

I.C. OF THE MONTH

by BRIAN DANCE

Number 61 MOTOROLA MC1339P STEREO PRE-AMP

THE Motorola MC1339P is a low-noise audio pre-amplifier package containing the two separate amplifiers required for a stereo system in a single 14 pin dual-in-line epoxy case. A power supply filter circuit is incorporated on the chip, whilst emitter follower circuits provide low output impedances.

CHARACTERISTICS

The MC1339P is normally used with a 12V power supply, the supply current being typically 17·5mA (max. 22mA for any device) at this voltage. Although the absolute maximum permissible supply voltage is 16V, it is wise to use a somewhat smaller value to allow some margin of safety, since any momentary excursion above 16V can result in the destruction of the device. The maximum permissible internal dissipation is 625mW at 25°C.

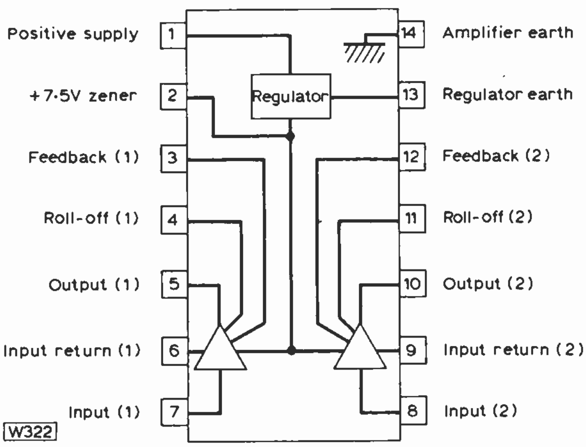

Fig. 1. The leadout connections for the MC1339P. The amplifiers are quite separate from each other.

The amplifiers of the MC1339P each have an open loop gain of typically 65dB. Their input resistance is about 250kΩ and the output resistance about 100Ω. The channel separation is typically 70dB whilst the internal circuit provides some 33dB power supply frequency rejection. The equivalent noise voltage at the input in the 100Hz to 10kHz range is about 0·7μV with a maximum of 3μV for any device.

The MC1339P is basically two operational amplifiers, with the connections shown in Fig. 1. It can be seen that various facilities are provided, such as a connection to pin 4 from which a by-pass capacitor can be connected to provide a rolling-off of the gain at high frequencies.

TYPICAL AMPLIFIER

A typical general purpose pre-amplifier with a flat response over a wide frequency range is shown in Fig. 2. The input impedance is 10kΩ and the voltage gain 100 times (40dB) with the component values shown. The voltage gain is equal to (R3+R2)/R2 and the values of these resistors may be adjusted for any reasonable value of gain. The frequency response rolls off below 100Hz, the gain falling to about 30dB at 15Hz. The high frequency response depends upon the value of C3. If the latter has a value of 500pF the response is flat to about 200kHz, whilst when C3 has a value of 1000pF the response is level to about 40kHz.

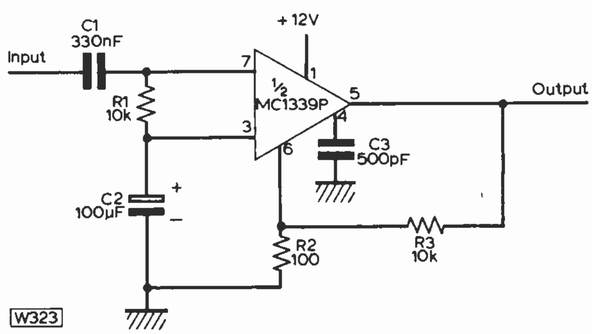

Fig. 2. Circuit of a wideband pre-amplifier using one half of the IC. The other half would be identical for stereo work.

The pin numbers shown are for the one amplifier of the MC1339P, but the other amplifier can be used in a similar circuit. This remark applies to the other circuits to be discussed.

RECORD PLAYER

The output of a typical magnetic cartridge of a record player is about 2 to 12mV RMS to a pre-amplifier with an appreciable gain is required before

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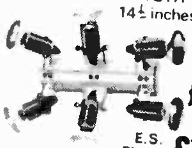

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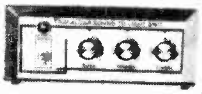

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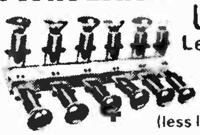

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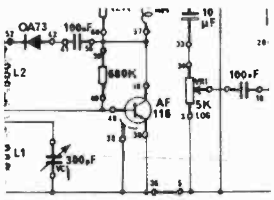

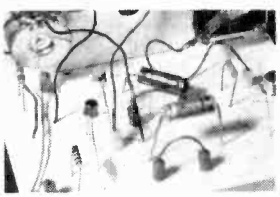

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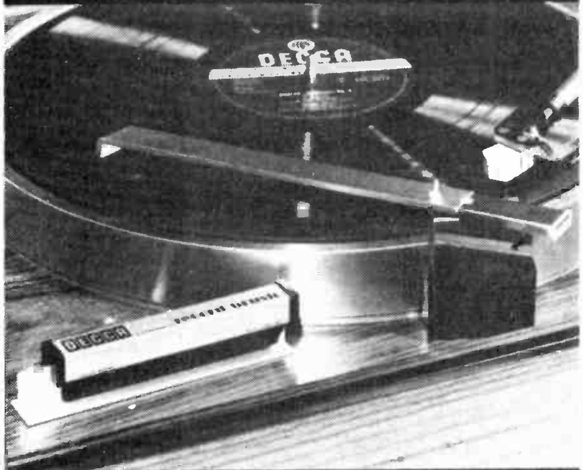

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the main amplifier. This pre-amplifier must also have the required response to match the RIAA recording characteristic used by record manufacturers. In contrast, crystal and ceramic pick-up heads are not usually used with a pre-amplifier, since they provide a much higher output voltage than magnetic cartridges.

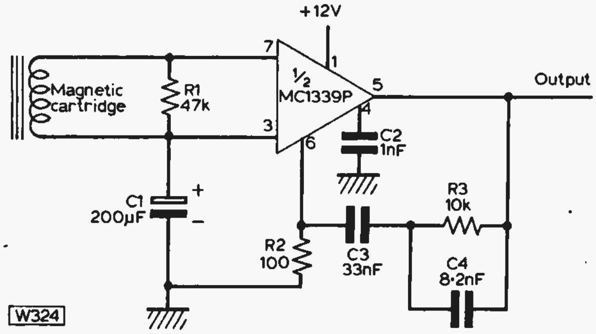
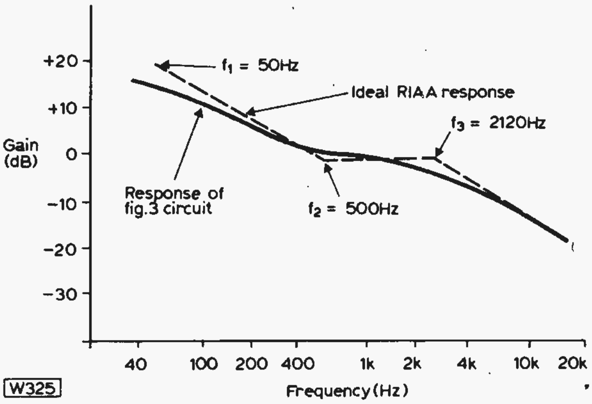


Fig. 3, above, in this application the MC1339P is used as an amplifier with a magnetic cartridge.

Fig. 4, below, the response to be expected from the circuit of Fig. 3 together with the ideal RIAA curve.



A pre-amplifier for use with a magnetic cartridge is shown in Fig. 3. This provides the response shown in Fig. 4 which is very close to the ideal RIAA response shown dotted in Fig. 4. The values of the two 'corner' frequencies f2 and f3 are determined by the values of C3 and C4 respectively. The low frequency response is determined by the value of C1.

$$f_2 = \frac{1}{2\pi R3C3} \qquad f_3 = \frac{1}{2\pi R3C4}$$

PLAYBACK AMPLIFIER

A low noise, high gain tape playback amplifier is shown in Fig. 5. This provides the special frequency compensation required to produce the NAB standard playback equalisation curve of Fig. 6. The output is about 100mV with an input from a tape head of 2·2mV at 1kHz. The low frequency response is determined by the value of C2, whilst C3 provides the bass frequency boost. The minimum high frequency gain is set by the ratio (R3+R2)/R2.

TAPE RECORDER AMPLIFIER

The frequency response of a tape recording amplifier must be the mirror image of the NAB

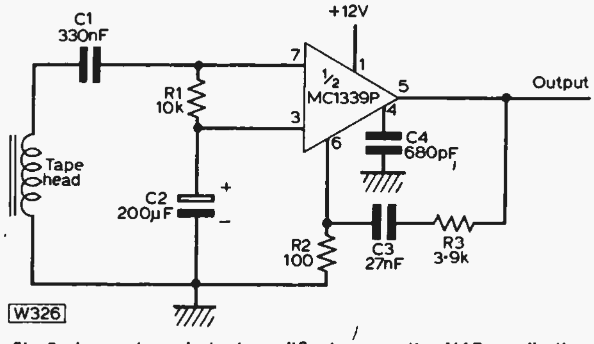
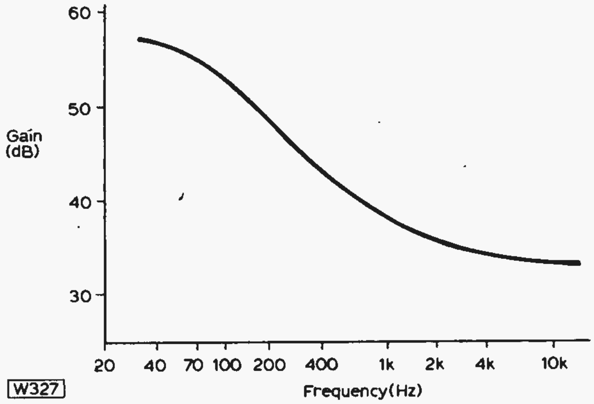


Fig. 5, above, a tape playback amplifier incorporating NAB equalisation.

Fig. 6, below, illustrates the frequency response of Fig. 5.



playback equalisation characteristic in order that the overall record/playback response shall be flat. The circuit shown in Fig. 7 will produce the required recording characteristic of Fig. 8.

The parallel inductance-capacitance circuit at the output of this amplifier forms the bias trap and must resonate at the bias oscillator frequency. It prevents the bias signal from passing to the output of the recording amplifier. Any reasonable inductance and capacitance values can be used, but the Q factor should be reasonably high for good bias rejection.

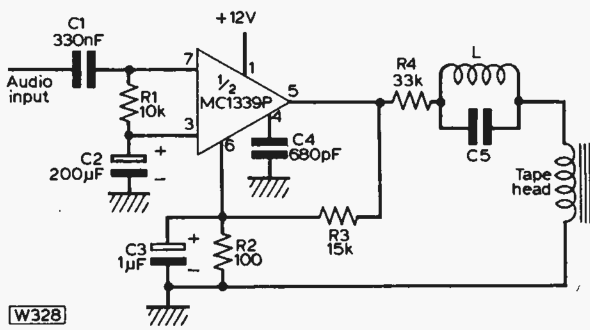


Fig. 7. Amplifier circuit for feeding a signal to a tape head during recording. Capacitor C5 resonates with inductor L at the bias frequency employed in the recorder.

This circuit is, for example, suitable for amplifying the 10mV output from a microphone to provide the 30μA recording current required by a typical tape recording head. The 30μA current is simulated by a 1V RMS signal at the output pin 5, feeding the head through the 33kΩ resistor R4 at 1kHz. The voltage gain required at this frequency is thus 100 (40dB) but the value of R3 is chosen to give a somewhat greater low frequency gain, since the open-loop gain of the amplifier is not infinite.

The response of a typical quarter track head at a tape speed of 3¾ i.p.s. is typically 3dB down at 1770Hz. The value shown for C3 provides the required compensating boost at this frequency. One might feel a resistor would be needed in series with C3 to roll off the high frequency gain at frequencies over 20kHz, but this is not necessary since the fall in the open loop gain of the amplifier itself provides the required roll off. The low frequency response is determined by the value of the coupling capacitor C1.

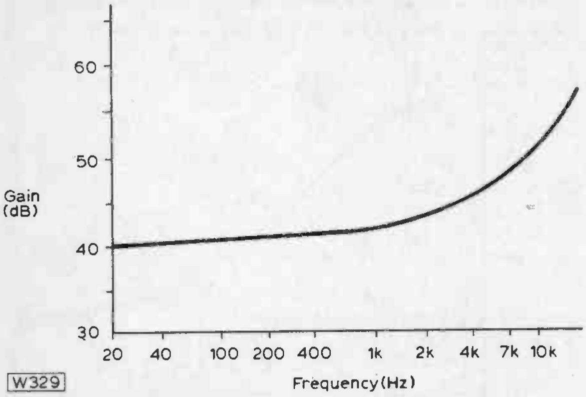


Fig. 8. Frequency response of the circuit in Fig. 7.

The MC1339P is available from Trampus Electronics Ltd., 58-60 Grove Road, Windsor, Berkshire SL4 1HS and from Chromasonic Electronics, 56 Fortis Green Road, Muswell Hill, London, N10 3HN.

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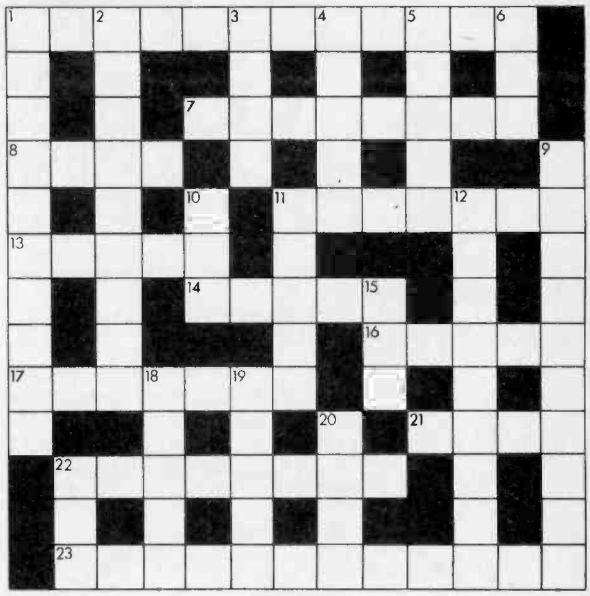
PW TECHNICROSS PUZZLE No.16



ACROSS

1 Utmost faith in such audio systems? (4, 8)
7 Trades 10 modulators for a wireless? (5-3)
8 Length of tape to make you look sideways, backwards! (4)
11 Bubbles to see Seth's changed hook-up? (7)
13 Then a transformer could be in a Welsh town? (5)
14 Skill in his comeback as conductor is zero! (5)
16 Disc that's taped as an honour? (5)
17 Blow-out in tin adaptor and you need percipience? (7)
21 Marconi made two starters for Mum? (4)
22 He's been given the target of transmission? (8)
23 Quite obvious it's like cats-whisker reception! (7, 5)

DOWN

1 Amplifier with a built-in listener? (7-3)
2 Makes a powerful contribution? (9)
3 Solid state based on oil in hair antennae? (4)
4 Battery-makers team with 500 between points (5)
5 Plan corner piece as a radio component? (5)
6 Your superhet outside still? (3)
9 Current source for your choice of stable relaxation? (10)
10 He's oscillating with her! (3)
11 Fish for reconditioned parts? (5)
12 Impedances in switching—in theory, anyway (9)
15 Initial label that made the dog spin! (3)
18 Object about old aerial and why sound irritating? (5)
19 Raise to his modulation? (5)
20 The Ringer recorded by Edison? (4)
22 Fabulous bird makes electro-coil centres? (3)

FOR AMUSEMENT ONLY
ANSWERS NEXT MONTH

ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

BACK in harness again, in dirty old London! I rather liked lying in the garden all day at home, gazing up at the swallows resting awhile on the aerial wires. Still, I'm fit and reasonably well again so there's nothing for it but to get back to the daily slog!

There are several readers this month writing in for the first time. One thought that I must get very fed up answering questions from beginners. Not at all OM! I have now been doing this feature long enough to see what were beginners a couple of years back, now getting their amateur transmitting licences, generally at the first attempt. It is very gratifying to me and, of course, it is a continuous process.

Judging by the Home Office figures on current amateur licences more people are joining the ranks than are leaving it which is a very healthy sign. However, the figures do not reveal how many of the licences are actually being used. Unfortunately the percentage is very low indeed, probably due to TVI problems, in the main. TVI can be cured so it behoves the TVI-troubled amateur, especially the newly licensed one, to persevere and get it cleared up rather than to give up the ghost at the first set-back. For sound practical advice on TVI there is no better source than the RSGB.

The logs and letters continue to come in so obviously a lot of people have decided to enjoy our own fantastic weather rather than chance it abroad! **Paul Barker** BRS34898 of Sunderland is in the throes of moving across town so holidays are probably far from his thoughts. However, he seems to have kept the receiver and the SSTV gear on the boil although he considered it a poor month from the latter angle, nothing logged outside Europe. Asia on 20m seemed the best for Paul and his best catch was KJ6DL on Johnston Is. First newcomer this month is **John Beer** of Barnstaple who has acquired a BC348 set and coupled it to a 100ft aerial via a home-made ATU to "PW specification" as John puts it. On 20m John managed an HK9 and some JA's which is not too bad for a start.

Steven Larkins in Wellingborough sent a list of stuff heard via the Cambridge repeater on 2m so Uncle Eric has had to send a nice little letter explaining that real amateur radio is something quite different and hoping he, Steve, will see the light very soon. Steven nearly died laughing when a very new G8+3 was called by "SK1RT" for his first "DX" QSO! **Robin Bayley** A9203 near Wolverhampton splits his time between studying for his RAE, building an all-bands receiver and listening on his Marconi R1475, finding 80 and 20m quite good but 40m very poor. Second newcomer is **Peter Bowyer** residing in Kettering, Northants, who has a Heathkit SW717G plus a "modified" Windom plus a 50ft dipole. What about making the 50ft into 66ft OM and getting the best out of it on both 7 and 21MHz? Peter, like several others, comments on the jamming station that seems to sit on 20m all day and night although I gather that it has moved off lately. I should not be surprised if those who operate these polluters of our ether find the amateur bands a good place to "park" their transmitters while they are finding some poor broadcaster for their attention!

Neil Braeman is our third newcomer, hailing from Southwater in Sussex. He is another who is starting the hard way with an old four-valve Pye superhet to which he added a BFO although this was not very successful. Coupling arrangements have to be just right, especially for SSB, so perhaps your lack of success is hardly surprising, Neil. He now uses a signal generator but even so SSB is hard to resolve. Neil aspires to the RAE in December, plus the morse test, so he's got a lot to do in the meantime. His way of learning Morse has a lot to commend it. He sat down with a copy of "Treasure Island" and hummed the letters to himself until he knew them by heart. Now he can do 16 wpm on a key, "buzz" at 32 wpm (!) but copy only at 5 wpm! This is where another and experienced operator is absolutely essential.

Old timer (to the column) **Alan Doherty** BRS34968 in Portrush, N. Ireland, is now off to ZL land for a few months but he promises to keep in touch. I don't know if it's business or pleasure but I reckon he'll want to stay there! His best catch recently has been VK9XI on Christmas Is. **Mr. P. Moore** only started his listening in April, on a Heathkit Mohican receiver, and is pleased with the 400 or so calls logged to date mostly on 80m SSB. At Fairwater, Cardiff he uses a long wire or a telescopic aerial. Now, more Moores! **John Moore** of Leicester is not really a newcomer since he used to dabble some five years ago until music and photography got a hold on him! Now he's back in the fold with a CR100, 2m converter and 132ft long wire. He's built another set using the Plessey SL600 IC's and copied over 90 countries on 20m in a few weeks. He says "the amount of pleasure I get from hearing DX on a receiver I have built myself is tremendous" which only confirms what I have always been saying! Build

ON THE AIR

it yourself! John comments on the many new prefixes which have been inflicted on us in recent years, quoting an AC3 thought to be in Sikkim but turning out to be Pennsylvania! What a let-down!

Brian Harrison uses an AR88 in Hastings, spending a bit more time on 10m than most, but 20 and 80m also get some attention. **J. Hodgson** of Morpeth, Northumberland is getting the hang of things now and learning to sort out the "goodies" from the rubbish on 20m SSB. His full-wave end fed wire feeds a Mini Clipper set but he'd like PW to publish a series on constructing a good communications receiver with explanatory details as the project went along. As he says, it would also help to spread the cost over a period of a few months.

Log Extracts (All SBB)

B. Harrison:—10m 7X4MD JY9TR 8R1J 6W8AAD; **20m** HL9TX OA4GM VR3HA 3B8DR 5U7BA 8R1X 9L1JM 9N1MM 9X5RK.

J. Moore:—20m AH3FF (US Samoa) KC4AAC KH6OT VP5SL 3D2AJ (Fiji) 4W9GR 5J3SB.

P. Moore:—80m CR5AK CX7BH HI1NR.

A. Doherty:—20m VK9XI VQ9HCS 9M2SV 9V1NR.

P. Bowyer:—20m CO2FR FM7AU FR7BI HK0LE HR3JJR JY9HQ VP1MPW VP2KAA YA3DO 5W1AX; **15m** CE3RC JA6XMM LU9VAB YB2VE ZD7SD 6W8AAD 9Q5SW 9V1SR.

R. Bayley:—20m DU1DBT FP8DH HK0COP TG9HL VP8AA **80m** A2GCO EA6CF KL7KV PY7HS PZ1DR.

J. Beer:—20m HK9BBJ VE8OMC 9K2DP.

J. Hodgson:—20m HC2LF HI8MVF HK6MA HP7XJS JY9HQ KV4AM VP1PTL VP2MAI YN1WB.

P. Barker:—20m A4XGQ (Masirah Is.) KJ6DL YB0IN 5N2NAS 7Z1AB 9L1JM 9V1NR **20m SSTV** DF1KJ HB9ADD I4EXY OK3TDH.

S. Budd:—80m CE3EZ FM7AV VP8PB ZE2KF ZS5LB; **40m** HK1CMO VK7CK 6W8FP; **20m** AH3GK (KS6) FW8CO HC8RG HK0LE (San Andres Is.) KG4SC PY0AW (Trinidade Is.) YB8ACK; **10m** CT6CAL TI2TB.

BROADCAST BANDS

SHORT WAVE BROADCASTS

by Derek Bell

THE holiday period is over at last and DXers can now settle down to the long winter nights with the dark hours giving reception from early evening to well into the late morning. For those that took a portable on holiday with them the change of QTH perhaps filled in some of the blanks in their log books. **Robin Bayley** of Albrighton was one such who while in Yorkshire with his Grundig Prima Boy logged:—

9570	Radio Australia at 0815
9860	Radio Peking at 1600
11780	Radio Nacional de Brazillia at 2000
11920	TWR Bonaire at 0100
15430	NHK Japan at 0800.

For those who were lucky enough to get abroad with a portable they were perhaps involved with the Customs who are always interested in one's possessions! So take along the bill from the shop that sold the receiver. Alternatively ask the Customs to give you a statement that you are taking the set out of the country. In fact it is always a good idea to have a note of the vital statistics of your equipment, such as the serial number, since should you be unlucky enough to have it stolen then such details can be a great help to the police.

Operating a short wave set from a hotel bedroom is fraught with problems. Indeed, operating from any room without access to a space for a decent aerial puts the DXer at a distinct disadvantage. **John Timms** of Manor House is in that position living in a bedsitter in the heart of London which is hardly conducive to good interference-free listening. He already has a 40ft wire draped round the room but this produces no results at all.

Two readers have passed on items of mail, the first relating to the recent on/off/on again overseas service of Radio New Zealand and sent by **Tom Mahoney** of Callander, Perthshire and is the official press statement from the New Zealand Minister of Broadcasting. Couched in the usual diplomatic language it makes clear that the funding for the service will now come from the Ministry of Foreign Affairs and be cheaper than the Telex and tape services that were planned to replace it. The statement says that the service is of "particular use to the island communities with which New Zealand had special relations." One concession to the wider world of DXing was made in the final paragraph which said that the new service would enable contact to be maintained with "New Zealanders in the South Pacific, with scientific staff in the Antarctic as well as with listeners in other parts of the world." This cut in the service must have drawn protests from all over the world. Anyway, the service is now restored with the bonus that being a relay of the internal service we can now hear what the New Zealanders hear. I would be interested to know if anyone pulls in Arthur Cushen's DX programme as it would be a shame if that were to be axed.

The second item is from **R. E. White** of Wallasey who takes issue with me on the old discussion regarding the value of the literature sent out by broadcasting stations. Mr. White presents a very cogent argument in favour by saying that these items are of particular use to the novice DXer. However, the questions and answers in publications such as the news bulletins of the Radio Budapest DX Club, that Mr. White used to back his argument, tend to be repetitive and do not give all round education in matters DX. The main argument against is that many stations send not items that improve the DXers knowledge of the hobby but political propaganda. Recently Radio Berlin International asked me if I

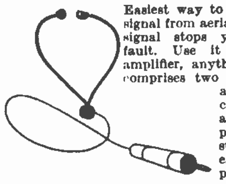
ROOM THERMOSTAT

Famous Satchwell, elegant design, intended for wall mounting. Will switch up to 20 amps at mains voltage, covers the range 0-30°C. Special snip this month £2·90, post and VAT paid.

NUMICATOR TUBES

For digital instruments, counters, timers, clocks, etc. Hi-vac XN11 Price £1·25 each. Post and VAT paid.

RADIO STETHOSCOPE



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

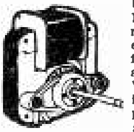
MAINS TRANSISTOR PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: main transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only £1·90 including post and VAT.

MOTORISED DISCO SWITCHES

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

MAINS MOTOR



Precision made—as used in record decks and tape recorders—ideal also for extractor fans, blower, heaters, etc. New and perfect. Snip at 95p + VAT & Postage 35p.
1" stackmotor £1·56 + VAT & postage 35p. 1½" stackmotor. £2 + VAT and Postage 40p.

WINDSCREEN WIPER CONTROL

Vary speed of your wiper to suit conditions. All parts and instructions to make. £3·75 post and VAT paid.

EXTRACTOR FAN

Cleans the air at the rate of 10,000 cubic feet per hour. Suitable for kitchens, bathrooms, factories, changing rooms, etc. It's so quiet it can hardly be heard. Compact. 5½" casing comprises motor, fan blades, sheet steel casing, pull switch, mains connector and fixing brackets. £5·25 INCLUDING POST & VAT
Monthly list available free; send long stamped envelope.

28 RPM GEARED MAINS MOTOR

This is a substantial motor (1" stack induction type) quite powerful definitely large enough to drive a rotating display or a tumbler for polishing stone etc. Approximate overall size 4" × 3½" × 2½" these are ex-unused equipment, carrying our normal ex-equipment guarantees. PRICE £2·95 POST and VAT PAID.

SOUND TO LIGHT UNIT

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

TELESCOPIC AERIALS

for portable car radio or transmitter. Chrome plated—six sections, extending from 7½ to 47in. 50p + 15p. Post & VAT. KNUCKLED MODEL FOR F.M. 80p + 17p Post and VAT.

NEED A SPECIAL SWITCH

Double lead contact. Very slight pressure closes both contacts 12p each. Plastic pushrod suitable for operating. 10p each, 10 for 68p.

MULLARD UNILEX

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

PP3/PP9 BATTERY ELIMINATOR

Made in Japan for Bush Radio. This is very neat little transformer driven full wave unit totally enclosed with input mains and output leads. This power supply unit which was originally marketed by Bush at over £6 is offered as this months snip. PRICE £2·60 INCLUDING POST & VAT.

TWIN OUTPUT POWER PACKS

These have two separate R.C. smoothed outputs so can operate two battery radios or a stereo amp without cross modulation (they will of course operate one radio/tape cassette/calculator, in fact any battery appliance, and will save their cost in a few months). Specs: Full wave rectification, double insulated mains transformer—total enclosed in a hard P.V.C. caxe—three core mains lead terminal output—when ordering please state output voltage 4½v, 6v, 7½v, 9v. 12v, or 24v. Price £3·85. Post and VAT included.

INFRA RED BINOCULARS

Made for military purpose during and immediately after the last war to enable snipers, vehicle drivers, etc. to see in the dark. The binoculars have to be fed from a high voltage source (5KV approx.) and providing the objects are in the rays of an infra-red beam then the binoculars will enable these objects to be seen. Each binocular eye tube contains a complete optical lens system as well as the infra-red cell, technical data on which is available. The binoculars are unused, believed to be in good working order, in fact they were never issued and are still in original cases, but since they were made a long time ago they can hardly be called new. Sold without guarantee. Price £17·50 per set + £1 carriage.

THIS MONTHS SNIP

This is a Satchwell thermostat, it is highly sensitive and can be set to control temperature within 1°C. Like most other very sensitive thermostats it is of low current rating so if you require it to switch heaters or similar then you will have to use a thermostat to switch a relay, the relay will switch the heaters. (We have supply suitable relays £1·00 + 8p each. These have three 10 amp changeover contacts so that with this the thermostat can control up to 6kW's of heating). This is wall mounting thermostat with white ventilator cover, regular price of this is probably £3 or £4. We are offering this month at £1·50. +12p. Our total stock is over 1,000 and anyone wishing to make an offer, bulk quantities up to £1,000, are invited to do so.

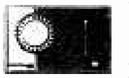
MICRO SWITCH BARGAINS

Rated at 5 amps 250 volts. Ideal to make a switch panel for a calculator and for dozens of other applications. Parcel of 10 for £1·00 VAT AND POST PAID.

HONEYWELL PUSH BUTTON PANEL MOUNTING MICRO SWITCH

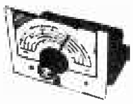
1-2-3-Bank; each bank consisting of the changeover micro switch rated at 10 amps 250 volts. Through panel fixing by 2 lock nuts complete with black 1" diameter knob. Prices:—1 bank 40p—2 bank 55p—3 bank 70p.

SMITHS CENTRAL HEATING CONTROLLER



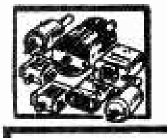
Push button gives 10 variations as follows: (1) continuous hot water and continuous central heating (2) continuous hot water but central heating off at night (3) continuous hot water but central heating on only for 2 periods during the day (4) hot water and central heating both on but day time only (5) hot water all day but central heating only for two periods during the day (6) hot water and central heating on for 2 periods during the day time only—then for summer time use with central heating off (7) hot water continuous (8) hot water day time only (9) hot water twice daily (10) everything off. A handsome looking unit with 24 hour movement and the switches and other parts necessary to select the desired programme of heating. Supplied complete with wiring diagram. Originally sold we believe at over £15. We offer these while stocks last at £7·50 each INCLUDING VAT and Postage.

SHORTWAVE CRYSTAL SET



Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 31, 29 metre bands—Kit contains chassis front panel and all the parts £1·50—crystal earphone 55p including VAT and Postage.

ONLY £1·50 FOR SEVEN ELECTRIC MOTORS



7 powerful batt. motors as used in racing cars and power models. Output and types vary for use in hundreds of projects—Tools, toys, models, etc. All brand new reversible and for 1½-12v batts. Wiring diag. inc. VAT, Post PAID.

TERMS: Where order is under £5 please add 40p surcharge to offset packing expenses

J. BULL (ELECTRICAL) LTD.

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

ITS FREE!

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

Remember 7.029? (again available). Electricians of the old school most certainly will, and most will agree how much better this is than its modern replacement 2·5mm. It has greater current carrying capacity (20 amps against 13 amps) and being stranded it will not break so easily and being larger it is easier to use. A fortunate buy enables us to offer 3 core 7·029 cheaper than we could offer 3 core 2·5mm, namely £9·50 against £11·50. If you are contemplating installing a ring main, an immersion heater, storage heaters or fires, then you should definitely buy some of this cable. It is p.v.c. covered, correctly colour coded and up to all British standards; in fact, was made by one of our most famous cable companies. Price £9·50p + 76p per 100 metre coil. Carriage £2·50 + 20p.

Remember 3.029? This would not be much good today as most installations call for a trailing earth wire as well as L. & N., however a special offer this month is 3 core 1·5mm at only £5·50p + 44p per 100 metres. Post £1·50p + 12p.

NCR Accounting Computer. This we understand was in working order immediately before being dismantled and delivered to us, but as we have no means of testing it and as also we don't have any spares for it, we cannot give any guarantee. If you buy it then you will have to take a chance. The computer is American made, it weighs over 1 ton, has an alphabetical numerical keyboard. We cannot see any type number on it but the numbers that do appear are as follows: Class 390-590-1. It comprises three main units with interconnecting leads, the first unit is a 10kw isolating same as the 416 amp described below. This is a very heavy transformer and new would cost at least £200. The second major unit is the computer control panel, this weighs nearly a ton and is full of components and hardware. The third unit is the desk with the alphabetical and numerical keyboards. The price we are asking for this computer is £375 and we feel certain that even if it could not be got going again it would realise a lot more than this if broken down and sold for its component parts. Important Note: Owing to its size this computer is not at our Croydon address. If you wish to view this please be prepared to travel into Sussex just off the Brighton Road and telephone us for the address and so that a mutually convenient time can be arranged. Tele No. 688 1833.

7kv EHT Transformer. This is made by Parmeko, this is a "c" core construction totally enclosed in black enamelled sheet steel case. The primary consists of two separate windings each 125 volts tapped with two 10 volt steps so it could be used on 115 volts or 230/240 volts. The secondary is centre tapped and has further tapping to give voltages as follows: 2·5kv-0-2·5kv, 3kv-0-3kv, 3·5kv-0-3·5kv. The current rating of the secondary is 248 ma r.m.s. Price £30 + £2·40p. Carriage £2 + 16p.

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

5 Bank Switch Panel. This is a Government Surplus item so it is very well made and contains switches which will break 15 amps *DC*. The 5 switches are completely separate so may be used to control seperate circuits or they may be ganged together to bring in 5 heaters in parallel suitable for mains or battery work. Size of the switch is approximately 5¼ × 1¾ × 1¼ and operation is by nickel plated toggles. Price 75p each + 6p. Post 20p + 2p.

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

Simmerstats. Often confused with thermostats the function of simmerstat is to pulse the supply into a heater or cooker. The longer the pulse is the greater will be the amount of heat dissipated and vice versa. The length of the pulse is determined by a control knob which in the case of a cooker is usually engraved—simmer, boil, fry. We have Sunvic Simmerstat as used in many high grade cookers as well as industrial heaters. Current rating is 15 amps 200/250 volts AC. Price £1·75p + 14p. Post 20p + 2p.

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

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was still interested in their RBI Journal, which is 99 per cent propaganda and only devotes a few column inches to DXing.

However, to get away from the problems of the world let us turn to **Andrew Linton** who had a Meridian superhet via Santa Claus last Christmas. Having hung it on the end of a 90ft wire and got used to all the knobs Andrew has logged the following:—

0590	Radio Norway at 1400
9701	Vatican Radio at 1131
11710	Radio Israel at 2000
11940	WYFR at 2200.

Andrew has one or two questions to ask, namely the location of WYFR and of the 7235 service of Radio Australia. WYFR is an American evangelist network with the call sign that happily translates into "Your Family Radio" and around 1973 or so if memory serves bought another gospel network "Radio New York Worldwide" in order to get some shortwave access. Their present address is: 290 Hegenberger Road, Oakland, California 94621. The Radio Australia transmitters are at Shepperton, Lyndhurst, Brisbane and Darwin.

To continue with the latest transmitter news I hear that Liechtenstein is awaiting the delivery of a 500kW transmitter and will be on the air around 1979 probably on 1386. **Niels Montanana** from Camberley mentions the Standard Frequency time signals that are so handy for calibrating the receiver. These usually consist of a morse signal identification with perhaps an announcement at regular intervals. To take one example, Turin comes in on 5000 with 5kW on the last quarter of each hour, from 0645 to 1800, in English, French and Italian and the call sign is IBF. With that I must declare the innings closed and wish 73s to you and yours.

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy

An interesting log of North American DX comes from Mirfield in Yorkshire where **Harold Emblem** at the controls of his Eddystone 730 and medium wave loop pulled-in CKCM in Grand Falls, Newfoundland on 620kHz, CKVO Clareville, Newfoundland on 710kHz, WNEW New York City on 1130kHz, WCAU Philadelphia on 1210kHz, CFGO Ottawa on 1440kHz and WMEX in Boston on 1510 kHz. Harold must surely have the last word over Istanbul when he claims that the site of the 1016kHz transmitter is on the Asiatic side of the Bosphorus which makes this station an Asiatic broadcaster without any doubt.

Medium wave stations often identify themselves over the air by the name of the town or city where the studios are located. Information on actual transmitting sites is not readily available and consequently a DXer who hears WCKY on 1530kHz announce itself as being in Cincinatti will count this one as being in the State of Ohio, not knowing that the transmitter is really in Kentucky. Vatican Radio on 1529kHz transmits from a site at Santa Maria di Galeria some 18km north of Rome and the Vatican State. This station is really in Italy! Collectors of "States Heard" will be disturbed to learn that some of the high power New York City outlets such as WINS on 1010kHz, WHN on 1050kHz and WNEW on 1130kHz transmit from an area of swamp land across the Hudson in New Jersey and should really count as belonging to that state. WNBC 660 kHz is on Long Island and WCBS 880kHz is on Columbia Island (in Long Island Sound) so these two do count as New York.

BROADCAST BANDS

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

AMATEUR BANDS

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

The writer enjoys his DX without worrying too much about the exact location of his quarry. DX clubs though, like to encourage competition among members by running "ladders" or tables of States, Provinces, Countries or Continents heard which can, now and again, lead to quite unexpected difficulties.

F. A. Ainsley reports from Hartlepool with details of his homebrew receiver which, he claims, performs better than an AR88 on the medium waves. Two RF stages and a mixer are followed by a 4-pole ceramic filter at 455kHz and two IF amplifiers, a detector and an audio stage. The receiver was specially made for medium wave DXing and is used with a medium wave loop, FET differential amplifier and a two stage RF sensing unit. Preferred time for DXing during the summer is at sunrise on a Sunday morning when local QRM is light. Stations heard between 0200 and 0400 include Trans World Radio on the island of Bonaire in the Caribbean on 800kHz, WBZ in Boston on 1030kHz, WOKO in Albany, New York on 1460kHz (not often heard), WTOP in Washington DC on 1500kHz and WQXR, the serious music station in New York City on 1560kHz. The latter is

ON THE AIR

owned by the New York Times and broadcasts programmes similar to those of BBC Radio 3.

Sunday morning is a good time for DXing on the medium waves at any time of the year in the UK. Stations in time zones to the east start to sign-on from 0300 onwards and during the week, DXing becomes difficult by 0500 owing to QRM. On Sundays however, many broadcasters make a late start which gives the DXer the chance to find a few spaces in the band to look for DX. This is the time to look for KOMO in Seattle on 1000kHz and WCFL in Chicago which is on the same frequency.

Ralph Newman who lives in Reading, has been experimenting with a loop and homemade FET loop amplifier. The amplifier, which uses a 2N5459 (MPF105) FET and two BC168 transistors, has an output emitter follower stage. With this set-up connected to an ordinary 6 transistor portable, CBN on 640kHz, CJON on 930kHz, WINS on 1010kHz and WCAU on 1210kHz were heard. How was the loop amplifier joined to the portable receiver Ralph? Readers would be interested in details. When the loop plus amplifier was used with a Barlow Wadley receiver Bagdad on 760kHz and the Voice of America relay in Thailand on 1580kHz were logged. Reception was during last winter. Ralph points out that you do not need a coupling winding on a loop when it is joined to an FET amplifier. Long leads between the loop and the amplifier should be avoided though, otherwise a poor null will be obtained due to the leads picking up signal. The amplifier was literally hung on the loop tuning capacitor to avoid this.

A long and interesting letter from **Fred Pilkington**, G3IAG, mentions medium and long wave DX on board ship during his seafaring day. Droitwich 200 kHz was heard during the day, half way across the Atlantic and as far south as Sierra Leone. After dark European longwave stations are heard regularly by DXers on the east coast of the United States. The range of the ground wave varies inversely with frequency. Even on the medium waves this effect can be observed. On a winters' afternoon start tuning from the LF end of the band, where North Africa can be heard in daylight, towards the HF end. At the writer's QTH long range reception peters out by the time 1200kHz is reached. After dark, long wave signals are reflected by the ionosphere and the range is considerably extended, just as on the medium waves.

Fred mentions a holiday in south Spain and his attempts to hear Radio Gibraltar on 1484kHz. The station, in a letter, admits that it is difficult to put out a decent signal from the rock (probably because of the difficulty obtaining a good earth). Radio Gibraltar, which transmits on one of the two international common frequencies, is on the air daily from 0655 until 2300 but so far as the writer is aware, it has not been heard in the UK. PW

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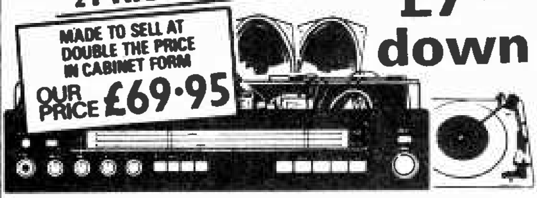

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ECC85	0·45	GZ30	0·65	PL504	0·85	3V4	0·85	12AT7	0·45
ECC88	0·50	GZ32	0·65	PL508	0·90	5R4GY	1·20	12AU6	0·50
ECH35	1·50	GZ34	0·75	PL509	1·55	5U4G	1·25	12AU7	0·38
ECH42	0·85	HN309	1·50	PL802	2·00	5U4GB	0·70	12AX7	0·35
ECH81	0·35	KT61	3·40	PX25	3·50	5Y3GT	0·65	12BA6	0·50
ECH83	0·50	KT66	3·40	PY33	0·63	5Z4G	0·95	12BE6	0·60
ECL80	0·60	KT81(7C5)	2·00	PY81	0·50	6/3OL2	0·90	30C1	0·40
ECL82	0·42	KT81	1·75	PY82	0·45	6AK5	0·45	30C15	1·00
ECL83	0·75	KT88	3·65	PY83	0·50	6AM5	2·60	30C17	1·00
ECL86	0·55	KTW61	1·50	PY88	0·63	6AQ5	0·50	30C18	0·90
ECLL800	3·50	MU14	1·00			6AS7G	1·90	30F5	1·00
						6AT6	0·60	30FL1	1·00
						6AU6	0·40	30FL2	1·00
						6BA6	0·38	30FL14	1·00
						6BE6	0·45	30L15	0·95
						6BH6	0·75	30L17	0·95
						6BJ6	0·75	30P4MR	1·30
						6BQ7A	0·55	30P12	1·00
						6BR7	1·30	30P19	0·95
						6BS7	1·40	30PL1	0·95
						6BW6	1·00	30PL13	1·10
						6BW7	1·00	30PL14	1·10
						6C4	0·40	35W4	0·60
						6CD6G	1·30	35Z4GT	0·70
						6CH6	2·20	50CD6G	1·20
						6CW4	4·00	807	1·00
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AA119	0·07	BD131	0·42	OA91	0·07	ZTX500	0·13	2N2904	0·20
AAZ13	0.12	BD132	0·50	OA200	0·08	ZTX501	0·15	2N2904A	0·25
AAZ15	0·10	BF115	0·20	OA202	0·06	ZTX503	0·16	2N2905	0·32
AC107	0·51	BF167	0·25	OC16	1·00	ZTX531	0·25	2N2905A	0·25
AC126	0·25	BF173	0·28	OC20	2·00	ZTX550	0·18	2N2906	0·20
AC127	0·25	BF179	0·33	OC23	1·25	1N914	0·06	2N2926	0·12
AC128	0·15	BF180	0·36	OC25	0·40	IN4001	0·06	2N3053	0·18
AC176	0·25	BF181	0·35	OC28	1·00	IN4002	0·07	2N3055	0·65
AC187	0·21	BF194	0·10	OC35	0·75	IN4003	0·08	2N3525	0·91
AC188	0·20	BF195	0·13	OC36	0·60	IN4004	0·08	2N3614	1·00
ACY21	0·35	BF197	0·15	OC42	0·40	IN4005	0·10	2N3615	0·65
ACY39	0·75	BF200	0·32	OC44	0·20	IN4006	0·12	2N3702	0·11
AD140	0·50	BFS61	0·25	OC45	0·20	IN4007	0·12	2N3703	0·12
AD149	0·75	BFS98	0·25	OC71	0·25	1N4009	0·06	2N3704	0·14
AD161	0·44	BFW10	0·61	OC72	0·28	1N4148	0·06	2N3705	0·15
AD162	0·44	BFX29	0·28	OC76	0·30	1S921	0·07	2N3706	0·11
AF115	0·25	BFX88	0·24	OC77	0·55	1S2033	0·20	2N3707	0·13
AF116	0·25	BFY50	0·20	OC81	0·29	1S2051A	0·20	2N3708	0·07
AF117	0·24	BFY51	0·20	OC81D	0·28	1S2100A	0·20	2N3709	0·10
AF186	0·48	BFY52	0·20	OC81Z	0·75	1S3010	0·25	2N3710	0·11
AF239	0·44	BR100	0·40	OC83	0·60	2N696	0·15	2N3711	0·11
ASY27	0·40	BY100	0·27	OC140	1·50	2N697	0·16	2N3819	0·38
ASY28	0·25	BY126	0·14	OC170	0·80	2N706	0·10	2N3820	0·50
BA102	0·25	BY127	0·12	OC171	0·30	2N706A	0·12	2N3823	0·50
BA115	0·10	BZX61 series	0·20	OC200	1·00	2N1131	0·25	2N3903	0·15
BC107	0·14	BZY88 series	0·10	OC201	1·50	2N1132	0·24	2N3904	0·20
BC108	0·13	CR81-05	0·45	OC202	1·50	2N1302	0·16	2N3905	0·25
BC109	0·12	CR81-40	0·65	OC203	1·25	2N1303	0·16	2N3906	0·25
BC113	0·15	CR83-05	0·40	OCP71	1·20	2N1304	0·22	2N4058	0·15
BC117	0·21	CR83-40	0·65	ORP12	0·60	2N1305	0·22	2N4059	0·10
BC143	0·30	MJE340	0·47	ORP60	0·55	2N1306	0·28	2N4060	0·10
BC147	0·10	MJE370	0·68	TIC44	0·39	2N1307	0·28	2N4061	0·13
BC148	0·08	MJE520	0·65	TIC226D	1·50	2N1308	0·30	2N4062	0·14
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BC182L	0·12	MPF102	0·40	ZTX107	0·12	2N1614	0·45	3N141	0·81
BC184L	0·12	MPF103	0·36	ZTX108	0·10	2N2147	1·25	40360	0·40
BC338	0·15	MPF104	0·35	ZTX300	0·13	2N2160	0·78	40361	0·45
BCY32	0·85	MPF105	0·36	ZTX301	0·14	2N2369A	0·16	40362	0·49
BCY33	0·88	NE555	0·42	ZTX302	0·18	2N2646	0·50	40430	0·65
BCY34	0·45	NKT404	1·00	ZTX304	0·24				
BCY70	0·18	OA5	0·72						
BCY71	0·22	OA10	0·40						
BCY72	0·15	OA79	0·10						
BCZ11	0·65	OA81	0·18						
BD121	1·00								
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SN7410	0·16	SN7453	0·16	SN74107	0·45	SN74176	1·26		
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SN7412	0·30	SN7460	0·16	SN74118	0·90	SN74191	2·00		
SN7413	0·36	SN7470	0·36	SN74119	1·68				
SN7416	0·36	SN7473	0·41	SN74121	0·50				
SN7417	0·36	SN7474	0·42	SN74122	0·70				
SN7420	0·16	SN7480	0·60	SN74123	1·00				
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HY5
Preamplifier

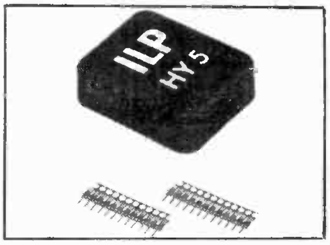
The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc) are catered for internally. The desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.

FEATURES: Complete pre-amplifier in single pack—Multi-function equalization—Low noise—Low distortion—High overload—Two simply combined for stereo.

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

SPECIFICATIONS:
INPUTS. Magnetic Pick-up 3mV; Ceramic Pick-up 30mV; Tuner 100mV; Microphone 10mV; Auxiliary 3-100mV; input impedance 4·7kΩ at 1kHz.
OUTPUTS. Tape 100mV; Main output 500mV R.M.S.
ACTIVE TONE CONTROLS. Treble ± 12dB at 10kHz; Bass ± at 100Hz.
DISTORTION. 0·1% at 1kHz. Signal/Noise Ratio 68dB.
OVERLOAD. 38dB on Magnetic Pick-up. SUPPLY VOLTAGE ± 16-50V.

Price £4·75 + 59p VAT P&P free.



HY30
15 Watts into 8Ω

The HY30 is an exciting 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.

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

APPLICATIONS: Updating audio equipment—Guitar practice amplifier—Test amplifier—audio oscillator.

SPECIFICATIONS:
OUTPUT POWER 15W R.M.S. into 8Ω; DISTORTION 0·1% at 1·5W.
INPUT SENSITIVITY 500mV. FREQUENCY RESPONSE 10Hz-16kHz—3dB.
SUPPLY VOLTAGE ± 18V.

Price £4·75 + 59p VAT P&P free.

Available June '76

HY50
25 Watts into 8Ω

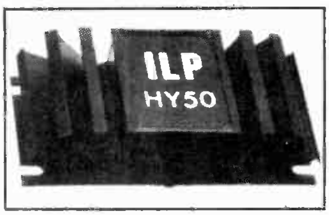
The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust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

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

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

SPECIFICATIONS: INPUT SENSITIVITY 500mV
OUTPUT POWER 25W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 25W at 1kHz
SIGNAL/NOISE RATIO 75dB FREQUENCY RESPONSE 10Hz-45kHz—3dB.
SUPPLY VOLTAGE ±25V SIZE 105 50 25mm

Price £6.20+77p VAT P&P free.



HY120
60 Watts into 8Ω

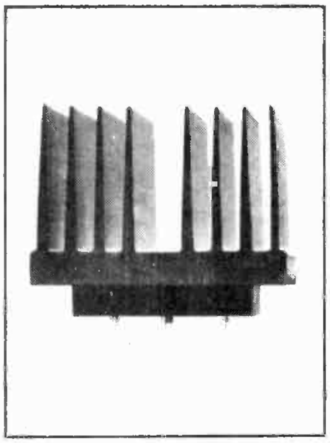
The HY120 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.

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

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

SPECIFICATIONS
INPUT SENSITIVITY 500mV.
OUTPUT POWER 60W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 60W at 1kHz
SIGNAL/NOISE RATIO 90dB FREQUENCY RESPONSE 10Hz-45kHz —3dB SUPPLY VOLTAGE ±35V
SIZE 114 50 85mm

Price £14.40+£1.16 VAT P&P free.



HY200
120 Watts into 8Ω

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

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

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

SPECIFICATIONS
INPUT SENSITIVITY 500mV
OUTPUT POWER 120W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·05% at 100W at 1kHz.
SIGNAL/NOISE RATIO 96 dB FREQUENCY RESPONSE 10Hz-45kHz—3dB SUPPLY VOLTAGE ±45V
SIZE 114 100 85mm

Price £21.20+£1.70 VAT P&P free.

HY400
240 Watts into 4Ω

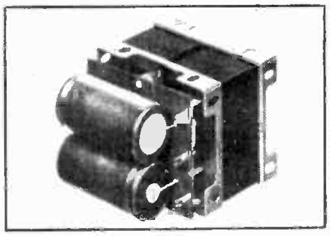
The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω! It has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.

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

APPLICATIONS: Public address—Disco—Power slave—Industrial

SPECIFICATIONS
OUTPUT POWER 240W RMS into 4Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·1% at 240W at 1kHz
SIGNAL NOISE RATIO 94dB FREQUENCY RESPONSE 10Hz-45kHz —3dB SUPPLY VOLTAGE ±45V
INPUT SENSITIVITY 500mV SIZE 114 x 100 x 85mm

Price £29.25+£2.34 VAT P&P free.



POWER SUPPLIES

PSU36 suitable for two HY30's £4.75 plus 59p VAT. P/P free.
PSU50 suitable for two HY50's £6.20 plus 77p VAT. P/P free
PSU70 suitable for two HY120's £12.50 plus £1.00 VAT. P/P free.
PSU90 suitable for one HY200 £11.50 plus £0·92 VAT. P/P free.

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R.C.S. 100 watt VALVE AMPLIFIER

Four inputs. Four way mixing, master volume, treble and bass controls. Suits all speakers. This professional quality amplifier chassis is suitable for all groups, disco, P.A., where high quality power is required. 5 speaker outputs. A/C mains operated. Slave output. Produced by demand for a quality valve amplifier. Send for details
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3½in. diam. 18,000 C.P.S. 25 WATTS 8Ω **£3·25**
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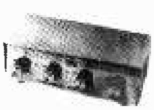

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Ideal for home handymen and experimenters. Suitable for Heating Pads, Food Warmers, Convector Heaters, etc. Must be clamped between two sheets of metal or asbestos, etc., to make efficient clothes dryers, towel rails—ideal for airing cupboards. Ideal for anti-frost device for the garage—preventing frozen radiators or acting as oil sump heater. Use in greenhouse for seed raising and plant protection. Invaluable aid for bird houses, incubators, etc., etc. Can be used in series for lower heat. Or in parallel for higher heat applications.

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30-14,500 c/s, 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s rated 25 watts. NOTE: 3 or 8 or 15 ohms must be stated.

Module kit, 30-17,000 c/s with tweeter, crossover, baffle and instructions. **£13**

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BAKER SPEAKERS "BIG SOUND"

Robustly constructed to stand up to long periods of electronic power. As used by leading groups. Useful response 30-13,000 cps. Bass resonance 55 cps.

GROUP "25" 12in 30 watt 3, 8 or 15 ohms. **£8·95** Post 50p

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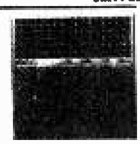
BAKER 150 WATT QUALITY TRANSISTOR MIXER/AMPLIFIER

All purpose transistorised. Ideal for Groups, Disco and P.A. 4 inputs speech and music. 4-way mixing. **£68** Carr. £1·00
Output 8/15 ohm. A.C. mains. Separate treble and bass controls. Guaranteed. Details S.A.E.
Professional amplifier using advanced circuit design. Ideal for disco, groups, P.A. or musical instruments. 4 inputs 4 way mixing. Master treble, bass and volume controls. 3 speaker output sockets to suit various combinations of speakers. 4 to 16 ohm. Slave output. A/C mains. Guaranteed. Details S.A.E.
Latest 50 watt Model £49

100 WATT DISCO AMPLIFIER CHASSIS

MADE BY JENNINGS MUSICAL INSTRUMENTS **£52**
4 speaker outputs, vol., treble, bass controls
CAN BE USED AS 100WATT SLAVE Carr. £1

QUALITY LOUDSPEAKER ENCLOSURE



Teak veneered ½in thick wood cabinet. Size 18½in × 13½in × 8½in. Weight 23lb. This cabinet features a wide mesh Silver Grill covering a separate compartment for mounting Tweeters or Mid-Range Horn. The fully sealed bass compartment is cut out for 6½in Woofer. £7·50. Carr. 85p. Rosewood Version £8·50. Carr. 85p. Baffle could be cut for larger speaker.

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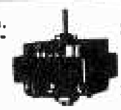

4 pole, 240 v. Size 3½ × 2¼in. 1200 rpm. Spindle 1/16in. diameter. 120v version £1. **£1·85** Post 45p

E.M.I. GRAM MOTOR

240V a.c. 2,400 rpm 2-pole. Size 2¾ × 2¼in. Collaro gram motor 120v. 75p. **£1·25** Post 35p

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2 x 12" CABINETS

for Disco or PA all fitted with carrying handles and corners. Black finish. Other cabinets in stock. SAE For leaflet

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EBF80	0·40
EBF83	0·45
EBF89	0·40
EC52	0·40
ECC81	0·45
ECC82	0·35
ECC83	0·35
ECC84	0·35
ECC85	0·45
ECC86	1·25
ECC88	0·55
ECC189	0·80
ECF80	0·45
ECF82	0·45
ECF801	0·75
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ECH42	0·85
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ECH84	0·60
ECL80	0·40
ECL82	0·40
ECL83	0·75
ECL86	0·60
EF36	0·65
EF37A	1·10
EF40	0·70
EF41	0·75
EF80	0·35
EF83	1·25
EF85	0·40
EF86	0·40
EF89	0·35
EF91	0·60
EF92	0·50
EF95	0·45
EF183	0·40
EF184	0·40
EFL200	0·75
EL34	0·70
EL35	0·70
EL37	2·70
EL41	0·80
EL81	0·60
EL84	0·35
EL85	0·60
EL86	0·50
EL90	0·50
EL91	1·00
EL95	0·70
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EL821	1·80
EM31	0·70
EM80	0·55
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PCC89	0·60
PCC189	0·65
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PCF82	0·40
PCF84	0·65
PCF86	0·65
PCF200	0·90
PCF201	0·90
PCF801	0·55
PCF802	0·55
PCF805	1·10
PCH200	0·80
PCL81	0·60
PCL82	0·40
PCL83	0·70
PCL84	0·50
PCL86	0·60
PCL805/85	0·60
PFL200	0·70
PL36	0·80
PL81	0·55
PL82	0·50
PL83	0·50
PL84	0·50
PL504	0·85
PL508	0·95
PL509	1·35
PL802	1·85
PY33	0·60
PY80	0·60
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UBL1	1·60
UBL21	0·75
UCC85	0·50
UCF80	0·80
UCH42	0·80
UCH81	0·50
UCL82	0·45
UCL83	0·70
UF41	0·70
UF80	0·40
UF85	0·50
UF89	0·50
UL41	0·70
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5Z3	1·20
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5Z4GT	0·65
6AB7	0·60
6AC7	0·60
6AH6	0·70
6AK5	0·45
6AK8	0·40
6AL5	0·30
6AL5W	0·60
6AM5	1·00
6AM6	0·60
6AN8	0·70
6AQ5	0·55
6AQ5W	0·70
6AS6	0·80
6AS7G	1·80
6AT6	0·60
6AU6	0·40
6AV6	0·50
6AX4GT	0·75
6AX5GT	1·00
6B7	0·70
6BA6	0·40
6BE6	0·40
6BG6G	1·00
6BJ6	0·75
6BQ7A	0·60
6BR7	1·30
6BW6	1·10
6BW7	1·00
6C4	0·40
6C6	0·50
6C6B	0·50
6CH6	1·60
6CL6	0·75
6D6	0·50
6EA8	0·75
6F7	1·10
6F8G	0·75
6F12	0·60
6F17	1·00
6F33	3·50
6H6	0·45
6J4WA	1·20
6J5	0·65
6J5GT	0·55
6J6	0·35
6J7	0·65
6J7G	0·40
6K6GT	0·80
6K7	0·55
6K7G	0·35
6K8GT	0·55
6L6M	1·90
6L7G	0·40
6SA7	0·55
6SC7	0·75
6SG7	0·55
6SJ7	0·60
6SJ7GT	0·35
6SK7	0·60
6SL7GT	0·55
6SN7GT	0·55
6SQ7	0·80
6V6GT	0·60
6X4	0·45
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6Z4	0·65
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7B7	0·80
7Y4	0·80
9D2	0·60
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11E2	6·00
12A6	0·60
12AT6	0·45
12AT7	0·45
12AU7	0·35
12AX7	0·35
12BA6	0·50
12BE6	0·55
12BH7	0·55
12C8	0·60
12E1	3·75
12K5	1·50
12K7GT	0·55
12K8GT	0·75
12Q7GT	0·50
12SA7GT	0·80
12SG7	0·55
12SJ7	0·55
12Y4	0·40
14S7	1·60
19AQ5	0·70
19G3	8·00
19G6	6·50
19H5	15·00
20P3	0·60
20P4	1·10
25L6GT	0·70
30C15	1·00
30C17	1·10
30F5	1·00
30FL1	1·10
30FL12	1·10
30L15	1·00
30L17	1·00
30P12	1·00
30P19	1·00
30PL13	1·10
30PL14	1·10
35L6GT	0·80
35W4	0·55
35Z4GT	0·70
50C5	0·65
50CD6G	1·20
75	1·00
75C1	0·75
76	0·75
78	0·70
80	0·75
85A2	0·75
803	6·00
805	18·00
807	0·75
813	6·50
866A	1·60
931A	6·00
954	0·50
955	0·50
956	0·50
957	0·50
1629	0·70
2051	1·00
5763	1·70
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ACY17	AF178	BF115	NKT304	OC70	2N696	3N154
ACY18	AF186	BF167	NKT404	OC73	2N708	3N159
ACY19	AF239	BF173	OA5	OC75	2N918	SX754
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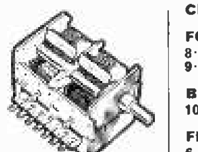

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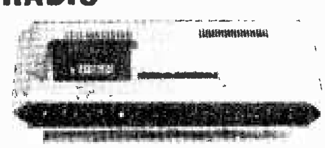

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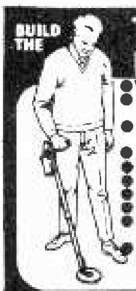

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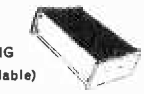

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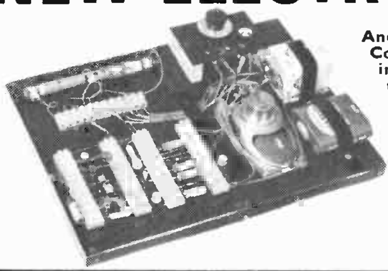

Another completely solderless Electronic Construction Kit with many more projects, including Transistor Radios of various types and wavebands. Amplifiers, Metronome, Sound Amplifier, Transistor Tester, Signal Generator, Quick check component Tester, Tuners, Crystal Set, Morse Code Practice Oscillator with Morse Key, A. F. Oscillator etc. etc., Also a special project V.H.F. Aircraft Receiver!!

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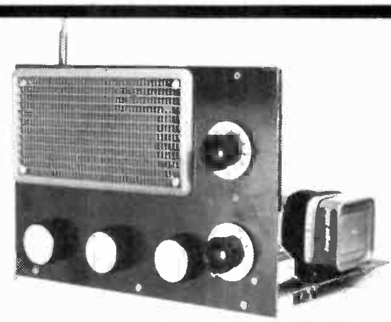

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QUALITY 5" × 3" LOUDSPEAKER

WITH Multiband V.H.F. section covering Mobiles. Aircraft, T.V. Sound, Public Service Band, Local V.H.F. Stations, etc., and Multiband A.M. section with Airspaced Slow Motion Drive Tuning Capacitor for easier and accurate tuning, covering M.W.1, M.W.2, LW. Three Short Wave Bands S.W.1. S.W.2. S.W.3 and Trawler Band. Built in Ferrite Rod Aerial for Medium Waves, Long Wave and Trawler Band, etc., Chrome Plated 7 section Telescopic Aerial, angled and rotatable for peak Short Wave and V.H.F. reception. Push Pull output using 600mw Transistors. Gain, Wave-Change and Tone Controls. Plus two Slider Switches. Negative Feedback circuit and **SPECIAL POWER BOOSTER SOCKET AND RESISTOR**, to virtually double gain if required. Powered by P.P.9 9 volt battery.

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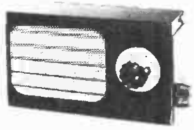
POCKET FIVE



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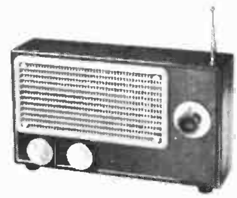

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CASE AND LOOKS AS TRANS EIGHT

6 Tunable Wavebands: MW, LW, SW1, SW2, Trawler band plus an extra Medium waveband for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 x 5½ x 2½in. approx.

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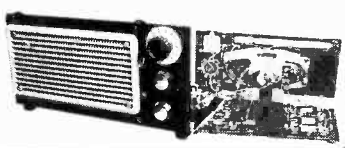

ECK 4 7 Transistors, 6 tuneable wavebands, MW, LW, TrawlerBand, 3 Short Wave Bands. Receiver Kit. With 5" x 3" Loudspeaker. Push/Pull output stage, Gain Control, and Rotary Switch. 7 Transistors and 4 Diodes. 6 section chrome-plated telescopic aerial. 8" Sensitive Ready Wound Ferrite Rod Aerial. Tuning Capacitor. Resistors, Capacitors, etc. Operates from a 9 Volt PP7 Battery (not supplied with kit). Complete kit of parts including construction plans.

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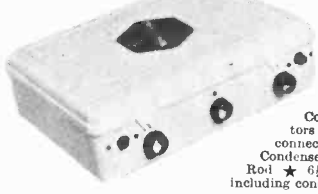

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